

निविदा फार्म/TENDER FORM

प्लाज्मा अनुसंधान संस्थान

(भारत सरकार के परमाणु ऊर्जा विभाग का सहायता प्राप्त संस्थान)

इंदीरा ब्रिज के पास, भाट, गांधीनगर - 382428, भारत

दूरभाष: 079-23962020/23962021, फ़ैक्स: 079-23962277

निमंत्रण निविदा और निविदाकारों को निर्देश करने के लिए

Invitation to Tender and Instructions to Tenderers

The Purchase Officer, Institute for Plasma Research invites online tenders in **TWO PART (INR quote only)** for supply of stores as detailed in the Purchaser's Tender documents. The conditions of contract and instructions to tenderers which will govern the contract pursuant to tender are given below.

If you are in a position to quote for the supply in accordance with the requirements stated in the attached Tender Form please submit your quotation **online. The quote should be in INR only.**

Tender submitted by **fax/cable/telegram or any mode other than online will NOT be considered at all** and all such tenders will be rejected without any notice to the tenderer.

Yours faithfully,

Purchase Officer-II/क्रय अधिकारी-II

के लिए और की ओर से प्लाज्मा अनुसंधान संस्थान/

For & on behalf of The Institute for Plasma Research

(खरीददार / The Purchaser)

Encl: as above.

INSTRUCTIONS FOR ONLINE SUBMISSION

- 1) It is mandatory for all the applicants to have **class-III digital signature certificate** from any of the licensed Certifying Applicant to participate in e-tendering.
- 2) In order to participate in online e-tendering process, it is mandatory for the applicants to have **user ID & password** to get access to the website www.tenderwizard.com/DAE. The applicants have to get registered their firm / company with the service provider, M/s ITI Limited for user ID & password. The registration shall be done by paying an annual registration fees to M/s ITI Limited and completing other formalities as mentioned in the website, www.tenderwizard.com/DAE. Validity of online registration is for one year from the date of its issuance and may be renewed by paying the applicable amount. For assistance/clarifications please contact Mr. Sunil K Patel at mobile 09624981992, e-mail: twhelpdesk426@gmail.com or nodalofficer.et@ipr.res.in or All India Help line No: 91-80-40482000/[18004255048](tel:18004255048), e-mail: daehelpdesk@tenderwizard.co.in.
- 3) The applicants, who have already obtained such valid user ID and password from M/s ITI Limited, for any other tender of DAE, need not obtain fresh user ID and password for the purpose of participation in the present tender.
- 4) The services for e-tendering in IPR/DAE is provided by M/s ITI Ltd., Tender wizard Help Desk Centre, # 24, 1st Floor, Sudha Complex, Near Havanoor Circle, 3rd Stage, 4th Block, Basaveshwaranagar, Bangalore - 560079, Ph:91-80-40482000/[18004255048](tel:18004255048), Telefax: 91-80-40482114, Email: daehelpdesk@tenderwizard.co.in.
- 5) The quotations shall be submitted online in the prescribed format before the date and time as mentioned in tender document. No other mode of submission is acceptable.
- 6) On successful e-payment of tender processing fees, the applicants can download the tender documents (including Excel sheets, if any) from the e-tendering portal.
- 7) Submission of the offer document after the due date and time shall not be permitted. Time being displayed on e-Tendering portal shall be final and binding on the applicant.
- 8) Applicants are advised to submit their documents well before the due date. IPR shall not be responsible for any delay in submission of documents for any reason including server and technical problems.
- 9) **Applicants are advised to fill all the mandatory fields (coloured cells) of the excel files of the Tender. If applicant keeps any mandatory cell blank, System will not allow to close/save the file.**
- 10) In case of any problem with the submission of the offer documents, the applicant may have the assistance of helpdesk or use the help manual given on the said website or mobile and e-mail mentioned elsewhere.

<p>प्लाज़्मा अनुसंधान संस्थान इंदीरा ब्रिज के पास, भाट, गांधीनगर - 382428 गुजरात राज्य दूरभाष: 079 23962020, 23962021 फैक्स: 079 23962277</p>	<p>INSTITUTE FOR PLASMA RESEARCH NEAR INDIRA BRIDGE, BHAT, GANDHINAGAR 382 428 GUJARAT STATE Phone: 079 23962020, 23962021 Fax: 079 23962277</p>
--	---

निविदा सूचना TENDER NOTICE NO: IPR/TN/PUR/TPT/ET/20-21/1

दिनांकित DATED 1-6-2020

निम्नलिखित के लिए प्रतिष्ठित और योग्य पार्टियों से ई-निविदा विधि के माध्यम से दो भाग में ऑनलाइन निविदा आमंत्रित की जाती है।

Online tender is invited in **TWO PART** through e-tendering mode from reputed and eligible parties for the following.

मद का विवरण Item Description	Design, Supply, Fabrication, Installation, Testing, and Commissioning of Cooling Water System for New Laboratories at IPR campus, Ahmedabad as per the specifications mentioned in the tender documents
निविदा प्रक्रिया शुल्क Tender Processing Fee	Tender Processing Fee of Rs.5,900.00 should be paid through electronic mode to M/s ITI Limited.
बयाना राशि जमा EMD	Rs.20,00,000.00 (Copy of Demand Draft to be uploaded with the quotation, Original DD should be sent to IPR on or before the specified closing date and time)
निविदा दस्तावेज वेबसाइट पर देखने और डाउनलोड करने के लिए उपलब्ध है Tender document available for view and downloading on website	09.00 hrs. on 2-6-2020 to 12.55 hrs. on 5-8-2020
साइट देखने का समय Site visit	Between 2-6-2020 and 26-6-2020 (Monday to Friday – Time: 10.00 hrs to 16.00 hrs) with prior appointment.
निविदा दस्तावेज के संबंध में स्पष्टीकरण Clarifications regarding Tender document	09.00 hrs. on 2-6-2020 to 16.00 hrs. on 26-6-2020
बोली-पूर्व बैठक Pre-Bid meeting	Date and time will be intimated later
बोली-पूर्व स्पष्टीकरण Pre-Bid clarification	Will be uploaded on e-portal after pre-bid meeting
निविदा ऑनलाइन जमा करने की अंतिम तिथि Closing of online submission of tenders	5-8-2020 at 13.00 hrs.
भाग-I के ऑनलाइन खोलने का समय और तिथि (तकनीकी बोली) Time and Date of online Opening of PART-I (Technical Bid)	5-8-2020 at 14.30 hrs.

भाग-II के ऑनलाइन खोलने का समय और तिथि (मूल्य बोली) Time and Date of online Opening of PART-II (Price Bid)	Will be declared later on
--	---------------------------

आवेदक निविदा दस्तावेज के बारे में वेबसाइट www.tenderwizard.com/DAE पर 26-6-2020 (16:00 बजे) तक अपने प्रश्नों को अपलोड करके स्पष्टीकरण (बोली-पूर्व) मांग सकते इसके अलावा, हमने स्पष्टीकरण पर चर्चा करने के लिए वीडियो कॉन्फ्रेंस के माध्यम से प्री-बिड मीटिंग की व्यवस्था की है। जो लोग प्री-बिड मीटिंग में भाग लेना चाहते हैं, उन्हें निविदा दस्तावेजों की धारा-सी के अनुभाग-नौ के तहत दिए गए पंजीकरण प्रारूप को प्रस्तुत करना चाहिए। वीडियो कॉन्फ्रेंस के माध्यम से प्री-बिड मीटिंग में भाग लेने के लिए तारीख, समय और लिंक बाद में पंजीकृत विक्रेताओं को सूचित किया जाएगा। स्पष्टीकरण उसी वेब पोर्टल www.tenderwizard.com/DAE पर अपलोड किए जाएंगे।

The applicant can seek clarifications (pre-bid) regarding the tender document up to 26-6-2020 (16:00 Hrs) by uploading their queries on website www.tenderwizard.com/DAE. Moreover, we have arranged a pre-bid meeting through Video conference to discuss on the clarifications. Those who wish to participate in the pre-bid meeting should submit the Registration Format given under Section-IX of Section-C of tender documents. The date, time and link for participating the pre-bid meeting through video conference will be intimated to the registered vendors later on. The clarifications will be uploaded on the same web portal www.tenderwizard.com/DAE.

साइट देखने के लिए आप निविदा दस्तावेजों के धारा-सी की धारा-VIII में वर्णित व्यक्तियों से संपर्क करें। कृपया ध्यान दें कि इस निविदा में तकनीकी या अन्य कोई भी स्पष्टीकरण की आवश्यकता हो तो, बोलियाँ प्रस्तुत करने से पहले किया जाएगा। बोलीदाता को एक बार जमा की गई बोली को संशोधित करने का कोई अधिकार नहीं होगा।

For site visit you shall contact the persons mentioned under Section-VIII of Section-C of tender documents. It may please be noted that any clarifications required in this tender either technical or otherwise shall be carried out before submission of bids. Bidder shall not have any right to revise the price bid once submitted.

विस्तृत निविदा सूचना, योग्यता मानदंड और निविदा दस्तावेज के साथ वेबसाइट www.tenderwizard.com/DAE पर निःशुल्क देखने और डाउनलोड करने के लिए उपलब्ध है। ई-निविदा प्रक्रिया में भाग लेने के लिए, उपर्युक्त ई-निविदा पोर्टल पर रजिस्टर करना अनिवार्य है और डिजिटल हस्ताक्षर प्रमाणपत्र (श्रेणी-III) होना आवश्यक है। बोलीदाता नए रजिस्ट्रेशन/टेन्डरिंग में सहायता के लिए पत्रि हेल्पडेस्क से daehelpdesk@tenderwizard.co.in पर संपर्क कर सकते हैं, फोन नंबर: (80)-40482000/ 9624981992/18004255048

Detailed tender notice along with Eligibility criteria and Tender Document is available on website www.tenderwizard.com/DAE for free view and downloading. For participating in the e-tendering process, it is mandatory to get registered on the above e-tender portal and required to have Digital Signature Certificate (Class -III). For new registration/ tendering help, bidders may contact DAE Helpdesk at daehelpdesk@tenderwizard.co.in Phone No: (80)-40482000/ 9624981992/ 18004255048

इस निविदा सूचना की एक प्रति संस्थान की वेबसाइट www.ipr.res.in//purchasetenders.html पर भी उपलब्ध है। अधिक जानकारी के लिए, कृपया संपर्क करें: 079 23962020/2021, फ़ैक्स: 079 23962277।

A copy of this tender notice is also available on the Institute's website www.ipr.res.in//purchasetenders.html. For further information, please contact: 079 23962020/2021, Fax: 079 23962277.

TWO-PART TENDER SECTION – A

Invitation to Tender and Tendering Conditions

1.0 INVITATION TO TENDER

1.1 Institute for Plasma Research (IPR) invites online tenders for supply of Plant, Machinery, Equipment/Components to the specifications detailed in Section "C" to this tender document. The conditions of contract/purchase order which will govern the contract pursuant to the tender are as contained in Section "B" of this tender document. If you are in a position to quote for supply in accordance with the technical specifications indicated in Section "C" to this tender document and as per the conditions stipulated in this Section and Section B, please upload your offer in a manner and method specified below.

2.0 MANNER AND METHOD FOR SUBMISSION OF TENDERS

2.1 All tenderers in response to this invitation shall be submitted through online mode only. Tender submitted by **fax/cable/telegram or any mode other than online will NOT be considered at all** and all such tenders will be rejected without any notice to the tenderer.

2.1.1 **Part-I (Techno-commercial):** This part of the tender shall include/contain documents related to eligibility criteria, all technical details, technical specifications, drawings and also the commercial terms and conditions of contract for the supplies to be made and the services to be rendered **EXCLUDING ANY PRICE DETAILS THEREOF.**

Proof for fulfillment of eligibility criteria mentioned in Annexure-A should be uploaded along with the tender. If the tender is submitted without valid documents, we shall not consider your offer. Tenders received without proof of eligibility criteria will be rejected. The offers which meets the eligibility criteria will only be considered for evaluation.

2.1.2 **Part-II (Price):** This part should contain only the prices of the stores offered for the services to be rendered. Part-II (Price) should be furnished in accordance with the format provided by the Purchaser at Section "D" of this tender document

2.1.3 If tenderer includes prices of any nature in Part-I (Techno-commercial) of the tender such offers are liable for rejection without any notice to the tenderers.

3.0 EARNEST MONEY DEPOSIT (EMD)

3.1 The Tenderer shall submit, as part of its bid, interest free Earnest Money Deposit (EMD) for an amount as specified in the Tender Notice. In the case of foreign bidders, the EMD shall be submitted either by the

principal or by the Indian agent and in the case of indigenous bidders; the EMD shall be submitted by the manufacturer or their specifically authorized dealer/bidder. EMD shall be submitted by way of Demand Draft from **SBI/nationalized banks or any one of the scheduled banks mentioned in the bracket (Axis Bank, HDFC Bank, ICICI Bank and IDBI Bank)** issued in favour of "**Institute for Plasma Research**" and payable at **Ahmedabad**. **Tender received without EMD will be rejected at the discretion of IPR.**

(Copy of Demand Draft to be uploaded with the quotation, Original DD should be sent to IPR on or before the specified closing date and time)

- 3.2 The EMD of unsuccessful Tenderer will be discharged/returned after finalizing award of the Contract/placement of Purchase order.
- 3.3 The successful Tenderers EMD shall be discharged upon the Bidder submitting the Security Deposit as specified in the contract/purchase order, without any interest.
- 3.4 **Exemption from payment of EMD:** The firms registered with DGS&D, NSIC, DPS or Micro & Small Enterprises (MSEs) which are actual producers/manufacturers of tendered items are exempted from payment of EMD provided valid registration certificate is uploaded along with the offer. In the case of foreign bidders, payment of EMD is exempted if they submit their bid directly or through their Indian agent in **foreign currency** against the tender document bought by them, so that the order can be placed directly on their Principals.
- 3.5 **The EMD may be forfeited:**
 - 3.5.1 If a Tenderer withdraws or amends or modifies or impairs or derogates its bid during the period of bid validity specified by the Bidder on the Bid Form; or
 - 3.5.2 In case of a successful tenderer, if the tenderer fails to furnish order acceptance within 15 days of the order or fails to submit the Security Deposit within 21 days from the date of contract/order.

4.0 LATE/DELAYED TENDERS

- 4.1 Uploading of the offer document after the due date and time shall not be permitted. Time being displayed on e-Tendering portal shall be final and binding on the applicant.

5.0 OPENING OF TENDERS

- 5.1 Unless otherwise pre-opened or postponed with advance intimation to the tenderers, tender will be opened in two stages on the date and time indicated on e-Tendering portal.
- 5.2 Part-I (Techno-commercial) of the tender will be opened at the first stage on the due date and time indicated for opening on the e-Tendering portal while the Part-II (Price) will be opened at the second stage after completion of the evaluation of the Techno-Commercial Part (Part-I) of the tender.
- 5.3 While all the tenderers who uploaded tenders within the due date and time will be permitted to participate in the opening of Part-I (Techno-Commercial) of the tender on the due date and time indicated on e-Tendering portal, opening of the Part-II (Price) of the tender can be attended to only by such of those tenderers whose Part-I (Techno-Commercial) of the tenders are found to be technical suitable/

acceptable to the Purchaser and to whom intimation thereof is given by the Purchaser by Email/letter or through e-Tendering portal.

- 5.4 The tenderers whose Techno-commercial part (Part-I) are found suitable/acceptable to the Purchaser, will be given seven days advance intimation by the Purchaser to enable such tenderers to depute their representative to participate in the opening of the Part-II (Price) of the tender. The technically unqualified tenderers will neither be given any intimation about the date and time of opening of Part-II (Price) of the tender nor will they be permitted to participate in the opening of the same. **Part-II (Price) of the technically disqualified tenderers will not be opened.**

6.0 AUTHORITY LETTER

- 6.1 The tenderers who wish to participate in the opening of the tenders may depute their representatives to IPR on the respective due date and time as indicated in the tender notice with an authority letter addressed to the Purchase Officer which should be produced to the officers who are opening the tenders, on demand to prove the bonafides of the representative who participates in the opening of the tender. In case the representative of the tenderer fails to produce such an authority letter on behalf of the tenderer, he will be debarred from participating in the opening of the tenders.

- 6.2 The tenderers representative, who reaches the venue of the tender opening late, i.e. after the starting time specified for opening of the tenders, may not be allowed to take part in the tender opening. It should be noted that only one representative of each tenderer will be permitted to participate in the tender opening.

7.0 EVALUATION OF TENDER

- 7.1 Evaluation of tender shall be based on all inclusive landed cost.

8.0 PURCHASER'S RIGHTS TO REJECT QUOTATION

- 8.1 The Purchaser reserves the right to reject any quotation without assigning any reason thereof.

9.0 TECHNICAL CLARIFICATIONS

- 9.1 After opening of Part-I (Techno-commercial) of the tender, if it becomes necessary for IPR to seek clarifications from the tenderers, the same will be sought for from the tenderers.

10.0 DATE FOR OPENING OF PART-II (PRICE):

After completion of technical evaluation, Part-II (Price) of only technically qualified tenderers shall be opened. The date and time of opening of Part-II (Price) shall be intimated only to the technically qualified tenderers. Whose Part-I offers have been found suitable will only be permitted to participate in the opening of the Part-II (Price) of the tender.

11.0 HOLIDAYS

If the date (s) specified for receipt and opening of the tenders is/are declared as holidays abruptly by the competent authority due to any administrative reasons, then the date(s) for opening of tenders will get postponed automatically to the next working day. As for instance, if the due date for receipt of tender and its opening falls on 3rd of a particular month and if the 3rd day of the month is declared as a holiday, then the

opening date of tender will stand automatically postponed to 4th day of the month at the same time. However, due date for submission of tender online will remain same as mentioned in the tender notice.

12.0 VALIDITY OF OFFERS

Offers shall be kept valid for acceptance for a period of of 120 (One hundred twenty) days from the date of opening of the tender. Offers with shorter validity period will be liable for rejection.

13.0 CATALOGUES/TECHNICAL LITERATURE

Vendor shall upload all necessary catalogues/drawings technical literature data as are considered essential for full and correct evaluation of the offers shall invariably accompany the Part-I (Techno-Commercial) of the tender. The quotations are liable to be ignored if this condition is not complied with.

14.0 TERMS AND CONDITIONS OF THE CONTRACT

It must be clearly understood that any contract concluded pursuant to this invitation to tender shall be governed by the General Conditions of the Contract as contained in Section "B" of this tender document. Tenderers must therefore, take special care to go through these general conditions of contract and in exceptional cases if any deviations are proposed, these must be clearly indicated in the Part-I of the tender as a separate annexure instead of merely enclosing their printed conditions of Sale. Tenders made subject to counter conditions or far too many deviations from the general conditions of contract, i.e. Section "B" of this tender document are liable to be ignored. It should also be realised that failure to bring out deviations from the General Conditions of Contract contained in Section "B" of this tender document will imply that the tenderer is willing to execute the contract as per the Purchaser's terms and conditions of contract.

15.0 TENDERING CONDITIONS FOR BIDS

- 15.1 The prices quoted must be FIRM and preference will be given to such tenders. In exceptional cases (e.g. items involving substantial use of raw materials susceptible to sharp fluctuations in prices) if prices quoted subject to variation it shall be on the basis of a standard 'Price Variation Formula'. The basis for calculation shall be very clearly stated. The responsibility for furnishing the documentary evidence for price variation lies with the vendor. Here again preference will be given to the tenders with a specific ceiling on escalation.
- 15.2 Prices quoted by the tenderer should include all charges involved for direct and safe-delivery of the stores to the consignee/place of delivery indicated in the tender document. If a tenderer so desires, separate lump sum charges for safe-delivery of the stores to the consignee/purchaser's site, could be furnished. However, the purchaser reserves the right to call for break-up. The purchaser will neither undertake responsibility for transit insurance nor pay for it separately.
- 15.3 In respect of tenders on Ex-works basis, in case the tenderer has not mentioned in the offer packing, forwarding and transportation charges for safe delivery up to Purchaser's site, 2% of the price quoted towards packing (in respect of both local and outstation firms), 1% of the basic price quoted towards safe delivery charges in respect of local tenderer and 3% of the basic price quoted towards safe delivery charges in

respect of outstation firm will be added for comparison of offers on safe door delivery at Purchaser's site.

- 15.4 The stores shall neither be despatched under 'owner's risk' nor consigned to 'self', but only to the consignee's name and address indicated in the Purchase order. Non-adherence to this condition shall make the contractor liable to bear all consequential penalties/expenses such as demurrage, wharf age, etc. which the Purchaser may incur.
- 15.5 The consignee will, as soon as possible, but not later than 45 days from the date of arrival of stores at destination notify the contractor of any loss or damage to the stores that may have occurred during transit to enable the contractor to repair/rectify the defects/damages or replace the goods as is appropriate, free of all charges. In case it is desired by the contractor for returning of the material to them all expenses towards transportation etc. will be borne by the supplier and also will furnish bank guarantee towards the cost of material.
- 15.6 In case an Indian supplier/Agent furnishes an offer for supply of outrightly imported stores, the price of such stores shall be quoted in Indian Rupees for delivery to the consignee's premises exclusive of import duties and on firm price basis.
- 15.6 **Conditional Discount:** In case the tenderer offers any conditional discount with regard to acceptance of their offer within a specific payment terms, delivery, quantity etc. the purchaser will not take into consideration such conditional discount while evaluating their offer.

16.0 SPARES AND ACCESSORIES

- 16.1 Tenders for plant/machinery/equipment/component shall also indicate prices for essential accessories, optional accessories and spares necessary for satisfactory operation of the plant/machinery/equipment.
 - 16.1.1 for a period of two years and
 - 16.1.2 for a period of five years
- 16.2 Prices for accessories and spares shall be itemized. Tenders where only lumpsum prices are indicated are liable to be ignored. Particular care must be taken to list out each item of spare and quantity recommended and also the individual price for these items. These details should be included only in Part-II (Price) of the tender. However, a list of spares and accessories without Price should be included in Part-I (Techno-Commercial) of the tender.

17.0 QUANTITY

The purchaser reserves the right to accept tenders for any quantity of his choice and the tenderer shall be bound to accept a contract for any quantity. The Purchaser also reserves the right to accept or reject lowest or any tender in full or in part without assigning any reasons.

18.0 STATUTORY LEVIES SUCH AS CUSTOMS DUTY, GOODS AND SERVICE TAX

18.1 CUSTOMS DUTY

- 18.1.1 The Purchaser is entitled for assessment of customs duty at the concessional rate as per Customs Notification No. 51/96-Custom dated 23.7.1996 issued by the Department of Revenue, Ministry of Finance, as amended from time to time, in respect of purchases made for the Research Institutions under the Department of Atomic Energy and the Purchaser will obtain the requisite

- certificate from the appropriate authority.
- 18.1.2 In case an Indian vendor/agent submits an offer for supply of outrightly imported stores in Indian Rupees, they should quote price for free and safe delivery of stores at destination.
- 18.1.3 Wherever, against a requirement, both indigenous as well as imported offers are received, the offers for imported stores will be evaluated on the basis of the total landed cost after loading the custom duty and other levies as may be applicable from time to time for taking purchase decision.
- 18.1.4 High Seas sale will not be considered.

18.2 FLUCTUATION IN THE CUSTOMS DUTY

- 18.2.1 Unless otherwise specifically agreed to in terms of the Contract, the purchaser shall not be liable for any claim on account of fresh imposition and /or increase in Customs Duty on raw materials and/or components used directly in the manufacture of the contracted stores, taking place during the pendency of the contract.

- 18.3 Offers from Indian Agents on behalf of foreign suppliers:** In case the tender is submitted by an Indian supplier/Indian agent on behalf of their foreign supplier/ principals, following documents should be submitted with the tender, failing which, their offer is liable to be ignored.

- 18.3.1 Photocopy of the Agency Agreement between the Principals and the Indian Agent showing the percentage or the quantum of agency commission payable and a Letter of Authority from the Principals authorizing the Indian Agents to submit the tender on their behalf.
- 18.3.2 The type and nature of after sales services to be rendered by the Indian Agent.
- 18.3.3 Both Indian Agent and Principal/OEM cannot bid simultaneously for the same item/product in the same tender.
- 18.3.4 The Indian Agents are allowed to quote on behalf of only one foreign Principal/ Supplier against this tender.
- 18.3.5 Copy of Registration Certificate with DGS&D or DPS.

18.4 GOODS AND SERVICE TAX

- 18.4.1 GOODS AND SERVICE TAX where legally leviable as per relevant HSN code will be admitted and reimbursed at the rate applicable during original delivery date.
- 18.4.2 GOODS AND SERVICE TAX intended to be claimed should be distinctly shown separately along with the price quoted. Where this is not done, no claim for GOODS AND SERVICE TAX will be admitted at any later stage and on any ground whatsoever.
- 18.4.3 The Purchaser is entitled for assessment of GST at the Concessional rate as per Notifications issued by the Government, as amended from time to time, in respect of purchases made for the Research and Development applications under the Department of Atomic Energy and other R&D units.
- 18.4.4 **GST for R&D Unit:** Goods and Service Tax (GST) wherever applicable will be paid extra at actual during the delivery period stipulated in the Purchase order. In terms of notifications issued by the Central Government and State Governments, R&D units of Department of Atomic Energy are entitled for IGST @ 5% or CGST @ 2.5% and SGST @ 2.5% as applicable for stores covered under the Purchase Order.

- 18.4.5 **GST for Services:** As applicable. Specify the SAC codes wherever services are involved.
- 18.4.6 It would be the responsibility of the contractor to ensure that relevant certificate is obtained from the Purchaser before effecting the delivery of goods ordered failing which the excess tax paid by the contractor shall not be reimbursed by the Purchaser.
- 18.4.7 When GOODS AND SERVICE TAX is claimed as extra by the vendor in general and on packing charges in particular, the following certificates should be submitted by the vendor to the Paying Authority on the bills itself.
- 18.4.8 Certified that the goods and packing charges on which GOODS AND SERVICE TAX has been charged have not been exempted under the Central Sales Tax or the State Sales Tax Act or the rules made there-under and the amount charged on account of GST on these goods and packing charges are not more than what is payable under the provision of relevant Act or the rules there-under.
- 18.4.9 Certified further that we have actually paid GOODS AND SERVICE TAX and are being assessed to GST on packing charges and also that where there are statutory exemption under the Relevant Act/Law of the State Government concerned, we have availed ourselves of it and certified non-availability of such a provision for GST on packing charges wherever claimed.
- 18.4.10 Certified further in respect of amount claimed into the bill no claim is pending for refund/or admissible. Certified that in the event of our getting refund in whole or in part of the element of GOODS AND SERVICE TAX on packing charges claimed from Government, we shall pass on the benefit to the Purchaser by remitting to Government the amount equivalent to the amount of refund obtained by us.
- 18.4.11 Further certified that we abide by the all the provisions of Acts of Governemnt and rules made thereunder especially regarding anti-profiteering provisions.
- 18.4.12 Certified further that we (our Branch or agent) _____
 (address) are registered as dealers in the State of _____
 under Local Regn. No. _____ and in the State of _____
 under Central Regn. No. _____ for the
 purpose of State/Central Tax.
 (Stamp & Signature of the Vendor)
- 18.4.13 The vendor shall solely be responsible for declaration of Goods and Service Tax made in his invoice and shall indemnify the purchaser from any claim or its liability from concerned authorities at any stage.
- 18.4.14 Certificate with each bill to the effect that no refund has been obtained in respect of the reimbursement of GST made to vendor during three months immediately preceding the date of the claim covered by the relevant bill.
- 18.4.15 AN UNDERTAKING to the effect that in case any refund of GST is granted to the vendor by concerned authorities in respect of stores supplied under the contract, they shall pass on the credit to the purchaser immediately alongwith a certificate from their Director/Manager/Proprietor/ Accountant to the effect that the credit so passed on relates to the GST originally paid for the stores

supplied under the contract. In case of their failure to do so within 10 days of the issue of the refund orders to them by the Authorities, the purchaser would be empowered to deduct a sum equivalent to the amount refunded by the authorities without any further reference to the vendor, from any of their outstanding bills against this or any other pending Government Contracts and that no dispute on this account would be raised by the vendor.

18.4.16 Statutory Deductions, as applicable shall be made from the supplier's bill.

18.5 **DEDUCTION OF TAX AT SOURCE (TDS)**

As per Government of India rules, it is mandatory that income tax shall be deducted at source at applicable rates as per relevant act, rules and notifications issued by the government from time to time.

18.5.1 **In case of Indigenous Vendors** (Indian Suppliers who provide indigenous products and services, Indian subsidiaries with permanent establishment in India who supply imported goods and services and paid in Indian currency only): Tax deducted at source will be applicable under Section 194-C for carrying out any work (including supply of labour for carrying out any work) in pursuance of contract as per Income Tax Act 1961. In case of technical or professional services, TDS will be applicable as per under Section 194-J of Income Tax Act 1961.

18.5.2 **In case of Foreign Vendors** (Foreign Suppliers who provide goods from abroad paid in foreign currency and providing technical services by Indian subsidiary paid in Indian currency): The TDS is applicable where services are rendered in India directly or through their Indian counter part against foreign Purchase order / Contract as per the provision of under Section 195 of Income Tax act of India. Wherever DTAA (Double Taxation Avoidance Agreement) agreement exists between India and the supplier country the provisions of the agreement shall be applicable. For getting benefit of DTAA (Double Taxation Avoidance Agreement), the following documents must be submitted, otherwise full TDS will be deducted.

- a) No Permanent Establishment in India certificate
- b) Tax Residency Certificate (TRC) issued by Tax authorities of their country
- c) Form 10F if TRC does not contain required details
- d) PAN (Permanent Account Number) details issued by Indian Income Tax Authority

Important Note:

- a) Where bifurcation is inappropriate and unacceptable for supply of material and providing services the purchase order / contract will be treated as **Composite Contract** and TDS will be deducted on whole contract / purchase order value as per applicable rate.
- b) TDS or any other leviable taxes or duties, if applicable, shall be deducted recovered from the Supplier's bill and necessary certificate will be issued to the supplier.

- c) Details on relevant sections of Income Tax Act and DTAA treaties can be obtained from [https://www.incometaxindia.gov.in/ Pages/acts/income-tax-act.aspx](https://www.incometaxindia.gov.in/Pages/acts/income-tax-act.aspx).

19.0 FLUCTUATION IN STATUTORY LEVIES

Unless otherwise specifically agreed to in terms of the Contract, the purchaser shall not be liable for any claim on account of fresh imposition and/or increase in statutory levies on raw materials and/or components used directly in the manufacture of the contracted stores, taking place during the pendency of the contract. However, any reduction in statutory levies on these raw materials and/or components must be passed on to the Purchaser.

20.0 SAMPLES/PROTOTYPES

If any called for shall be submitted free of all charges by the Tenderer and the Purchaser shall not be responsible for any loss or damage thereof for any reason whatsoever. In the event of non-acceptance of the tender, the tenderer will have to make arrangements to remove/collect the sample/prototypes at his own expenses.

21.0 QUANTITIES

Quantities indicated are approximate only and one or more of the items of the stores tendered, or a portion of any one or more of the items of such stores may be accepted and the tenderer notwithstanding that his Tender has not been accepted in whole shall be bound to supply contracted quantity to the Purchaser.

22.0 SUBMISSION OF DRAWINGS

The tenderer shall furnish all drawings pertaining to the plant/machinery/ equipment/component to the Purchaser along with the tender for correct understanding and appreciation of the tender in quadruplicate. Besides, tenderers should also furnish general arrangement, schematic and such other drawings prescribed by the Purchaser within 4 weeks from the date of receipt of a Purchase Order for approval. Such drawings should be furnished along with Part-I (Techno-Commercial) of the tender. Tenderer's drawing will form part of the purchase order/contract only after these are approved by the Purchaser.

23.0 INSTALLATION AND COMMISSIONING

23.1 Wherever, the purchaser's invitation to tender calls for installation and commissioning or supervision of installation and commissioning of the instrument/equipment by the tenderer, the tenderer must clearly and separately quote the prices for the supply of the stores and the charges and the terms for installation and commissioning or supervision of installation and commissioning, as the case may be. The charges towards installation and commissioning should not be included in the price of the stores.

23.2 In respect of contracts involving installation and commissioning by vendors including overseas vendors where identifiable charges for the same has been quoted by the vendor, he shall bear the Income-tax liability as per the rates prevailing at the time of undertaking the job in accordance with the Income-tax Act in force in India.

23.3 Wherever, the scope of the contract includes installation and commissioning, it shall be the sole responsibility of the contractor to undertake the installation and commissioning as and when called for, by the Purchaser.

24.0 INSPECTION

24.1 The Contractor shall be responsible for and perform all inspection and testing required in accordance with the contract/purchase order and specifications included therewith.

24.2 The Purchaser may at his option depute his representative for inspection of the stores to be supplied under the contract or authorize and nominate a Quality Surveillance Agency of his choice for the purpose hereinafter called, in either case, the inspection.

24.3 The supplier shall give notice of readiness for inspection to the Purchaser so that the Inspector can be present at the requisite time. In such an event delivery shall not be effected until an authorization or shipping release is obtained from the Purchaser.

24.4 The contractor shall allow reasonable facility and free access to his work/factory and records to the inspector for the purpose of inspection or for ascertaining the progress of delivery under the contract.

25.0 FACTORY REGISTRATION/SHOP & ESTABLISHMENT CERTIFICATE

The tenderers shall upload the copy of the Factory Registration/License or Shop & Establishment Certificate as applicable, along with the tender, failing which the tenders are liable for rejection.

26.0 PRODUCTS WITH ISI MARK

26.1 Products with ISI mark will be preferred.

26.2 In respect of following categories of item, Purchaser will consider offers for products with ISI mark only:

- Fire Extinguisher
- Building Material
- PVC Pipes & fittings
- Agricultural Implements & sprayers
- Medical instruments such as syringes, needles, BP apparatus etc.

27.0 SHOP/FACTORY EVALUATION, QUALITY SURVEILLANCE /INSPECTION AND SUBMISSION OF PROGRESS REPORTS

27.1 The Purchaser or his technical authorities may at his option and prior to evaluation of the tender depute his Inspector or any quality surveillance Agency of his choice to the factory/workshop of the tenderer to assess and establish the manufacturing capability etc. of the tenderer. Similarly, the Purchaser may also depute his inspector/Quality Surveillance agency of his choice for inspection of the plant/machinery/equipment/component during the various stages of manufacture in such an event the tenderer/contractor shall:-

27.1.1 Allow reasonable facility and free access to his factory/work/ records to the Inspector for the purpose of inspection or for ascertaining the progress of manufacture and delivery.

27.1.2 Provide the drawings, toolings, gauges, instruments etc. required for carrying out the inspection work.

- 27.1.3 Produce an inspection plan to the Purchaser's satisfaction notifying him when check points on the plan are imminent.
- 27.1.4 Not supply or deliver the plant/machinery/equipment/ component unless and until a Shipping Release or an authorisation for despatch is obtained in a format provided by the Purchaser. Failure to comply with this instruction will not only result in withholding of the payment to the contractor/supplier, but also hold the tenderer/contractor liable for payment of compensation to the Purchaser due to delay in clearance of the Equipment/plant/machinery/ component from the carriers.

28.0 INSTRUCTION MANUAL

In respect of plant/ machinery/ equipment/ instrument/ apparatus, where instruction/ operation manual is normally necessary to enable the user to put the plant/machinery/equipment/instrument/ apparatus to proper use, the Contractor shall furnish such an instruction/operation manual specific to the stores being supplied along with the plant/machinery/equipment/instrument/apparatus. The Contractor shall clearly specify in the offer about his readiness to supply instruction/operation manual

29.0 PACKING

- 29.1 Tenderers shall note that packing for shipment shall be in accordance with the instructions outlined in this tender document, each package shall be limited to the size and weights that are permissible under the existing Air and Sea limitations. Even when no packing specification is included in the invitation to tender, it will be Supplier's responsibility to provide appropriate packing depending upon the nature of the supply and the transportation and handling hazards.
- 29.2 The equipment shall be so packed and protected as not to suffer deterioration, damage or breakage during shipment and storage in a tropical climate.
- 29.3 Each package shall be properly labeled to indicate the type and quantity of material it contains, the purchase order number, its dimensions and weight and any other necessary data to identify the equipment and relate it to contract.

30.0 DEVIATIONS TO PURCHASER'S SPECIFICATIONS AND CONDITIONS OF CONTRACT

- 30.1 If any deviation or substitution from the technical specifications contained in Section "C" to this tender document is involved, such details should be clearly indicated in Part-I (Techno-Commercial) and should be added as an annexure to Part-I (Techno-commercial) of the tender as otherwise it shall be an admission on the part of the tenderer that he will supply the equipment as specified by the Purchaser. Similarly, deviations to the Purchaser's General Conditions of Contract/Special Conditions of Contract contained in Section "B" of this tender document shall be indicated by the tenderer in another annexure to Part-I (Techno-commercial) of the tenderer.

30.2 Part-II (Price) should be furnished in accordance with the format provided by the Purchaser at Section “D” of this tender document.

31.0 DELIVERY

Tenderer should note that no tender will be considered by the Purchaser unless the Tenderer can meet the delivery schedule specified by the Purchaser. All equipments/machinery/plant/ component covered by this tender document should be supplied on or before _____ or _____ month from the date of approval of drawings or ____ month from the date of receipt of free issue materials. The prices quoted by the tenderer should include all charges involved for direct and safe delivery of the items by Road to the project site of the Purchaser. If a tenderer so desires/separate lumpsum charges for transportation and safe delivery to Purchaser’s site could be furnished. Purchaser will neither undertake responsibility for transit insurance nor pay for it separately. No other, delivery term will be accepted by the Purchaser.

32.0 ACCEPTANCE OF TENDERS

32.1 The purchaser shall be under no obligation to accept the lowest or any other tender and shall be entitled to accept or reject any tender in part or full without assigning any reasons whatsoever.

32.2 Acceptance of tenders by the Purchaser will be sent by fax, E-mail, letter etc. within the validity date of the tender and such a fax, letter etc. would then be followed by a formal purchase order/contract. The tenderer whose offer is accepted will proceed with the execution of the contract on the basis of such advance acceptance of tenders without waiting for a formal purchase order/contract, and will be responsible to seek and obtain whatever clarifications that are necessary from the Purchaser to proceed with the manufacture without waiting for a formal purchase order/contract and delivery period will be reckoned from the date of the Letter of Intent.

33.0 SETTLEMENT OF COMMERCIAL TERMS AND CONDITIONS OF CONTRACT

In case the commercial terms and conditions of sale/contract stipulated in Part-I (Techno-commercial) of the tender submitted by the tenderer are at variance with the Purchaser’s General Conditions of all Contracts/Special Conditions of Contract stipulated in Section “B” of this tender document, the Purchase Officer will settle the commercial terms and conditions of contract with the tenderers chosen for award of the contract by holding discussions with them OR by sending Fax/Letter/E-mail etc. In case the concerned tenderer to whom an intimation thereof is given does not respond/fail to respond to communication sent by the Purchaser within the date specified, his tender is liable for rejection at the discretion of Director, IPR and no complaints whatsoever will be entertained from the tenderer for rejection of this tender. The tenderers should not discuss with the technical authorities/user department any of the commercial terms and conditions of contract and any agreement/understanding reached between the tenderer and the technical authorities will not be valid and binding.

34.0 **COMPLIANCE WITH THE SECURITY REQUIREMENTS OF THE PURCHASER**

The Contractor shall strictly comply with the Security Rules and Regulations of the Purchaser in force and shall complete the required formalities including verification from Police and any other authority and obtain necessary prior permission for entry into the Purchasers premises, wherever authorized by the Purchaser.

35.0 **PAST PERFORMANCE**

In case the past performance of the tenderer is not found to be satisfactory with regard to quality, delivery, warranty obligation and non-fulfillment of terms and conditions of the contract, their offer is liable to be rejected by the purchaser.

36.0 **CAPACITY & FINANCIAL STANDING**

In case it is found that the tenderer does not possess the requisite infrastructure, capacity, capability and their financial standing is not satisfactory, such tender is liable to be rejected by the Purchaser.

37.0 **CONFIDENTIALITY**

Drawings, specifications, prototypes, samples or any other correspondence/details/information provided by the Purchaser relating to the tender or the contract shall be kept confidential by the contractor, and should not be disclosed or passed on to any other person/firm without the prior written consent of the purchaser. This clause shall apply to the sub-contractors, consultants, advisers or the employees engaged by the Contractor.

38.0 **RESTRICTED INFORMATION CATEGORIES UNDER SECTION 18 OF THE ATOMIC ENERGY ACT, 1962 AND OFFICIAL SECRETS UNDER SECTION 5 OF THE OFFICIAL SECRETS ACT, 1923**

Any contravention of the above mentioned provisions by the contractor, sub-contractor, consultant, adviser or the employees of the contractor will invite penal consequences under the aforesaid legislation.

39.0 **PROHIBITION AGAINST USE OF THE NAME OF ANY INSTITUTION OF DEPARTMENT OF ATOMIC ENERGY WITHOUT PERMISSION FOR PUBLICITY PURPOSES**

The Contractor or sub-contractor, consultant, adviser or the employees engaged by the contractor shall not use the name of any Institution of Department of Atomic Energy for any publicity purpose through any public media like Press, Radio, TV or Internet without the prior written approval of the Purchaser.

40.0 **FREE ISSUE MATERIAL** *(This clause shall apply only to contracts for supply of fabricated equipment with purchaser's Free Issue Materials (FIM)).*

40.1 Wherever contracts envisage supply of Free Issue Material (FIM) by the Purchaser to the contractor, such Free Issue Material shall be safeguarded by an insurance policy to be provided by the Contractor at his own cost for the full value of such materials and the insurance policy shall cover, the following risks specifically and shall be valid for six months beyond the contractual delivery date.

- **Risk to be covered:** Any loss or damage to the Purchaser's material due to fire, theft, riot, burglary, strike, civil commotion, terrorist act, natural calamities etc. and any loss or damage arising out of any other causes such as other materials falling on purchaser's materials.
- **Insured by:** (Name of the Contractor)
- **Beneficiary:** Institute for Plasma Research, Near Indira Bridge, Bhat, Gandhinagar-382428.
- **Amount for which insurance policy to be furnished:** The amount will be indicated in the respective contract.

Free Issue Material (FIM) will be issued to the Contractor only after receipt of the Insurance Policy from the Contractor. The contractor shall arrange collection of the FIM from the Purchaser's premises and safe transportation of the same to his premises at his risk and cost.

Notwithstanding the insurance cover taken out by the Contractor as above, the contractor shall indemnify the purchaser and keep the Purchaser indemnified to the extent of the value of free issue materials to be issued till such time the entire contract is executed and proper account for the FIM is rendered and the left over/surplus and scrap items are returned to the Purchaser. The contractor shall not utilize the Purchaser's free issue materials for any job other than the one contracted out in this case and also not indulge in any act, commission or negligence which will cause/result in any loss/damage to the Purchaser and in which case, the Contractor shall be liable to the Purchaser to pay compensation to the full extent of damage/loss. The Contractor shall be responsible for the safety of the free issue materials after these are received by them and all through the period during which the materials remain in their possession/control/ custody. The free issue materials on receipt at the Contractor's works shall be inspected by them for ensuring safe and correct receipt of the material. The Contractor shall report the discrepancies, if any, to the Purchaser within 5 days from the date of receipt of the material. The Contractor shall take all necessary precautions against any loss, deterioration, damage or destruction of the FIM from whatever cause arising whilst the said materials remain in their possession/custody or control. The FIM shall be inspected periodically at regular intervals by the Purchaser for ensuring safe preservation and storage. The contractor shall also not mix up the FIM with any other goods and shall render true and proper account of the materials actually used and return balance remaining unused material on hand and scrap along with final product and if it is not possible within a period of one month from the date of delivery of the final product covered by this purchase order. The Contractor shall also indemnify the Purchaser to compensate the difference in cost between the actual cost of the FIM lost/damaged and the claim settled to the Purchaser by the insurance company. The decision of the Director, Institute for Plasma Research, as to whether the Contractor has caused any loss, destruction, damage or deterioration of the FIM while in his possession, custody or control from

whatever cause arising and also on the quantum of damage suffered by the government, shall be final and binding upon the Contractor.

41.0 EXPORT LICENCE/EXPORT PERMISSION

41.1 It is entirely the responsibility of the vendors who are quoting for materials of foreign origin to ensure obtaining export permission/licence/authorisation as required from the respective Government before arranging shipment. This Department would not accept post supply inspection by any agency/authority of any foreign country. It is, therefore, necessary that the vendors offering materials from foreign countries shall have thorough knowledge of export contract regulations in vogue in those countries.

41.2 The vendors shall indemnify the purchaser against any consequences in respect of any end-use declaration they/their overseas Principals may furnish to the government/government agencies of the country of origin of the materials, while seeking export permission/licence. Post supply inspection, contrary to the terms and conditions of purchaser's contract shall be deemed to be null and void.

42.0 END USE CERTIFICATE

42.1 Whenever an End-use Certificate is desired by the vendor, the same shall be clearly mentioned in the quotation and the purchaser shall provide an Enduser Certificate as per the format given below. The Purchaser will not provide any other document/declaration in this regard.

END USER STATEMENT:

"We hereby certify that the item/s i.e. _____, being procured from M/s _____ against our Purchase Order No. _____ dated _____ will be used for _____. We also certify that the item/s will not be used in designing, developing, fabricating or testing of any chemical, biological, nuclear, or weapons of mass destruction or activities related to it. It is further certified that we will not re-export the Item/s prior to obtaining permission from the concerned authorities as may be required".

43.0 COUNTRY OF ORIGIN

43.1 Wherever the tenders are for imported stores, the Country of Origin of the stores must be clearly specified in the quotation.

44.0 LIABILITY

44.1 Vendors shall be liable for any damage to the purchaser or any third party out of any patent or latent defect in the goods supplied by him or sub-standard services rendered by him.

45.0 RIGHT TO REJECT QUOTATION

45.1 The Purchaser reserves the right to reject any quotation, which is not in conformity with the above instructions.

45.2 The Purchaser also reserve the right to reject any quotation without assigning any reason whatsoever.

46.0 **PRICE / PURCHASE PREFERENCE**

Purchase/Price preference to industries will be given as per the policy of the Government of India in force at the time of evaluation provided their offer is in compliance with the conditions of the policy.

47.0 **PERMANENT ACCOUNT NUMBER (PAN)**

47.1 Vendors are required to upload a true copy of the PAN Card/Letter issued by the Income-tax Department, failing which the tenders are liable to be rejected.

48.0 MSE bidders should declare their UAM (Udyog Aadhar Memorandum) number on CPPP portal to avail benefits as per Public Procurement Policy for MSE's order 2012.

49.0 The bidder shall not be under a declaration of ineligibility for corrupt or fraudulent practices or blacklisted with any of the Government Agencies.

Any additional conditions attached to this Invitation to Tender shall also form part of the contract conditions.

SECTION 'B'

**GENERAL CONDITIONS OF
CONTRACT**

**INSTITUTE FOR PLASMA RESESARCH
PURCHASE SECTION**

**GENERAL CONDITIONS OF ALL
CONTRACT**

&

**SPECIAL CONDITIONS OF CONTRACT
GOVERNING SUPPLIES OF
PLANT AND MACNHINERY**

GENERAL CONDITIONS OF CONTRACT

1. DEFINITIONS

- 1.1 The term 'PURCHASER' means the Institute for Plasma Research or its successors or assigns.
- 1.2 The term 'PARTICULARS' means the following:
 - 1.2.1 Specification
 - 1.2.2 Drawing
 - 1.2.3 Sealed pattern denoting a pattern sealed and signed by the Inspector
 - 1.2.4 Proprietary make denoting the produce of an individual firm
 - 1.2.5 Any other details governing the construction manufacture and/or supply as existing for the contract.
- 1.3 The term 'CONTRACTOR' or 'SUPPLIER' means, firm or company with whom or with which the order for the supply of stores is placed and shall be deemed to include the Contractors/Successors (approved by the Purchaser), representatives, heirs, executors and administrators unless excluded by the contract.
- 1.4 The term 'CONTRACT' or 'PURCHASE ORDER' means and comprises of a Letter or Email or ink signed or digitally signed document conveying acceptance of Contractor's offer and invitation to tender, tender containing offer, advance acceptance of offer, general and special conditions of contract specified in the acceptance of offer and any subsequent amendments/alterations thereto made on the basis of mutual agreement.
- 1.5 The term 'STORES' or 'MATERIAL' means, the goods specified in the contract/purchase order which the contractor has agreed to supply under the contract.
- 1.6 The term 'SUB-CONTRACTOR' or 'SUB-SUPPLIER' means any contractor or supplier engaged by the contractor or the supplier with the prior approval of the Purchaser in relation to the contract/purchase order.
- 1.7 The term 'INSPECTOR' or 'QUALITY SURVEYOR' means any person nominated and deputed by the purchaser or their appointed Consultants or Quality Surveillance Agency or any other person from time to time authorized by the Purchaser to act as his representative for the purpose of inspection of stores under the contract/purchase order.

2. AUTHORITY OF PERSON SIGNING THE CONTRACT ON BEHALF OF THE CONTRACTOR

The person signing the contract or the purchase order or any other document in respect of the contract or purchase order on behalf of the contractor shall be deemed to warrant that he has the authority to bind the contractor.

3. SUBLETTING OF CONTRACT OR BILLS OR ANY BENEFIT ACCRUING THEREFROM

- 3.1 The Contractor shall not sublet, transfer or assign the Contract or any part thereof or bills or any other benefits, accruing therefrom or under the contract without the prior written consent of the Purchaser (All Sub-contractors are required to be appraised and approved by the Purchaser before placement of orders by the Contractor/Supplier). However, such consent shall not be unreasonably withheld by the Purchaser, if such stores are not normally manufactured by the Contractor, such assignment or subletting shall not relieve the Contractor from any contractual obligation or responsibility under the Contract.
- 3.2 Any breach of this condition shall entitle the Purchaser to cancel the Contract or any part thereof and to purchase from other sources at the risk and cost of the Contractor and shall recover from the Contractor damages arising from such cancellations.
- 3.3 In case the Contractor sublets, transfers or assigns any part of the Contract with the prior written consent of the Purchaser, all payments to the Sub-Contractor shall be the responsibility of the Contractor and any requests from such sub-Contractor shall not be entertained by the Purchaser.

4. SECURITY DEPOSIT

- 4.1 On acceptance of tender, the Contractor shall at the option of the Purchaser and within the period specified by him, submit a Bank Guarantee from SBI or any one of the nationalized banks or reputed private banks, viz. AXIS Bank, ICICI Bank, IDBI Bank and HDFC Bank towards Security Deposit not exceeding 10% (ten percent) of the tendered value of the contract/purchase order valid till at least 2 months beyond the acceptance date of the material, as the Purchaser shall specify.
- 4.2 If the Contractor is called upon by the Purchaser to submit Security Deposit and the contractor fails to provide the same within the period specified such failure shall constitute a breach of the Contract and the Purchaser shall be entitled to make other arrangements for the repurchase of the stores contracted for at the risk and expenses of the Contractor in terms of clause 9.2.4 hereof and/or recover from the Contractor damages arising from such cancellation. No claim shall lie against the purchaser either in respect of interest if any due on Security Deposit or depreciation in value.
- 4.3 Offers wherein contractors declined to submit Security Deposit are liable to be rejected.

5. DRAWINGS & SPECIFICATIONS

- 5.1 The drawings and specifications are intended to be complementary and to provide for an comprise everything necessary for the completion of supply. Any material shown on the drawing even if not particularly described in specifications or vice versa is to be supplied by the Contractor as if it were both shown and specified.

- 5.2 Should any discrepancy be noted in the drawings and/or specifications and should any interpretation of the same be required, the matter shall be referred to the Purchaser for clarification which shall be binding upon the contractor. Otherwise, the contractor shall assume responsibility for the interpretation of the drawings and specifications including interpretation by his sub-contractors.
- 5.3 Should any difference or dispute arise with regard to the true intent and meaning of drawings or specification or should any portion of the same be obscure or capable of more than one interpretation, the same shall be decided by the Purchaser whose decision shall be final.
- 5.4 All lettering on the drawings is to be considered as part of the specification and contract. In all cases figured dimensions are to be followed rather than those indicated by scale. Large scale drawings will take precedence over small scale drawings.
- 5.5 The contractor's drawings shall, when approved by the Purchaser, be deemed to be included in the list of drawings which form part of the contract. The Contractor shall not proceed with fabrication until all drawings associated therewith have been duly approved by the Purchaser.
- 5.6 The Contractor shall be responsible for and shall pay for any alterations of the stores and shall indemnify the Purchaser for any consequential expenditure incurred by the Purchaser due to any discrepancies, errors, omissions in the drawings or other particulars supplied by him whether such drawings or specifications have been approved by the Purchaser or not, provided that such discrepancies, errors or omissions be not due to inaccurate information or specifications furnished to the contractor on behalf of the Purchaser.
- 5.7 **General Warranty**
- 5.7.1 The stores supplied by the contractor under the contract shall be of best quality and workmanship. The contractor shall supply the stores in accordance with the contract specifications unless any deviation has been expressly specified in the contract and any amendments agreed thereto.
- 5.7.2 The contractor's offer to supply stores in accordance with the tender specifications shall be deemed to be in admission on his part that he has fully acquainted himself with the details thereof and no claim shall lie against the Purchaser on the ground that the contractor did not examine or acquaint himself fully with the tender specifications.
- 5.8 **Contractor's Liability for Defective Stores**
- 5.8.1 For a period of twelve months after the stores have been accepted by Purchaser the Contractor shall be responsible for any defects that may be discovered therein notwithstanding that such defects could have been discovered at the time of inspection or any defects therein are found to have developed under proper use, arising from faulty materials, design or workmanship and the Contractor shall remedy all such defects as aforesaid at his own cost provided he is called upon within a period of 14 months from the date of acceptance thereof to do

so, by the Purchaser who shall state in writing in what respect the goods are faulty and further if in the opinion of the Purchaser the defects are of such a nature that it is necessary to replace or renew any defective stores, such replacement or renewal shall be made by the Contractor without any extra costs to the Purchaser, provided notice informing the Contractor of the defect is given by the Purchaser within the said period of 14 months. The decision of the Purchaser notwithstanding any prior approval or acceptance of the Inspector as to whether or not the stores delivered are defective or any defect has developed within the said period of twelve months or as to whether the nature of defects renewal or replacement shall be final conclusive and binding on the Contractor.

6. ALTERATIONS

6.1 The Purchaser may, from time to time, make changes in the drawings specifications and issue additional instructions without altering the purchase order in any manner provided that no changes shall have been ordered which materially alter the character and scope of the supply under the contract.

6.2 It shall be lawful for the parties to the contract to alter by mutual consent at any time and from time to time the drawings and specifications and as from the dates specified by him stores to be supplied shall be in accordance with such altered drawings and specifications provided that if any such alterations involve increase or decrease in the cost of or in the period required for production, a revision of the contract price and/or the period prescribed for delivery shall be made by mutual agreement in respect of the stores to which the alteration applies. In all other respects, the contract shall remain unaltered.

7. SAMPLES

7.1 Samples submitted for any reason shall be supplied without charge and freight paid without any obligation of the Purchaser as regards safe custody or safe-return thereof. All samples submitted must be clearly labelled with the Contractor's name and address and tender number. If the Contractor submits the sample with his tender the same shall not govern the standard of supply except when it has been specifically stated in the Purchase Order that it is accepted instead of any sealed pattern. Should certified samples be lent to the Contractor by the Purchaser, the Contractor is responsible for the return in perfect order of all certified samples with the labels intact.

8. PACKING

8.1 The contractor shall be held responsible for the stores being sufficiently and properly packed for transport by rail, road, sea or air so as to ensure their being free from any loss or damages on arrival at their destination. The packing and marking of packages shall be done by and at the expenses of the Contractor. Each package shall contain a Packing

Note quoting Purchase Order number and date and showing its contents in detail.

- 8.2 Unless otherwise provided in the contract all containers (including packing cases, boxes, tins, drums and wrappings) in which the stores are supplied by the contractor shall be considered as property of the Purchaser and their cost as having been included in the contract price.

9. DELIVERY:

9.1 TIME FOR AND DATE OF DELIVERY, THE ESSENCE OF THE CONTRACT:

The time for and the date of delivery of the stores stipulated in the purchase order/contract shall be deemed to be of the essence of the contract and delivery must be completed not later than the date/dates stipulated.

9.2 EXTENSION OF DELIVERY SCHEDULE

- 9.2.1 If any delay in delivery shall have arisen from any cause such as strike, Lock-outs, fire, accidents, riot or the like which the purchaser may admit as reasonable ground for grant of extension of delivery schedule, the purchaser will allow such additional period for the purpose as he may consider necessary taking the circumstances into consideration.

- 9.2.2 If the contractor fails to deliver the stores or any instalment or part thereof within the period fixed for such delivery or such additional period allowed by the purchaser in accordance with foregoing paragraphs or any time before the expiry of such period repudiates the contract, the Purchaser may without prejudice to the rights of the purchaser.

- 9.2.3 Recover from the contractor as Liquidated Damages and not by way of penalty as detailed under clause No.222 given herein below for any stores which the contractor has failed to deliver within the period fixed for delivery in the contract or such additional period as mentioned in paragraph 9.2.1. during which the delivery of such stores, may be in arrears where delivery thereof is accepted after expiry of the aforesaid period. (For the purpose of computing the damages for delayed supplies under the clause, the cost of the entire plant/machinery/equipment/instrument will be taken into consideration if the plant/machinery/equipment/instrument cannot be put to the intended use for want of delayed portion of supply).

- 9.2.4 Purchase or authorise the purchase elsewhere without notice to the contractor, on account and at the risk of the contractor of the stores not so delivered or others of a similar description (where stores exactly complying with the contract specification are not in the opinion of the Purchaser, which opinion shall be final, readily procurable) without cancelling the contract in respect of the portion instrument not yet due of delivery, OR

- 9.2.5 Cancel the contract or portion thereof and if so desired purchase or authorise purchase of the stores not so delivered or others of a similar description (where stores exactly complying with the contract specification are not in the opinion of the Purchaser, which opinion shall be final, readily procurable) at the risk and cost of the contractor, if the contractor had defaulted in the performance of the original contract, the purchaser shall have the right to ignore his offer in response to risk purchase enquiry even though the lowest.

- 9.2.6 Where action is taken under sub-clause 9.2.4 or sub-clause 9.2.5 above the contractor shall be liable for any loss which the purchaser may sustain on that account provided that the repurchase, or if there is an agreement to repurchase then such agreement, is made within a reasonable period from the date of such failure, depending upon the nature / merit of the purchase and in case of repudiation of the contract before the expiry of the aforesaid period of delivery, shall not be entitled to any gain on such purchase and the manner and method of such purchase shall be in the entire discretion of the Purchaser. It shall not be necessary for the purchaser to serve a notice of such purchase on the contractor.

10. INSPECTION

- 10.1 The contractor shall be responsible for and perform all inspection and testing required in accordance with the contract/purchase order and specifications included herewith.
- 10.2 The Purchaser may at his option depute his representative for Inspection of the stores to be supplied under the contract or authorize and nominate a Quality Surveillance Agency of his choice for the purpose hereinafter called, in either case, the inspection.
- 10.3 The contractor shall give notice of readiness for inspection to the Inspector (deputed under clause 10.2 above) so that the Inspector can be present at the requisite time. In such an event delivery shall not be effected until an authorization or shipping release is obtained from the Purchaser's Inspector.
- 10.4 The contractor shall allow reasonable facility and free access to his work/factory and records to the inspector for the purpose of inspection or for ascertaining the progress of delivery under the contract.

11. RECTIFICATION AND REPLACEMENT OF DEFECTIVE STORES

- 11.1 If the inspector find that the contractor has executed any unsound or imperfect work, the inspector shall notify such defects to the contractor and the contractor on receiving the details of such defects or deficiency, shall at his own expenses, within seven days or otherwise within such time as may be mutually agreed upon as reasonably necessary, proceed to alter, reconstruct or remanufacture the stores to the requisite standard and specifications as called for by the tender specification.

12. INSPECTION AND REJECTION

- 12.1 **Inspection and Rejection:** The stores shall be tendered by the Contractor for inspection at such places as may be specified by the Inspector, at the Contractor's own risk, expenses and costs and shall lie at such places of inspection at the risk of the Contractor and the stores will be subject to inspection and test as may be considered necessary by the inspector and his decision as regards rejection of goods shall be final and binding on the Contractor. If any goods are rejected as aforesaid, then without prejudice to the foregoing provision, the Purchaser shall be at liberty to
- 12.1.1 Allow the Contractor to re submit without prejudice to the Purchaser's right to claim and recover Liquidated damages as provided in clause 9.2.3 hereof, stores in replacement of those rejected within a time specified by the Purchaser (which time shall be essence of the contract), the contractor bearing the

- cost of freight for such replacement without being entitled to any extra payment, or
- 12.1.2 Buy the quantity of stores rejected or others of a similar nature elsewhere at the risk and cost of the Contractor in accordance with the provisions contained in second paragraph of clause 9.2.4 thereof without effecting the Contractor's liability as regards the supply of any further consignments due under the Contract, or
- 12.1.3 Terminate the Contract and recover from the Contractor the loss Purchaser thereby incurred
- 12.2 **Removal of rejection:** Any stores submitted for inspection and rejected by the Inspector must be removed by the Contractor within fourteen days from the date of receipt of intimation of rejection, provided that in the case of dangerous infected or perishable stores, the Inspector (whose decision shall be final) shall notify the Contractor to remove such stores within 48 hours of receipt of intimation of rejection and it shall be the duty of the Contractor to remove them accordingly. Such rejected stores shall lie at the Contractor's risk from the time of such rejection and if not removed within the aforementioned time, the Purchaser shall have the right either to return the rejected stores to the Contractor at the Contractor's risk by such mode of transport as Purchaser may select or to dispose off or segregate such stores as he thinks fit at the Contractor's risk and on his accounts and to appropriate such portion of the proceeds as may be necessary to cover any loss or expenses incurred by the Purchaser in connection with the said sale. Freight to destination of stores rejected after examination at destination shall be recoverable from the Contractor at the Tariff Rate.
- 12.3 **Test Certificate and Guarantees:** Test Certificate Guarantees, if required by the Inspector shall be obtained and furnished by the Contractor free of costs.

13. RECOVERY OF SUMS DUE

- 13.1 Whenever any claim for payment of, whether liquidated or not, moneys arises out of or under this contract against the Contractor the Purchaser shall be entitled to recover sum by appropriating, in part or whole, by encashing the Bank Guarantee submitted towards Security deposit by the Contractor, if a Security Deposit is taken against the Contract. In the event of the security being insufficient or no Security Deposit has been taken from the Contractor then the balance or the total sum or which at any time hereafter may become due to the Contractor under this or any other contract with the Purchaser, should this sum be not sufficient to cover the full amount recoverable, the Contractor shall pay to the Purchaser on demand the remaining balance due. Similarly, if the Purchaser has or makes any claim, 'whether liquidated or not against the Contractor under any other contract with the Purchaser the payment of all moneys payable under the contract to the contractor including the security deposit shall be withheld till such claims of the Purchaser are finally adjudicated upon and paid by the Contractor.
- 13.2 All demurrage, wharfage and allied expenses incurred by the Purchaser, if any, due to delayed clearance of Stores in view of non receipt, incomplete or delayed receipt of documents by the Purchaser, shall be recovered from the payment due to the Contractor.

14. BAR/PERT CHART

- 14.1 The contractor at the discretion of the Purchaser shall submit the BAR/PERT chart indicating various activities from the date of purchase order to handing over of the stores.

15. PERFORMANCE BANK GUARANTEE

- 15.1 In the event of acceptance of the offer in respect of plant, machinery, equipment, instrument, etc. the tenderer will be required to submit a performance bank guarantee for 10% of the total value of the stores inclusive of all statutory levies and other charges admitted in the contract, from SBI/any nationalized bank or private sector banks, namely, ICICI Bank, IDBI Bank, HDFC Bank and AXIS Bank, on a non-judicial stamp paper of appropriate value valid till 2 months beyond the expiry date of warranty period as per the Purchaser's format towards satisfactory performance of the plant, machinery, equipment, instrument, etc. during the warranty period. In case of bids in currency other than INR performance bank guarantee shall be furnished from any bank of international repute.
- 15.2 In case of non-submission of performance bank guarantee by the Contractor, an amount equivalent to 10% of the total value of the stores and other charges admitted in the contract will be retained by the purchaser till the expiry of the warranty period of the stores.
- 15.3 Offers of the tenders who are not agreeable to furnish performance bank guarantee or retaining of an equivalent amount by the purchaser as per clause No.15.1 and 15.2 above, are likely to be rejected.

16. PERMIT AND LICENCES

- 16.1 The contractor shall secure and pay all licenses and permit at his end which he may be required to comply with all laws ordinances and regulations of the public authorities in connection with the performance of his obligations under the contract. The contractor shall be responsible for all damages and shall indemnify and save the purchaser harmless from against all claims for damages and liability which may arise out of the failure of the contractors to secure and pay for any such licenses and permits or to comply fully which any and all applicable laws ordinances and regulations.

17. PATENTS & PATENT RIGHTS INDEMNIFICATION

- 17.1 The Contractor shall indemnify and keep indemnified the Purchaser from and against any and all claims, actions, costs, charges and expenses arising from or for infringement of patent rights, copy right or other protected rights, of any design plans, diagrams, drawings in respect of the stores supplied by the contractors or any of the manufacturing methods or process adopted by contractor for the stores supplied under the contract.
- 17.2 In the event of any claim being made or action being taken against the purchaser in respect of the matter referred to clause 17.1 above, the contractor shall promptly be notified thereof and he shall at his own expense, conduct all negotiations for the settlement of the same and any litigation that may arise therefrom.
- 17.3 In the event of any designs, drawing, plans or diagrams or any manufacturing methods or process furnished by the contractor constituting infringement of patent or any other protected rights and use thereof is restrained, the contractor shall procure for Purchaser, at

no cost to the latter, the rights to continue using the same or to the extent it is possible to replace the same so as to avoid such infringement and subject to approval by the Purchaser or modify them so that they become non-infringing, but such modifications shall otherwise be to the entire satisfaction of the Purchaser.

- 17.4 The provision of the clause remains effective and binding upon the Contractor even after the completion, expiration or termination of the contract.

18. LAW GOVERNING THE CONTRACT

- 18.1 This Contract shall be governed by the laws of India for the time being in force. The marking of all stores supplied must comply with the requirements of India Acts relating to Merchandise Marks and all the rules made under such Acts.

19. JURISDICTION

- 19.1 The Courts within the local limits (i.e. Gandhinagar) of whose jurisdiction the place from which the purchase order is issued is situation only shall, subject to Arbitration Clause, have jurisdiction to deal with and decide any matter out of this Purchase Order/Contract.

20. SETTLEMENT OF DISPUTES

- 20.1 The Purchaser and the Contractor shall make every effort to resolve amicably by direct informal negotiation any disagreement or dispute arising between them under or in connection with the Contract.
- 20.2 If the parties have failed to resolve their dispute or difference by such mutual consultation, then either the Purchaser or the Supplier may give notice to the other party of its intention to commence arbitration, as hereinafter provided, as to the matter in dispute, and no arbitration in respect of this matter may be commenced unless such notice is given. Any dispute or difference in respect of which a notice of intention to commence arbitration has been given in accordance with this Clause shall be finally settled by arbitration. Arbitration may be commenced prior to or after delivery of the Goods under the Contract.

21. ARBITRATION

- 21.1.1 In the event of any dispute or difference arising out or of in connection with any of the terms and conditions of the Purchase Order/Contract, the matter shall be referred to the Director, IPR for settlement. In case the parties to the Purchase Order are not in a position to settle the dispute mutually, the matter shall be referred to a Sole Arbitrator to be appointed in accordance with the Arbitration & Reconciliation Act, 1996 & Arbitration and Conciliation (Amendment) Act, 2015 as amended time to time.

22. LIQUIDATED DAMAGES

- 22.1 As per Standard Terms & conditions, the Purchaser reserves the right to levy the Liquidated Damages, for delay in supply beyond the contractual delivery date at the rate of half percent (0.5 percent) of the total Contract price (Basic price) for each calendar week of delay. The total liquidated damages shall not exceed five percent (5%) of the contract price (Basic price). Stores/Goods will be deemed to have been delivered only when all its component parts are also delivered. If certain

components are not delivered in time, the Stores/Goods will be considered as delayed until such time as the missing parts are delivered.

- 22.2 Where the Contract entered into is a composite one with supply cum erection and installation/commissioning activities and the completion of erection and installation/commissioning is delayed irrespective of the fact that whether supply of material has been made within the original delivery period, the contract is to be considered as a whole and Liquidated Damages will be recovered on the total contract value.

23. EXERCISING THE RIGHTS AND POWERS OF THE PURCHASER

- 23.1 All the rights, discretions and powers of the Purchase under the contract shall be exercisable by and all notices on behalf of the Purchaser shall be given by the Purchase Officer and any reference to the opinion of the Purchaser in the terms and conditions contained in these General Conditions of all Contracts shall mean and be construed as reference to the opinion of any of the persons mentioned in this clause.

24. TRAINING

- 24.1 The successful tenderer shall, if required by the Purchaser, provide facilities for the practical training of Purchaser's engineering or technical personnel for their active association on the manufacturing process throughout the manufacturing period of the Contract/stores, number of such personnel to be mutually agreed upon. If demanded by the Purchaser, such training shall be conducted at Purchaser's site by the Contractor free of charge. The duration of training shall be mutually decided upon by the Purchaser and the Contractor.

25. RISK PURCHASE

- 25.1 In the event supplier fails to fulfill the contractual obligations as per the terms and conditions of the Contract, the Purchaser has an option of completing the Contract at the risk and expenses of the Contractor. While initiating risk purchase at the risk and expenses of the supplier, the Purchaser must satisfy himself that the supplier has failed to deliver and he has been given all the opportunities as per the Contract to execute the Contract and also adequate and proper notice. Wherever risk purchase is resorted to, the supplier is liable to pay the additional amount spent by the government, if any as compared to contracted amount. All the factors including the method of recovering such amount should also be considered while taking a decision to invoke the risk purchase.

26. LIEN IN RESPECT OF CLAIMS IN OTHER CONTRACTS

- 26.1 Any sum of money due and payable to the Contractor under any contract may be withheld or retained by way of lien by the purchaser or any other person or persons contracting through the Director, IPR against any claim of the Purchaser or such other person or persons in respect of payment of a sum of money arising out of or under any other contract made by the contractor with the Purchaser or with other such person or persons.
- 26.2 It is an agreed term of the contract that the sum of money so withheld or retained under this clause by the Purchaser will be kept withheld or retained as such by purchaser till this claim arising out of in the same

contract or any other contract is either mutually settled or determined by the arbitrator, and that the contractor shall have no claim for interest or damages whatsoever on this account or on any other ground in respect of any sum of money withheld or retained under this clause and duly notified as such to the contractor.

SPECIAL CONDITIONS OF CONTRACT GOVERNING SUPPLIES OF PLANT AND MACHINERY

In addition to the General Conditions of Contract hereinbefore set out the following special conditions shall apply to contracts for the supply of Plant and Machinery and manufactured equipment. These Special Conditions where they differ from the General Conditions shall over-ride the later.

27. DEFINITION OF PLANT

27.1 The word "PLANT" wherever, appears in these "Special Conditions of Contract governing supplies of Plants and Machinery" shall mean all machinery, plants, equipment or parts thereof or what the Contractor agrees to supply under contract as specified in the Purchase Order.

28. MISTAKES IN DRAWING

28.1 The Contractor shall be responsible for and shall pay for an alterations of the works due to any discrepancies, errors or omissions in the drawings or other particulars supplied by him whether such drawings or particulars have been approved by the Purchaser or not.

29. RESPONSIBILITY FOR COMPLETENESS

29.1 All fittings or accessories which may not be specifically mentioned in the specification but for which are usual or necessary, are to be provided by the Contractor without extra charge and the plant must be complete in all respects.

30. REJECTION OF DEFECTIVE PLANT

30.1 If the completed plant or any portion thereof before it is finally accepted is found to be defective or fails to fulfill the requirements of the contract, the Purchaser shall give the Contractor notice setting forth with the details of such defects or failure and the contractor shall forthwith rectify the defective plant or alter the same to make comply with the requirement of the contract. Should the contractors fail to do so within a reasonable time the Purchaser may reject and replace at the cost of the Contractor, the whole or any portion of the Plant as the case may be, which is defective or fails to fulfill the requirement of the contract. Such replacement shall be carried out by the Purchaser within a reasonable time and at reasonable price and where reasonably possible to the same specifications and under competitive conditions. The Contractor shall be liable to pay to the Purchaser the extra cost, if any, of such replacement delivered and or erected as provided for in the contract such extra cost being the difference between the price paid by the Purchaser under the provisions above mentioned for such replacement and the contract price for them. Contractor shall refund to Purchaser any sum paid by the Purchaser to the Contractor in respect of such defective plant.

31. INSPECTION AND FINAL TESTS

31.1 All tests necessary to ensure that the plant complies with the particulars and guarantees shall be carried out at such place or places as may be determined by the inspector. Should, however, it be necessary for the final tests as to performance or guarantees to be held over until the Plant is erected at site they shall be carried out within

one month of completion of erection.

32. TRANSPORT AND RESPONSIBILITY FOR BREAKAGES EN-ROUTE

32.1 Unless otherwise specified the Purchaser will take delivery of the plant from the place named in the purchase order but the contractor will be responsible for any damage which may be caused to the Plant during transit to the site of erection thereof.

33. ERECTION AND COMMISSIONING

33.1 In all cases where contracts provide for supervision of erection and commissioning or for test at the Purchaser's premises the Purchaser except where otherwise specified, shall provide free of charge, such labour, materials, fuels, stores, apparatus and instruments as may be required from time to time and as may reasonably be demanded by the contractor to carryout efficiently such supervision of erection and commissioning and for the requisite test. In case of contracts requiring electricity for the completion of erection, commissioning and testing at site, such electricity shall be supplied free to the contractor.

33.2 Action by the Purchaser under the clause shall not relieve the contractor of his warranty obligations under the contract.

34. WARRANTY

34.1 The contractor warrants that stores to be supplied under the contract shall be free from all defects and faults in materials, workmanship and manufacture and shall be of the highest grade and consistent with the established and generally accepted standards for stores of the types under the contract in full conformity with the specifications, drawings or samples, if any and shall if operable, operate properly. This warranty shall expire (except in respect of complaints notified to the contractor prior to such date) twelve months after the date of receipt of the last lot of stores under the contract at the ultimate destination stipulated in the contract.

34.2 For a period of twelve calendar months after the plant/machinery/equipment/instruments has been put into operation (or a suitable mutually agreed longer period to be reckoned from the date of last major shipment depending upon the nature of the plant/machinery/equipment/instrument) the Contractor shall be responsible for any defects that may develop under conditions provided for the contract and under proper use, arising from the faulty materials, design or workmanship in the plant or from faulty erection of the plant by the Contractor, but otherwise and shall rectify such defects at his own cost when called upon to do so by the Purchaser who shall state in writing such defects.

34.3 If it becomes necessary for the Contractor to replace or renew any defective portions of the plant for purpose of rectification under this clause, the provisions of this clause shall apply to the portions of the plant so replaced or renewed under the expiration of six months from the date of such replacement or renewal or until the end of the above mentioned period of twelve months whichever may be the later. If any defects not rectified within reasonable time, the purchaser may proceed to get the work done at contractor's risk and expenses but without prejudice to any other rights which the Purchaser may have against the Contractor in respect of such defects as provided in clause 9.2.4 or 9.2.5.

- 34.4 All inspections adjustments, replacements or renewals carried out Contractor during the warranty period shall be subject to the same conditions as in the contract.
- 34.5 Contractor shall, spare parts of equipment before going out of production, give adequate advance notice to the purchaser so that the latter may order requirement of spares in one lot if so desires.
- 34.6 The contractor shall further guarantee that if spare parts go out of production, will make available blue prints, drawings of spare parts and specifications of material at no cost to the Purchaser, if and when required in connection with the equipment to enable Purchaser to fabricate or procure spare parts from other sources.
- 34.7 The provision of this clause shall remain effective and binding upon the Contractor even after the completion or expiration of the contract and till the plant/machinery/equipment supplied under the contract is in use by the Purchaser.

35. MODE OF PAYMENT

- 35.1 Unless otherwise agreed to in writing between the Purchaser and the Contractor, payment for the delivery of the material will be made as follows.
- Within 30 days from the date of final acceptance and on receipt of Performance Bank guarantee for 10% of the contract value amount from SBI/nationalized banks or any one of the scheduled banks mentioned in the bracket (Axis Bank, HDFC Bank, ICICI Bank and IDBI Bank) valid through out the guarantee period mentioned in the contract/purchase order.**
- 35.1.1 In case any of the vendors seek advance or progressive payment prior to delivery of the material, such requests can be considered only in exceptional cases of large value items, in which case the vendor will be required to furnish a bank guarantee for an equivalent amount of the advance/progressive payment sought for, valid till the execution of the contract. The bank guarantee shall be got executed as per the Purchaser's format from the State Bank of India (SBI)/nationalized banks or any one of the scheduled banks mentioned in the bracket (Axis Bank, HDFC Bank, ICICI Bank and IDBI Bank).
- 35.1.2 Besides, the offers of the vendors seeking advance/progressive payment will be evaluated by loading 12% interest charges per annum on the amount of advance desired up to the delivery period quoted.
- 35.1.3 In case any of the vendors seek pro-rata payment for the stores to be supplied they should clearly mention in their offer the maximum number of installments of supply. However, such installment delivery and pro-rata payment will be considered only in respect of contract involving large value and sizeable quantity of the item and the maximum number of installments shall be normally restricted to four. Acceptance or otherwise of this condition is reserved by the purchaser.
- 35.1.4 **Bank Charges:** All bank charges to be borne by the Contractor/Supplier.
- 35.1.5 No correspondence will be entertained within 30 days from the date of receipt of material and bills, whichever is later.
- 35.1.6 **Interest for delay in supply beyond the contractual delivery date:** Wherever advance payments are sought for by the contractor and

admitted in the contract, against Bank Guarantee for equivalent amount, in the event of any delay in supply beyond the contractual delivery date for reasons attributable to the contractor, interest charges @ 12% shall be levied for the period beyond the contractual delivery date, on the amount of balance advance payment to be adjusted.

36. DELAY IN ERECTION

36.1 Wherever erection of a plant or machinery is the responsibility of the Contractor as a term of the contract and in case the Contractor fails to carry out the erection as and when called upon as to do within the period specified by the Purchaser, the Purchaser shall have right to get the erection done through any source of his choice. In such an event, the contractor shall be liable to bear any additional expenditure that the Purchaser may incur towards erection. The Contractor shall, however, not be entitled to any gain due to such an action by the Purchaser.

SECTION 'C'

**TECHNICAL SPECIFICATIONS
OF
STORES AND DRAWINGS**

Please refer tender document

SECTION 'D'

FORMAT FOR SUBMISSION OF PART-II (PRICE)

Please refer tender document

TENDER FORM

प्लाज्मा अनुसंधान संस्थान

(भारत सरकार के परमाणु ऊर्जा विभाग का सहायता प्राप्त संस्थान)

इंदीरा ब्रिज के पास, भाट, गांधीनगर - 382428, भारत

दूरभाष: 079-23962020/23962021, फैक्स: 079-23962277

Following terms are replaced in our Form for Tender No.IPR/TN/PUR/TPT/ET/20-21/1 dated 1-6-2020.

- 1) Sr.No.3.1 (Section-A) under heading "Earnest Money Deposit (EMD)" of Form No.IPR-LP-ET-02.V5 (Terms and Conditions) is replaced with the following: The Tenderer shall submit, as part of its bid, interest free Earnest Money Deposit (EMD) for an amount as specified in the Tender Notice. EMD shall be submitted by way of Demand Draft from **SBI/nationalized banks or any one of the scheduled banks mentioned in the bracket (Axis Bank, HDFC Bank, ICICI Bank and IDBI Bank)** issued in favour of "*Institute for Plasma Research*" and payable at **Ahmedabad**. **Tender received without EMD will be rejected at the discretion of IPR.**
(Copy of Demand Draft to be uploaded with the quotation, Original DD should be sent to IPR on or before the specified closing date and time)
- 2) Sr.No.3.4 (Section-A) under heading "Earnest Money Deposit (EMD)" of Form No.IPR-LP-ET-02.V5 (Terms and Conditions) is replaced with the following: **Exemption from payment of EMD:** The firms registered with DGS&D, NSIC, DPS or Micro & Small Enterprises (MSEs) which are actual producers/manufacturers of tendered items are exempted from payment of EMD provided valid registration certificate is uploaded along with the offer.
- 3) Sr.No.18 (Section-A) under heading "Statutory Levies such as Customs Duty, Goods and Service Tax" of Form No.IPR-LP-ET-02.V5 (Terms and Conditions) is replaced with the following:
Clause Nos.18.1, 18.2, 18.3, 18.5.2 and its sub-clauses deleted from Form No: IPR-LP-ET-02.V5.
- 4) Sr.No.31 (Section-A) under heading "Delivery" of Form No.IPR-LP-ET-02.V5 (Terms and Conditions) is replaced with the following:
Delivery: All equipments/machinery/plant/component covered by this tender document should be supplied, installed, tested in all respect and commissioned at IPR within 20 months from the date of approval of drawings. The prices quoted by the tenderer should include all charges involved for direct and safe delivery of the items by Road to the project site of the Purchaser. Purchaser will neither undertake responsibility for transit insurance nor pay for it separately. No other, delivery term will be accepted by the Purchaser

- 5) Sr. No. 35 (Section-B) under heading Mode of Payment of “General Conditions of Contract” of Form No.IPR-LP-ET-02.V5 (Terms and Conditions) is replaced with the following:

Payment: Unless otherwise agreed to in writing between the Purchaser and the Contractor, payment for the delivery of the tendered items, will be made as follows.

- a) 10% of supply portion of SOQ (i.e. basic price of Item Sr.No.1 to 14 & 16 to 33 of Part-II - Price Bid) will be paid after approval of final design and related engineering designs, submission of Bank Guarantee for an equivalent amount from SBI/nationalized banks or any one of the scheduled banks mentioned in the bracket (Axis Bank, HDFC Bank, ICICI Bank and IDBI Bank) as per IPR format, valid till delivery of the entire material and on receipt of proforma invoice triplicate.
- b) 50% of supply portion of SOQ (i.e. basic price of Item Sr.No.1 to 14 & 16 to 33 of Part-II - Price Bid) + 100% of all other charges will be paid on pro- rata basis (Maximum 3 {three} bills) after receipt of material at IPR site and its verification by IPR representative and on receipt of invoice intriplicate.
- c) 20% of supply portion of SOQ (i.e. basic price of Item Sr.No.1 to 14 & 16 to 33 of Part-II - Price Bid) will be paid after completion of installation and on receipt of proforma invoice in triplicate.
- d) Balance 20% of Item Sr.No.1 to 14 & 16 to 33 of Part-II - Price Bid (Part- II - supply portion) along with 100% of remaining items (i.e. Sr.No.15, 34 & 35 and installation, testing and commissioning charges mentioned under Part-II - Price Bid) will be paid within 30 days from the date of final acceptance and on receipt of Performance Bank Guarantee for 10% of the contract value from SBI/nationalized banks or any one of the scheduled banks mentioned in the bracket (Axis Bank, HDFC Bank, ICICI Bank and IDBI Bank) valid throughout the warranty period (**Plus additional 2 months grace period**) and on receipt of final invoice.

Following terms is **added to** our Form No. IPR-LP-ET-02.V5 for Tender No.IPR/TN/PUR/TPT/ET/20-21/1 dated 1-6-2020.

- a) **TDS as per CGST Act:** As per the provisions mentioned under Section No. 51 of the CGST Act 2017, TDS @ 2% (IGST 2% or CGST 1% and SGST 1%) will be deducted while making payment to the suppliers where total value of the purchase order/contracts/work orders exceeds Rs.2.5 Lakhs. Necessary TDS Certificate will be issued to the supplier after TDS deduction.

IMPORTANT NOTE:

- [1] QUOTATIONS ARE INVITED IN INDIAN CURRENCY ONLY**
- [2] QUOTATIONS RECEIVED OTHER THAN “INR” QUOTE SHALL SUMMARILY BE REJECTED.**

INSTITUTE FOR PLASMA RESEARCH

BHAT, GANDHINAGAR-382 428, INDIA

TENDER DOCUMENT

FOR

“Design, Supply, Fabrication, Installation, Testing, and Commissioning of Cooling Water System for New Laboratories” at IPR campus, Ahmedabad

(Please note that the bidder should sign on all pages)

SECTION-C

CONTENTS

1	SECTION-I: ELIGIBILITY QUALIFICATION CRITERIA	9
2	SECTION-II: SCOPE OF WORK AND DELIVERABLES	10
2.1	SCOPE OF WORK	11
2.1.1	DOCUMENTS PROVIDED BY IPR.....	14
2.2	DOCUMENTS (DELIVERABLES) BY CONTRACTOR.....	14
2.3	EXCLUSIONS	15
2.4	FREE ISSUE MATERIALS	15
3	SECTION III: TECHNICAL SPECIFICATIONS.....	16
3.1	INTRODUCTION.....	17
3.1.1	BASIS OF DESIGN	18
3.1.2	SITE CONDITION.....	18
3.1.3	DESIGN PARAMETERS	19
3.2	MECHANICAL EQUIPMENTS.....	21
3.2.1	COOLING TOWER (INDUCED DRAFT).....	22
3.2.2	SCREW CHILLERS (WATER COOLED).....	37
3.2.3	PUMPS FOR WATER CIRCULATION (CENTRIFUGAL TYPE).....	52
3.2.4	PLATE TYPE HEAT EXCHANGER (PHE).....	96
3.2.5	PRESSURIZERS AND WATER TANK	118
3.2.6	PIPING AND FITTINGS	127
3.2.7	VALVES AND ACTUATORS	146
3.2.8	BELLOWS AND STRAINERS	157
3.2.9	THERMAL INSULATION.....	164
3.3	ELECTRICAL ITEMS	167
3.3.1	THREE PHASE INDUCTION MOTORS	168
3.3.2	VARIABLE FREQUENCY DRIVES	175
3.3.3	ELECTRICAL PANELS, CABLING AND EARTHING	183
3.4	INSTRUMENTATION AND CONTROL.....	196
3.4.1	SCOPE.....	196
3.4.2	TYPE.....	196
3.4.3	TECHNICAL DATA SHEET FOR INSTRUMENTS.....	197
3.5	DATA ACQUISITION AND CONTROL SYSTEM.....	209
3.5.1	SCOPE:.....	209
4.	SECTION- IV INSPECTION, TESTING AND MEASUREMENT.....	229

4.1	INSPECTION, TESTING & ACCEPTANCE	230
4.2	TEST CERTIFICATES.....	231
4.3	SITE INSPECTION AND TESTING.....	231
4.3.1	EQUIPMENTS/COMPONENTS/ITEMS TESTING	232
4.3.2	ACCEPTANCE	232
4.4	MEASUREMENT OF WORK	233
4.4.1	MEASUREMENT OF PIPING	233
4.4.2	MEASUREMENT OF STRUCTURAL STEEL WORK	233
4.4.3	MEASUREMENT OF INSULATION.....	234
4.4.4	MEASUREMENT OF ELECTRICAL PANEL, WIRING AND CABLING	234
5.	SECTION-V: PAINTING COLOUR CODE.....	235
5.1	PAINTING COLOUR CODE.....	236
6.	SECTION-VI: LIST OF MAKES	237
6.1	MECHANICAL ITEMS	238
6.2	INSTRUMENTS AND CONTROLS	239
6.3	ELECTRICALS	239
7.	SECTION-VII: SCHEDULE OF QUANTITY	241
7.1	NOTES TO BIDDER:.....	242
7.2	SCHEDULE OF QUANTITY	245
7.3	IMPORTANT NOTES:.....	262
8	SECTION-VIII: SITE VISIT	263
9	SECTION-IX: REGISTRATION FORM FOR ATTENDING PRE-BID MEETING	264

LIST OF TABLES

Table 1: DELIVERABLES	14
Table 2: DESIGN PARAMETERS	19
Table 3: DESIGN DATA AND PERFORMANCE.....	23
Table 4: MATERIAL OF CONSTRUCTION	29
Table 5: DESIGN DATA FOR PRIMARY COOLING LOOPS PUMPS	54
Table 6: DESIGN FOR SECONDARY COOLING LOOPS PUMPS.....	54
Table 7: MATERIAL FOR ALL PRIMARY COOLING LOOPS PUMPS.....	63
Table 8: MATERIAL FOR SECONDARY COOLING LOOPS PUMPS.....	64
Table 9: ICECRH LOOP	97
Table 10: DNBHP LOOP	98
Table 11 : DNBLP LOOP.....	98
Table 12 : DNBCH LOOP.....	99
Table 13 : IPRCH LOOP	99
Table 14: PROCESS FLUID DATA	102
Table 15: MATERIALS OF CONSTRUCTION	104
Table 16: PIPE MATERIAL SPECIFICATION (PMS)	128
Table 17: Valve Specification Sheet (VSS)	150
Table 18: Valve Data sheet.....	151
Table 19: Non-Metallic Bellows Data Sheet	159
Table 20: Performance requirement.....	169
Table 21: TESTS ON AC MOTORS FOR VFD APPLICATION.....	173
Table 22: PRESSURE GAUGE.....	197
Table 23: TEMPERATURE GAUGE.....	198
Table 24: PRESSURE TRANSMITTER.....	200
Table 25: TEMPERATURE SENSOR CUM TRANSMITTER.....	201
Table 26: CONDUCTIVITY METER AND TRANSMITTER.....	202
Table 27: PH METER AND ANALYZER	203
Table 28: DO METER AND ANALYZER.....	205
Table 29: LEVEL TRANSMITTER	206
Table 30: FLOW TRANSMITER.....	207
Table 31: SPECIFICATIONS FOR MAIN CONTROLLER	211
Table 32: CONTROL CABLING.....	224
Table 33: INSPECTION, TESTING & ACCEPTANCE.....	230
Table 34: STANDARD COLOUR CODE	236
Table 35: UNITS FOR PRICING THE CHANGE PROPOSAL.....	243

LIST OF ANNEXURES- TECHNICAL DATA SHEET, PFDs, PIDs & SLD

Annexure 1: Induced draft Cooling Tower	34
Annexure 2: Screw Chillers (Water Cooled).....	49
Annexure 3: Centrifugal pumps (ICECRH-Loop).....	70
Annexure 4: Centrifugal pumps (DNBLP-Loop).....	73
Annexure 5: Centrifugal pumps (DNBHP-Loop).....	76
Annexure 6: Centrifugal pumps (DNBCH-Loop).....	79
Annexure 7: Centrifugal pumps (IPRCH-Loop).....	82
Annexure 8: Centrifugal pumps (Chillers Loop).....	85
Annexure 9: Centrifugal pumps (Cooling Tower-Pumps).....	88
Annexure 10: Centrifugal pumps (Condenser-Pumps).....	91
Annexure 11: Centrifugal pumps (Drain Pumps).....	94
Annexure 12: Plate Type Heat Exchangers (ICECRH-Loop).....	108
Annexure 13: Plate Type Heat Exchangers (DNBHP-Loop).....	110
Annexure 14: Plate Type Heat Exchangers (DNBLP-Loop).....	112
Annexure 15: Plate Type Heat Exchangers (DNBCH-Loop).....	114
Annexure 16: Plate Type Heat Exchangers (IPRCH-Loop).....	116
Annexure 17: Pressurizer for Primary Cooling Loops	124
Annexure 18: Pressurizer for Chiller Cooling Secondary Loop	125
Annexure 19: Storage Tank of Chilled Water-Cooling Loop.....	126
Annexure 20: Data Sheet for Electric Actuators	155
Annexure 21: ICECRH PFD.....	265
Annexure 22 : DNBHP PFD.....	266
Annexure 23: DNBLP PFD	267
Annexure 24: DNBCH PFD	268
Annexure 25: IPRCH PFD.....	269
Annexure 26: HRS PFD	270
Annexure 27 : ICECRH PID	271
Annexure 28: DNBHP PID	272
Annexure 29: DNBLP PID	273
Annexure 30: DNBCH PID	274
Annexure 31: IPRCH PID.....	275
Annexure 32: CHILLER PID	276
Annexure 33: HRS PID	277
Annexure 34 : SINGLE LINE DIAGRAM	278

ABBREVAITIONS

AGMA	- American Gear Manufacturer Association
AHRI	- American Heating and Refrigeration Institute
ANSI	- American National Standards Institute
API	- American Petroleum Institute
ARI	- Air conditioning and Refrigeration Institute
ASHRAE	- American Society of Heating, Refrigeration and Air conditioning Engineers
ASME	- American Society of Mechanical Engineers
ASTM	- American Society for Testing and Materials
AWS	- American Welding Society
AWWA	- American Water Works Association
BE	- Beveled Ends
BEP	- Best Efficiency Point
BPO	- Back Pull Out type pump
CAD	- Computer Aided Design
CI	- Cast Iron
COP	- Coefficient of Performance
CS	- Carbon Steel
CT	- Cooling Tower
CTI	- Cooling Technology Institute
CWS	- Cooling Water System
DAC	- Data Acquisition and Control
DM	- Demineralized
DNBCH	- Diagnostic Neutral Beam Chilled water
DNBHP	- Diagnostic Neutral Beam High Pressure
DNBLP	- Diagnostic Neutral Beam Low Pressure
DO	- Dissolved Oxygen
DP	- Dye Penetrant
EJMA	- Expansion Joint Manufacturer's Association
EMC	- Electro-Magnetic Compatibility
EPDM	- Ethylene Propylene Diene Monomer
EQC	- Eligibility Qualification Criteria
FAT	- Factory Acceptance Test
FPS	- Foot Pound Second
FRP	- Fiber Reinforced Plastic
GAD	- General Arrangement Drawing
GI	- Galvanized Iron
GUI	- Graphical Users Interface
GTAW	- Gas Tungsten Arc Welding
HDG	- Hot Dipped Galvanized
HMI	- Human Machine Interface
HRS	- Heat Rejection System
HSC	- Horizontal Split Casing type pump
HTRI	- Heating Transfer Research Institute
ICECRH	- Ion Cyclotron and Electron Cyclotron Resonance Heating
IDCT	- Induced Draft Cooling Tower
IEC	- International Electro-technical Commission

IEEE	- Institute of Electrical and Electronics Engineers
IPLV	- Integrated Part Load Value
IPR	- Institute for Plasma Research
ISA	- International Society of Automation
ISO	- International Organization for Standardization
ITER	- International Thermonuclear Experimental Reactor
KW	- Kilowatt, electrical power measurement unit
LCD	- Liquid Crystal Display
LED	- Light Emitting Diode
LMTD	- Logarithmic Mean Temperature Difference
MIP	- Manufacturing and Inspection Plan
MOC	- Material of Construction
MPR	- Motor Protection Relay
MS	- Mild Steel
MW	- Mega Watt (Heat Load unit)
MWC	- Meter Water Column
NBR	- Nitrile Butyl Rubber
NPSHR	- Net Positive Suction Head Required
OEM	- Original Equipment Manufacturer
OLR	- Over Load Relay
PCB	- Printed Circuit Boards
PE	- Plain Ends
PEEK	- Polyether Ether Ketone
PFD	- Process Flow Diagram
PHE	- Plate type Heat Exchanger
PHTS	- Primary Heat Transfer System
PID	- Process and Instrumentation Diagram
PLC	- Programmable Logic Controller
PMS	- Pipe Material Specification
PRV	- Pressure Reducing Valve
PTFE	- Poly Tetra Fluoro Ethylene
PVC	- Poly Vinyl Chloride
QA	- Quality Assurance
RCC	- Reinforcement Cement Concrete
RMS	- Root Mean Square
RPM	- Revolution Per Minute
RPP	- Reverse Phase Preventer
RTD	- Resistance Temperature Detector
SAT	- Site Acceptance Test
SCADA	- Supervisory Control And Data Acquisition
SHTS	- Secondary Heat Transfer System
SLD	- Single Line Diagram
SMAW	- Shielded Metal Arc Welding
SOQ	- Schedule of Quantities
SPP	- Single Phase Preventer
SS	- Stainless Steel
TEFC	- Totally Enclosed Fan Cooled
TR	- Tonnage of Refrigeration
UPS	- Uninterrupted Power Supply

VFD	- Variable Frequency Drive
VSS	- Valve Specification Sheet
WPQR	- Welding Procedure Qualification Record
WPS	- Welding Procedure Specification
WPU	- Water Polishing Unit
XLPE	- Cross Linked Polyethylene

1 SECTION-I: ELIGIBILITY QUALIFICATION CRITERIA

**REFER ANNEXURE-A (ELIGIBILITY CRITERIA) OF BID
FORMAT/COMMERCIAL TERMS**

2 SECTION-II: SCOPE OF WORK AND DELIVERABLES

2.1 SCOPE OF WORK

The scope of work covered under this tender includes design, supply, installation, testing & commissioning of the Cooling Water System (CWS) for the application mentioned, and shall be in general, as per the schedule of quantities and scope/tender drawings.

The scope of work to be carried out under this contract is illustrated in Drawings, Specifications and Schedule of Quantities (SOQ). The contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the directions of and to the satisfaction of IPR/IPR Engineer In-charge. The contractor shall furnish all labor, materials and equipment as listed under SOQ and specified otherwise, transportation and incidentals necessary for supply, installation, testing and commissioning of a complete system as described in the specifications and as shown in the Drawings. This also includes any materials equipment, appliances and incidental work not specifically mentioned herein or not on the Drawings / Documents as being furnished or installed, but which are necessary and customary to make a complete installation. The bidder must cover all the items/works covered under the scope of work.

The main scope of work of the contractor includes, but not limited to, the following tasks:

- a. Design, preparation of the drawings and documents for all the systems, structures and equipment/ components engineered by the contractor such as system design description, control philosophy, optimization studies, calculations and analysis as required , technical specifications, datasheets etc. and also preparation of equipment manufacturing drawings, manufacturing inspection plan, detailed procedure for erection , installation, commissioning and testing, operating procedure for each of the equipment and integrated system, operation and maintenance manuals for all the systems, structures and equipment is in the scope of the contractor. The covered scope under this contract is detailed in Section III and bill of quantity.
- b. All the systems, structures and components required for proper functioning and safety of the systems are included in the scope of Design, procurement and works, unless specifically excluded in scope of supply and works.
- c. Supply, installation, testing and commissioning of the equipment, components, and other items of CWS as indicated in the SOQ is based on preliminary design and is indicative and may undergo change based on the final design to be carried out by the contractor.
- d. The contractor has to study the PFDs, P&IDs and drawings of proposed system thoroughly and develop detailed design with optimization without affecting the system's performance. The contractor shall also study the space available inside plant room for all equipment installation as well as outside plantroom for CT installation. Accordingly, he may propose/refine the equipment, piping and instrumentation layout wherever required without affecting the required flow and pressure requirements in each water supply line of users.
- e. Contractor shall perform piping stress analysis of portion of piping which is passing through pipe racks (crossing the road in between Plant room and ITER-India Lab building) using any piping analysis software (normally used in industries practice) and validate the structural integrity as per ASME B31.3. If required contractor shall propose/refine/reroute

- piping layout and location of instrumentation and valves/supports for safe operation and design.
- f. Contractor shall perform design and analysis of piping supports for complete piping of cooling water system for new laboratories using any piping supports analysis software (normally used in industries practice) and validate the structural integrity as per ASME B31.3. If required contractor shall propose/refine in piping support design, their selection and location for the safe operation and design.
 - g. All the changes/modifications on the design and layout carried out by contractor are subjected to approval by IPR. However, the contractor may note that achieving the desired technical specification is sole responsibility of contractor.
 - h. Contractor shall generate PFDs, P&IDs, Isometric drawings for piping, detailed engineering drawings, Electrical load list, instrumentation list, control logic notes for PLCs, SLDs, cable schedule, equipment General Arrangement Drawing (GAD) for all required items and submit to IPR for approval before the procurement of items under this package.
 - i. Preparation of final technical specification and technical data sheets of all equipment like Chillers, Heat exchangers, cooling towers, pumps with motors, piping, valves, motors, VFD, instrumentations, etc. based on your final design.
 - j. Preparation of electrical load list with the total power requirement in all the systems, earthing scheme, motor control philosophy, cabling/wiring and routing drawing
 - k. Finalizing the Bill of Quantities based on the final design.
 - l. Design of RCC support structure for Cooling tower basin and other equipment/ storage tank foundations etc., as required.
 - m. Optimization of overall project schedule of the contract and provide the summarized schedule in excel or in any recommended software like primavera.
 - n. Procurement of pipes and pipe fittings such as elbows, tees, reducers, purge tapings, drain points, wooden haunches, flanges, valves, actuators, strainers, gaskets, studs, nuts & bolts, washers, insulations, instrumentation, non-conducting flexible hose with fittings, flexible bellows etc. for cooling water distribution, interconnecting piping between equipment, drain piping, make up and overflow piping up to the nearest point. The fittings to be used in the piping network shall be as per Pipe Material Specifications (PMS).GI piping and its fittings for drain/overflow of equipment and CWS piping network shall be as per relevant standards. The contractor is responsible for procurement of portion of piping with isolation valves interconnecting the Water polishing units. Please note that Water polishing unit shall be installed inside the CWS plant room within the space allocated. Necessary interfaces shall be addressed and resolved under this scope of contract by the contractor. Accordingly, contractor is responsible to carryout interconnected piping and cabling, instrumentation as well as DACs to accommodate WPU operation requirement.
 - o. Procurement of nitrogen tubing with ancillaries as required with the N2 cylinders mounting arrangement is under the scope of this contract.
 - p. Procurement of equipment/ items required to complete CWS project comprising of Water-cooled screw chillers, Cooling towers, centrifugal pumps with motors, plate type heat exchangers, pressurizers, storage tanks, VFDs, Electrical and instrumentation panels, Data acquisition and control systems, power and control cabling, instruments and controls etc.
 - q. On-site/off-site fabrication and erection of piping and fittings, instrumentation and other enumerated materials given under the scope of supply shall be as per approved manufacturing drawings.

- r. On-site/off-site fabrication and erection of SS and CS piping supports like shoe, saddles, guide, limits, supporting fixtures, bracket cantilever. Anchors, etc. as per approved drawings.
- s. Providing Civil works such as RCC support structure for Cooling Tower Basin, foundation/ pedestals for equipment, RCC blocks/footings wherever required for the erection of support structures for entire piping layout as per the approved drawings is under the scope of contractor. Excavation and filling and making the ground to the normal for foundation/pedestal/civil work and laying buried portion of piping/cables (if required) shall be under the scope of contractor. Prior intimation and approval are required for any such work in IPR's premises.
- t. Contractor shall submit all quality documents, material certificates, test certificates and calibration certificates for all the components, raw material and instrumentations respectively.
- u. Contractor shall perform inspection and testing for the acceptance of all fabricated pipelines and joints as per relevant section of the tender documents
- v. Contractor has to design and provide power cabling to the signal conditioning setup from nearest power point available in the lab.
- w. Contractor needs to carry out hydrotest of integrated piping system as per specifications with pressurized water at Site.
- x. The contractor shall provide all the necessary arrangements like temporary pipe connections, supports, other materials, tools, equipment, instruments, scaffoldings, other services and labor required to perform the acceptance test of the CWS at site.
- y. Contractor is responsible for safe delivery, loading and unloading, transportation storage and shifting on site for all the components, equipment, materials, systems required during execution of this contract. The safety and security of all components, equipment, materials, systems delivered at IPR site shall be the sole responsibility of the contractor
- z. The contractor/vendor shall supply the equipment in accordance with this specification. Any accessories that are necessary to make cooling water system complete and safely operable not specifically identified herein shall be in the contractor/vendor's scope of supply.

Notes:

- i. The entire work shall be carried out in accordance with these terms and conditions and generally as per the scope, technical specifications, data sheets, drawings set forth in the documents. The liability of the contractor shall not be limited to the scope of work mentioned, but shall also extend to achievement of the inside conditions as per the design, as well as complete, safe and satisfactory operation of the system as approved by the Engineer In-Charge. Any equipment/component/instruments, material and labor required in order to achieve the completeness of the CWS system as above shall be deemed to be included in the scope of the contractor without any extra cost to the client.
- ii. If any kind of major or minor fault will arise during warranty period, then original parts/spares/components (including all kind of consumables, gas, oil etc.) from the OEM (Original equipment manufacturer) shall be used to set right the fault and bring back the system in the operation condition.

- iii. For defects noticed during the warranty period, replacement/ rectification should be arranged free of cost (including supply and procurement of spares, taxes, labor charges, maintenance (preventive and breakdown) and transport charges from site to the manufacturer's works and back and free repair/adjustment etc.) within a reasonable period of such notification from the purchaser.

2.1.1 DOCUMENTS PROVIDED BY IPR

- a. Preliminary PFDs
- b. Preliminary P&IDs
- c. CAD Model of cooling water system for new laboratories (shall be provided after award of contract)
- d. SLD

2.2 DOCUMENTS (DELIVERABLES) BY CONTRACTOR

Table below shows the documents that are minimum to be delivered during the execution of the contract phase by the contractor which need to be approved by IPR. There shall be other documents/reports/drawing/diagrams/manual required to be provided during the execution, testing and final acceptance by the contractor (apart from the listed in Table-2), which shall be finalized during detailed engineering/design phase.

Table 1: DELIVERABLES

1	Quality Plan
2	Detail schedule of project execution.
3	Revised PFDs, P&IDs, Design reports of process flow calculations and integrated stress analysis
4	2D CAD isometric/GA drawings of cooling water distribution network
5	SLD of electrical line distribution for all instrumentations.
6	Bill of materials, tools and Equipment required for fabrication of entire CWS work.
7	Technical Compliance report along with makes for the items under scope of supply as per relevant annexure
8	Manufacturing and Inspection Plan (MIP)
9	Test Certificates/ Calibration Certificates/ Manufacturer's Warranty of all supplied equipment/components/instruments and controls/materials etc.)
10	Weld plan, WPS, WPQR, and Welder Qualification Record.
11	As built isometric & GA Drawings along with Schedule of Quantity (SOQ) after commissioning. All drawings should be submitted in native editable file format such ".dwg" etc. as well as in pdf format

12	Factory & Site Acceptance Test (FAT& SAT) Report
13	Operation and maintenance Manual

2.3 EXCLUSIONS

- a. Major civil works such as construction of plant building, construction of RCC slab/floors etc. are excluded from the scope of the contractor
- b. Nitrogen cylinders for the operation of Pressurizers are excluded from the scope of the contractor. (However, necessary arrangement for mounting the Nitrogen cylinders and its interconnected manifold/tubing and other relevant accessories required to make the nitrogen supply functional shall be in the scope of this contract)

2.4 FREE ISSUE MATERIALS

- a. IPR shall provide free power and water for the commissioning and testing of CWS. Power and water required during construction/ erection/ installation and civil work at site, will be charged and recovered (at the prevailing market rates) for this project.

Note:

IPR shall provide main incoming power to main Electrical panel within the plant room. Necessary power to carry out the work under the contract should be tapped from the main SFU (through the certified energy meter in case of chargeable work). Approximate requirements for the same shall be indicated in the offer / Bid.

3 SECTION III: TECHNICAL SPECIFICATIONS

3.1 INTRODUCTION

Institute for Plasma Research (IPR) located at Bhat, Gandhinagar (Gujarat) is an internationally renowned research institute under the Department of Atomic Energy, Government of India.

IPR intends to install Cooling Water System (CWS) for various experimental components set up in ITER India Lab building such as ICRH, ECRH, DNB and other systems of IPR for testing of various components. Some of the testing components are critical components on the basis of very stringent water quality i.e. low dissolved oxygen and very low ionic conductivity for which Water Polishing Unit (WPU) shall be installed. Please note that WPU is not in the scope of this contract.

On this basis of requirement received from various users, Overall cooling water system is composed of seven loops as under:

1. ICECRH Loop
2. DNBHP Loop
3. DNBLP Loop
4. DNBCH Loop
5. IPRCH Loop
6. CHILLER Loop
7. HRS Loop

Loop No. 1 to 5 shall be considered as Primary Heat Transfer System (PHTS) which are dedicated closed loop cooling water circulating system for absorbing heat from the ITER Test facility components. The makeup and initial filling water shall be generated through water polishing unit system. Nitrogen blanketing shall be provided to avoid atmospheric oxygen ingress back into circulating water.

The main components of the cooling loops are Centrifugal pumps (with motor and VFD), Plate type heat exchanger, interconnected piping, fittings, valves and actuators, pressurizer etc. forming closed water circulating cooling loops.

Loop No. 6 shall be considered as Secondary Heat Transfer System (SHTS) shall absorb all the heat from PHTS and composed of chilled water system operating on refrigerant vapor compression Chiller with pump sets, valves and actuators, interconnected piping. This cooling loop shall have soft water. The soft water shall be made available by a separate standalone centralized Water treatment facility/existing water treatment plant.

Loop No. 7 shall be Heat Rejection System (HRS) i.e. Tertiary heat transfer loop, which shall absorb total heat from SHTS and PHTS and reject to atmosphere. HRS shall be equipped with Induced Draught Cooling Tower (IDCT) made of FRP and pumping system, wherein the soft water shall be used as make up water. The soft water shall be made available by a separate standalone centralized Water treatment facility/existing water treatment plant

3.1.1 BASIS OF DESIGN

Proposed system design / engineering may be treated as indicative and preliminary design. The contractor shall validate, redesign / modify / optimize the system or part of the system design if required. All such changes / modifications are subject to approval by IPR.

3.1.2 SITE CONDITION**1. Site:**

Institute for Plasma Research
Opp. Bhat village, Near Indira Bridge, Gandhinagar, Gujarat. -382 428.

2. Site Location:

4 km away from Ahmedabad Airport.
Nearest port: Mumbai / Kandla/Mundra
Nearest Railway station: Ahmedabad.

3.1.2.1 OUTDOOR DESIGN CONDITIONS

Weather	Dry bulb temp.	Wet bulb temp.	Relative humidity %
Summer, °C	42.5	28	60
Monsoon, °C	33.9	28.7	90
Winter, °C	15.5	10.5	88

3.1.2.2 INDOOR DESIGN CONDITIONS

For all laboratories: Temperature: $24 \pm 1^{\circ}\text{C}$,
RH : $\leq 60\%$.

3.1.2.3 EXTREME AMBIENT CONDITIONS

Temperature : Max. 47°C . Min. 4.5°C .
RH : Max. 86% . Min. 17%

3.1.2.4 RAIN FALL

Average 823 mm.

3.1.2.5 WIND DATA

Max. Wind speed : 130 Kmph.
Wind direction : SW to W.
Design wind pr. : 100 kg / m^2

3.1.2.6 SITE ELEVATION

55 m above MSL.

3.1.2.7 WATER PIPING

Design Flow velocity: 2.5 m/s

Max. Pressure drop: 0.1 MWC per Meter of pipe.

3.1.3 DESIGN PARAMETERS

A basic design of water-cooling distribution is developed for cooling water system to provide and maintain necessary flow rates, temperature, pressure and quality of water as per the input requirements shown in below table.

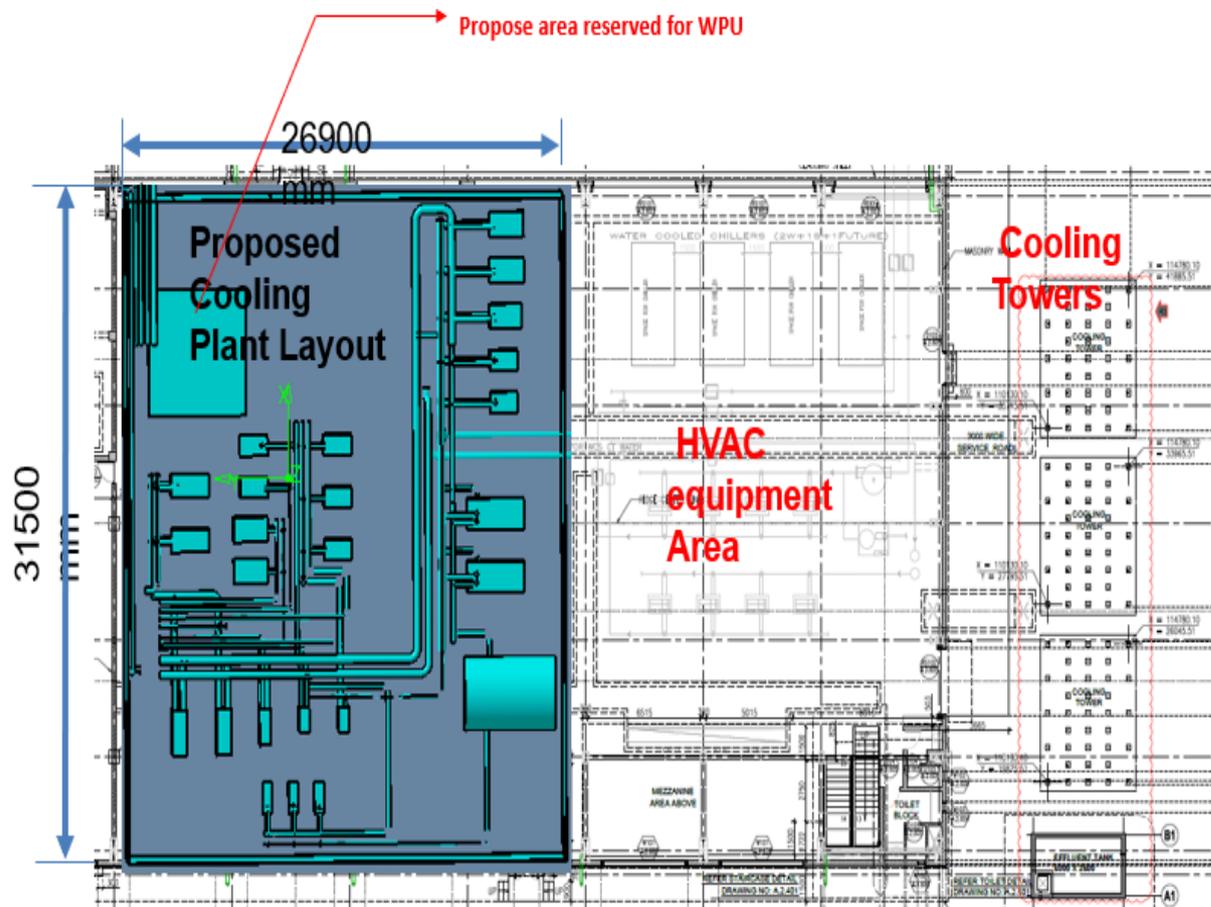
Table 2: DESIGN PARAMETERS

Sr. No	System Description	Heat Load, (MW)	Flow rate, M		Typical Inlet Temp. T_i (°C)	Max. Inlet Temp., $T_{i\max}$ (°C)	Inlet Press. (Kg/cm ²)	Pressure Drop, ΔP (Kg/cm ²)	water quality		
			(kg/s)	m ³ /hr					Cond. (μ S/cm)	DO level, ppm	pH
1	ICECRH LOOP	8.94	117	421	35	35	7	6	≤ 1	≤ 0.1	6.5-7.5
2	DNBHP LOOP	1.68	31	112	38	40	22	20	≤ 0.1	≤ 0.01	7.0-9.0
3	DNBLP LOOP	2.62	66	237	38	40	15	12	≤ 0.1	≤ 0.1	7.0-9.0
4	DNBCH LOOP	0.55	10	36	20	22	5	1	≤ 0.1	≤ 0.1	7.0-9.0
5	IPRCH LOOP	0.6	20	72	20	22	5	4	DM WATER		
6	CHILLER LOOP	1	51	184	14	14	4	2	SOFT WATER		
7	HRS LOOP	15	305	1098	32	32	4	2	SOFT WATER		

Contractor is required to take these as inputs for designing the process piping and performs network flow distribution analysis and may propose/refine the design wherever needed so that final flow distribution design meets the flow, pressure and temperature requirements in each water channel. After validating the flow distribution and getting approval from IPR, contractor shall generate detailed P&ID diagram with all pipe sizing, instrumentation, and fabrication and installation details.

Contractor shall perform stress analysis for the portion of piping passing on pipe racks (crossing road in between plant room and ITER-India Lab building) including support qualification and check for the structural integrity according to ASME B31.3 and improvise the design if required to make the design safe. After getting approval of the layout design from IPR, the contractor shall generate and submit detailed engineering and manufacturing 2D CAD isometric & GA drawings of complete water distribution system. The contractor is required to provide detailed design of the CWS process and its equipment/components/items according to the latest applicable codes and standards available at the time of award of the contract.

The plant room which shall accommodate all equipment is already constructed and having area earmarked for the installation of all equipment. The Cooling tower shall be installed in the open area adjoining to the propose Cooling plant room space shown in the below picture.



(Picture showing the space for CWS equipment- shaded area (31.5 m x 26.9m) appx. with clear height appx 20 ft. This plant room area also includes the space for Water Polishing units to be procured separately by IPR)

All users of CWS are located mainly in two buildings (ITER-India Lab and New Laboratory building) which are nearby the CWS plantroom. A road is separating plant room with above two buildings.

Overall Cooling system equipment/main components' technical specification is covered in section-3. The section-3 is divided mainly in 4 part as mechanical equipment, electrical items, instrumentation & controls and Data acquisition and controls.

3.2 MECHANICAL EQUIPMENTS

3.2.1 COOLING TOWER (INDUCED DRAFT)

3.2.1.1 SCOPE

This specification establishes technical requirements covering, design, engineering, preparation of detailed drawings, procurement of materials, manufacture, assembly, inspection, shop testing, painting, packaging, safe delivery at site, unloading, installation, commissioning, testing and performance guarantee of Mechanical induced draft counter flow type cooling tower consisting of multiple Cells of heat rejection capacity of 15 MW. The Cooling tower shall be complete with all accessories, controls, electric motors, piping, valves, etc. as per the tender specifications.

Design, engineering, procurement of all materials, Complete manufacture, assembly, shop testing, supply, delivery at site, unloading, installation, commissioning and acceptance test of mechanical induced draft counter flow cooling tower as per specification along with the accessories as listed below:

- a. Hot water piping including distribution valves for each cell shall be terminated at one point outside the tower with flange and counter-flange and with necessary gasket and hardware.
- b. Provision for adequate size drain for each sump with suitable piping up to nearest drain point
- c. Provision for adequate size overflow for each sump connection
- d. Anchor bolts for fixing the cooling towers.
- e. The suction embedment pipe of adequate size to each sump ending with flange and counter flange and nut, bolts shall be included in the supply.
- f. 2 nos. SS 304-wire screen of 10 meshes complete in SS construction with guide channels for each cell.
- g. 2 nos. ladder from Floor level to Hot water deck.
- h. Inside walkways, fan deck handrails, special tools required for maintenance of the cooling tower unit.
- i. Safety rail around the cooling tower with suitable anchoring
- j. The suitable Electric Motors for fans
- k. First fill of lubricants
- l. The vibration cut out switch with provision for alarm for each fan.
- m. Low lubricating Oil Level Switch for each gear reducer.
- n. Civil design & detailed engineering of cooling tower basin and cooling tower structure,
- o. Preparation of Civil Design Basis Report, Design Calculations, Concrete forming drawings including embedded plates for piping / equipment support. Preparation of detailed engineering drawings; approval of all drawings, QA plans; manufacturing schedules purchaser's approval and records thereafter.

- p. Construction of Civil foundations, beams and columns etc to support the FRP basin at site including providing finish floor below basin with suitable slops and drain paths to be able to connect nearest storm water main line.
- q. Erection, testing/ commissioning of cooling tower at site.
- r. Performance Guarantee of cooling tower.
- s. Set of startup and commissioning spares.
- t. Set of standard special tools
- u. Painting: All exposed iron and steel components shall be thoroughly painted as per specifications.

3.2.1.2 APPLICABLE SPECIFICATION, STANDARDS AND CODES

The design, materials, construction, manufacture, inspection, testing and performance of the cooling tower shall comply with all currently applicable statutes, regulations and safety codes in the locality where it is to be installed. The cooling tower shall also conform to the latest applicable Indian or British standards and publications of the Cooling Technology Institute (CTI). All documents listed below of the issue in effect on the date of the pertinent Tendering Documents constitute a part of this specification to the extent defined in the subsequent sections of this specification. In the event the certain requirements of the specification, the governing requirements shall at the criteria of the purchaser.

- a. CTI Test Code ATC-105 : Code for testing cooling towers.
- b. BS 4485 part-2 : Method of test and acceptance of cooling tower
- c. BS 4485 Part-3 : Thermal and functional design of cooling tower
- d. IS-1363 & IS-1367 : For all threaded fasteners
- e. IS-823 : Welding requirements
- f. AMCA Codes Section : Testing of Axial fans
- g. ASME Section IX : Procedure for welding and welders Qualification
- h. IS-1239 & 3589 : For piping
- i. AGMA : American Gear manufacturing Association.
- j. IS 2629 : Adhesion test for GI coating
- k. IS 3202/4759 : Coating thickness testing (Magnetic)

3.2.1.3 DESIGN DATA AND PERFORMANCE OF THE COOLING TOWER

Table 3: DESIGN DATA AND PERFORMANCE

Sr. No.	Description	Values
1.	Total heat rejection (operating), MW	14.6
2.	Total heat rejection (Design), MW	15.0
3.	No. of cells	Multiple cells in single row

4.	Operation philosophy	All cell working
5.	Water flow rate (total), kg/s	305
6.	Design hot water inlet temperature, °C	44
7.	Design cold water outlet temperature °C	32
8.	Design entering wet bulb temperature °C	28.7
9.	Design ambient wet bulb temperature °C	28.7
10.	Design maximum ambient temperature °C	44.2
11.	Wind velocity for design of structure, kmph	130
12.	Site elevation above MSL, meter	55

3.2.1.4 TECHNICAL REQUIREMENTS

3.2.1.4.1 GENERAL REQUIREMENT

- a) The cooling tower is envisaged for cooling of condenser water of chillers and all plate type heat exchangers' secondary side hot water of CWS loops.
- b) The proposed cooling tower will be located adjacent to Plant room in the allocated space on the civil structure to be constructed by the contractor on the ground level. Design & detailed engineering of cooling tower basin and cooling tower structure, preparation of civil design basis report, design calculation, concrete forming drawings including embedded plates for piping/equipment support. Preparation of detailed engineering drawings, QA plans, manufacturing schedules for purchaser's approval and records thereafter.
- c) The cooling tower shall be designed for continuous operation throughout the year. All cells of the cooling tower shall be under operation to deliver full capacity.
- d) It should have minimum maintenance design criteria using for both functional and structural components. Routine maintenance should be minimum and easy. It should have very good maintainability.
- e) All bolted parts should have lock washer and lock nuts.

3.2.1.4.2 SPECIFIC DESIGN REQUIREMENT

- a) The cooling towers shall be mechanical induced draft counter flow and shall meet the duties as specified. It will ensure more wetted surface, uniform water distribution and higher heat transfer rate.
- b) In multi cell construction, each cell shall be identical with the other cells of the cooling tower in all respects. The total heat load and flow shall be equally shared amongst the number of operating cells.
- c) The design shall ensure maximum volume of air movement at lower applied horsepower.
- d) All the cells of the cooling tower shall be constructed on a common RCC structure. The FRP cold water basin shall be designed to take all cooling tower structural load. Each Cell shall be mounted on the common cold-water basin with pipe EP's for Outlet, drain. Each sump shall have two screens made of GI frame with wire mesh 100.
- e) Structural frame work for cooling tower shall be of Pultruded FRP inclusive of cooling tower superstructure, structural casing, structural column, cooling tower fan deck, louvers, fill

support material, louvers support etc. and designed for operational load and wind load of projected area in any horizontal direction.

- f) The FRP members shall be constructed of fire retardant, self-extinguishing resin system with a flame spread rating of 25 or less. The FRP member shall be protected from UV degradation by the use of surfacing veils and UV stabilizers incorporated in resin system.
- g) Drift losses in the cooling tower shall be less than 0.005%.
- h) The Pultruded FRP members to be used in construction of this tower shall be classified, defined and specified as a minimum per CTI 137.
- i) FRP classification conforming to Type II, III & IV Pultruded shapes are acceptable with surface veils to provide long term UV protection
- j) Resin Grade conforming to Grade 1 or Grade 3 are acceptable for the structure with a flame spread rating of 25 or less.
- k) The spray nozzles shall be selected with minimum pressure drop and shall not exceed 4 meters of water column.
- l) The vibration measured on the fan deck shall not be more than latest code requirement as per approved design.
- m) Noise level shall not exceed 85 dB (A) measured at distance of 1 m from fan deck surrounding the cooling tower.

3.2.1.4.2.1 FANS

- a. Fans shall be propeller fans with aero-foil blades and shall run smooth without undue noise and vibration.
- b. The cooling tower shall be sized and selected by the bidder to accommodate additional flow of 10% of the design flow and also the 10% of additional heat load per cell.
- c. Fan tip speed shall not exceed 60 m/sec.
- d. Entire fan blade assembly shall be statically and dynamically balanced / smooth to grade ISO-1940 Gr. 6.3 and vibration free operation.
- e. Fan cylinder shall be made of Pultruded FRP.
- f. The fan drive shall be gearbox type. Gear drives shall be enclosed type with one class of higher duty and shall operate in oil bath considering the factor of safety as 2(two).

3.2.1.4.2.2 GEAR REDUCER

- a. It will be designed for minimum service factor of 2 as per AGMA standard and shall be suitable for cooling tower service. Gear reducer shall be of spiral bevel type.
- b. The flexible coupling bushings shall be of rubber. Drive shaft shall be dynamically balanced at rated speed. Service factor of 2 shall be considered for gear reducers.

3.2.1.4.2.3 ELECTRICAL MOTOR

Each fan shall be driven electric motor through gear reducer. The motor shall be totally enclosed fan cooled (TEFC) weather proof squirrel cage induction motor to the specification as laid down in "Technical Specification for electrical motor". The motors shall be of approved make as per the list in the tender. Electric motors shall be suitable to operate on A.C. Supply 415 volts 3 phase. Motor shall be suitable in all respects for specified fan duty, outdoor moist and general

corrosive environment. The motor rating shall be at least 115% of fan power requirement at design conditions. Suitable canopy covers made of FRP shall be provided for protection of motors against rains. The design of cover shall be such as to provide sufficient ventilation for motors shall have at least cover 100 mm clearance all around motor and have adequate exhaust louvers.

3.2.1.4.2.4 CONTROL AND MONITORING SYSTEM

Each fan of cooling tower shall be individually controlled and monitored with Data acquisition and control (DAC) system. All necessary arrangement shall be made by the contractor under the scope of procurement as specified in the relevant chapter of DACs.

3.2.1.5 MANUFACTURING/CONSTRUCTION/ASSEMBLY AT WORKS EQUIREMENTS

3.2.1.5.1 BASIN AND SUMP

The basin & sumps for cooling tower shall be of pultruded Fiber Reinforced Plastic (FRP) type. The FRP structure shall be designed as per CTI 137 (latest edition) and other relevant IS Codes and as per enclosed specifications. The basin including sumps shall have minimum water depth of 600 mm & width of suction sump shall be about 1500 mm and same shall be finalized during detailed engineering. The top of basin and sumps shall be tapered inside. The basin shall have adequate provision for the following:

- a. Sumps' outlet for pump suction of adequate size HDG MS pipe with puddle flange.
- b. Drain off and sludge removal arrangement with piping and flanges etc. of HDG.
- c. Overflow arrangement of adequate size HDG MS pipe with puddle flanges
- d. The min water level in the basin shall not less than 750 mm leaving volume for overflow.
- e. 2 No. Screens at the suction in each sump shall be of the rectangular shape type made out of SS-304. A suitable strainer guide of Stainless steel shall be grouted on the sump for fixing of screens. The effective velocity through the strainer screen shall not be more than 0.3 m/sec no. of screens provided shall be two in addition one spare screen shall also be supplied.
- f. All design calculations for all civil works shall be submitted to the purchaser for approval.

3.2.1.5.2 AIR INLET LOUVERS

Air inlet louvers shall be suitably designed and supported and arranged that there will be minimum restrictions to air flow and prevent down coming of water from splashing out of the tower. The material of construction shall be of Pultruded FRP of minimum thickness of 6 mm. The louvers shall be properly supported and sufficiently close centers to prevent their sagging more than 12 mm under worst condition.

3.2.1.5.3 FRAME WORK

Structural frame work for cooling tower shall be of Pultruded FRP inclusive of cooling tower superstructure, structural casing, structural column, cooling tower fan deck, louvers, fill support material, louvers support etc. and designed for operational load and wind load of projected area

in any horizontal direction. The column anchor plates shall be fabricated from stainless steel along with fasteners.

The FRP members shall be constructed of fire retardant, self-extinguishing resin system with a flame spread rating of 25 or less. The Pultruded FRP members to be used in construction of this tower shall be classified, defined and specified as a minimum per CTI 137.

3.2.1.5.4 CASING

Casing shall be of pultruded FRP applied vertically and are lapped to shed water. They will be lapped and sealed at all joints. FRP louvers shall be located on wide centers, supported by tower columns on wall casing. It shall be made water tight against leakage of the cooling tower to the outside. It shall be designed such a way that to replace the fill without dismantling the cooling tower. All structural joints are bolted and shear plates or split rings connectors shall be used wherever necessary. The casing shall be bolted at lapped joints with Stainless steel fasteners with SS 316.

3.2.1.5.5 FILLS

The PVC fills shall be film type, in honeycomb design which provides the wetted surface and air turbulence necessary for proper heat transfer while minimizing resistance to air flow and low fan HP.

3.2.1.5.6 FILLS SUPPORTS

Fill shall be properly supported at span not exceeding 610mm and no grids shall be used as a common support for neighboring by a state member. Material of construction for grids/supports is Pultruded FRP.

3.2.1.5.7 DRIFT ELIMINATOR

Drift eliminators shall be rigid virgin PVC designed to minimize entrainment losses to 0.005% of the circulation rate with lowest pressure drop. Drift Eliminator shall be of herringbone pattern supported on Pultruded FRP of "C" type aero foil rigid PVC blades with PP spacers.

3.2.1.5.8 FAN CYLINDER CUM RECOVERY CONE

Fan cylinder cum recovery cone shall be made from Pultruded FRP and shall be 5 mm thick minimum. It will have aerodynamic contour to allow close tolerance and less resistance to air passing through the tower. Fan cylinder shall have an extended stack of Venturi shape to attain conversion of velocity pressure to static pressure. The height of the stack shall be such that the recirculation effects of air shall be reduced to minimum possible. Fan cylinders shall include hot dipped galvanized steel fan guard's in sturdy construction.

3.2.1.5.9 GEAR BOX

Gearbox shall be of spiral bevel type with gears and bearings selected for 5-Years life. Double oil seals are preferred to minimize the leakage of oil or ingress of moisture. Lubricating oil used shall be of turbine type to avoid emulsification due to water connection. Gear shall be balanced dynamically. There shall be an oil line provided of G.I. for filling the gearbox however the flexible connection to gearbox shall be of S.S. Hose. Lubrication, grease nipples and oil level indicators shall be taken to the outside of the fan to facilitate servicing, wherever applicable.

3.2.1.5.10 DRIVE SHAFT

Drive shaft shall be preferably carbon fiber or EN-8. Drive shaft shall be provided with suitable guard. Entire fan blade assembly shall be statically and for dynamically balanced/smooth to grade ISO 1940 Gr. 6.3 and vibration free operation.

3.2.1.5.11 VIBRATION CUT OUT SWITCH

A vibration cutout switch with provision for alarm to stop the electric motor of fans in the event of high vibration shall be provided. The switch must be provided with reset device to set its action at the desired level of vibration above the normal. The switch shall be suitable to operate on single phase A.C. Supply 230 Volts. Potential free contact shall be provided for indication in control room for operation and tripping.

3.2.1.5.12 AUTOMATIC LOW OIL LEVEL SWITCH

An automatic float operated lubricating oil level control switch for each gear reducer shall be provided to protect the gear reducer in the event of low lubricating oil level. The switch shall be suitable to operate on single phase A.C. Supply 230 Volts.

3.2.1.5.13 HOT WATER DISTRIBUTION SYSTEM

The hot water distribution shall be pressure spray type made out of MS Hot dip galvanized/ FRP main header and branch pipes which are bolted to top of the tower structure. The piping shall be Carbon steel Hot dipped galvanized with minimum Galvanizing coating of 160 microns as per the relevant standards and the pipes shall be as per ISI-1239 & ISI- 3589 and shall be so done that each individual cell of the tower is possible to be isolated for maintenance testing, operation, etc.

3.2.1.5.14 SPRAY NOZZLES

Hot water distribution system shall be through non-clogging jet spray. The nozzles shall be selected based on tower area, depth of space above fills and shall be spaced and arranged to obtain uniform spray over entire cooling tower area with least resistance. They shall be highly resistant to temperature and adverse weathering conditions. The nozzle shall be fixed to the hot water distributor through suitable adapters.

3.2.1.6 MATERIAL OF CONSTRUCTION

All materials used must conform to the applicable standards and codes listed under Section of this specification and must be new and first class in all respective parts shall be machined true in a workman like manner. Where materials are not specified here in, they shall be properly selected by the Contractor to the best standards followed in the industry for the particular application, subject to the approval of the Purchaser.

All materials shall be tested quality. These shall be free from defects and imperfections. They shall be of certified quality for physical and chemical properties. Materials shall be of IS, ASTM, BS or any equivalent standard. Liberal factor of safety shall be used in selecting thickness of materials.

Table 4: MATERIAL OF CONSTRUCTION

Sr. No.	Description if items	Material of construction	Relevant code & standard
1.	Basin	Pultruded FRP	CTI 137
2.	Casing	Pultruded FRP	CTI 137
3.	Inlet Louvers	Pultruded FRP	CTI 137
4.	Fills	PVC	
5.	Fills support	Pultruded FRP	CTI 137
6.	Drift eliminators	PVC	
7.	Spray nozzles	PP	
8.	Partition walls	Pultruded FRP	CTI 137
9.	Structure frame work	Carbon steel Hot dipped Galvanized/ FRP	
10.	Covers for cold water basin, wherever required	6 mm thick Aluminum chequered plate/PVC of suitable thickness	
11.	Hardware	HDGS / Stainless steel 316	ASTM A 193/194
12.	Fan cylinder	Pultruded FRP	CTI 137
13.	Fan blades	Aluminium Alloy	
14.	Flanges ANSI Class	Forged carbon steel	ASTM 105 ANSI Class 150

3.2.1.7 SPARES AND SPECIAL TOOLS

The contractor shall include in the scope necessary spares and tools & tackles required for the commissioning and testing of the equipment.

3.2.1.8 QUALITY ASSURANCE, INSPECTION AND TESTING

3.2.1.8.1 GENERAL

- a) The minimum inspection requirements for all components/equipment shall conform to the specifications and reference codes and standards and approval drawings.
- b) All tests and tests procedure along with the time schedule proposed by manufacturer shall be submitted for Purchaser's approval.
- c) The purchaser will carry out inspection or his representative who should be informed at least 10 days period to vendor's inspection dates.
- d) The contractor or his sub-contractor should allow access at all reasonable time during manufacture, assembly. Testing and inspection to the premises where the work is being carried out and shall provide all gauges, instruments, testing facilities required for inspection and testing of component/equipment.
- e) All material used should be new and conforming to specific standards. Test certificates for composition and physical properties of the material used shall be provided before pre-dispatch inspection or testing, as applicable
- f) All welds shall be checked by dye penetrant inspection. Test certificates and mill certificate shall be provided for the material of the pipes.

3.2.1.8.2 INSPECTION AND TESTING AT MANUFACTURER WORKS

- a) The purchaser will depute his authorized engineer for witnessing the tests as per approved
- b) Q. A. plan. The hot dipped galvanizing procedures shall be got approved by the purchaser.
- c) All rotating parts like shaft, couplings, and fan hub and fan blades shall be witnessed for dynamic balancing as per ISO 1940 Gr 6.3.
- d) The gearbox shall be mechanical run tested for 2 hrs. and after successful then it is load tested as per the service factor stated in the specifications. The test shall also include to measure the desired speed, vibration, temperature rise etc.,
- e) All the materials like fills, inlet louvers, eliminators shall be checked for relevant standards, approved drawings and relevant test certificates.

3.2.1.8.3 SITE INSPECTION AND TESTING

- a) As soon as the cooling tower has been erected by the contractor as per scope of supply and approved drawings, the contractor shall perform the tests as mentioned below and other test if any to ensure the correctness of cooling tower for the intended design requirement.
- b) Mechanical Run test: Each fan will be mechanical run tested at rated RPM for 72 hrs. of endurance test. The parameters like vibration, noise, current and temperature raise for Lube oil of gear reducer and motor temperature and vibration.
- c) Air flow measurement: The guaranteed air flow measurement for the required water loading for each cell.
- d) Power consumption: Power consumption will be measured and shall be within the guaranteed limit mentioned specifications and in data sheets.
- e) Vibration: The vibration shall be measured and shall be within the guaranteed limit mentioned in specifications and in data sheets.

- f) Noise: Noise level shall not exceed 85 dB (A) measured at distance of at 1 m surrounding the cooling tower.

3.2.1.9 PROTECTION DURING SHIPPING AND STORAGE

The contractor shall be responsible for ensuring that all Equipments/Items/Deliverables are carefully boxed, crated, or otherwise protected for preventing any possible damage during transportation. Contractor shall be held responsible for all damages due to improper or poor packing. All exposed-machined surfaces shall thoroughly grease application before dispatch.

3.2.1.10 ERECTION AND INSTALLATION

3.2.1.10.1 GENERAL ERECTION AND INSTALLATION

The contractor shall unload, assemble, install, test and commission entire cooling tower at site. The contractor shall provide all necessary labor, materials, tools, hoisting equipment, necessary scaffoldings, and construction equipment, required for erection and installation, at site:

- a) Contractor shall be completely responsible for successful erection, installation testing and commissioning of the cooling tower.
- b) On completion of the work, the contractor shall remove & dispose of all unwanted and other unsightly materials caused by his working and thereby, leaving the premises and the cooling tower in good, clean, safe & operable condition.
- c) Purchaser or his authorized representative will have the right to inspect at any stage of manufacture and construction, all materials, components and workmanship and testing of material.
- d) The contractor shall provide all facilities for inspection and testing without any extra cost to the IPR.
- e) The bidder shall depute at least one competent engineer with proven experience on similar works to supervise the erection of cooling tower and skilled and unskilled labor to ensure completion of works in time.
- f) All the grout for the equipment shall be carried out using non-shrinkable grout. Surface receiving the grout shall be prepared to receive grout.
- g) The cooling tower shall be erected in accordance with the specific instructions given on the approved drawings, methods and procedures.
- h) The contractor shall follow the safety procedures/regulations/codes or safety instructions from the purchaser and shall take necessary measures at his own cost.

3.2.1.10.2 FOUNDATION, PEDESTAL AND CIVIL WORK INCLUSIONS

Design & detailed engineering of CT basin support structure and its foundations, water piping support pedestal, (viz location of foundations & input for foundation size & loads - like forces, moments etc.) & Civil Design Calculations, Concrete forming drawings including embedded plates for piping / equipment support shall be provided before starting civil work at site. The wetted design calculation shall be submitted for the conformity of civil structure design.

3.2.1.10.3 MARKING, LEVELLING, HANDLING AND STORAGE

- a) The contractor shall unload and place in storage at site, at locations designed by the purchaser, until such times as required all materials and equipment to be incorporated in the works.
- b) The contractor shall be responsible for loading and transportation from the place of storage to the point of installation for the equipment.

All packages shall be clearly, legibly and durably marked for correct identification with uniform block letters (preferably water proof paint) on at least three sides with:

- a) Delivery address as communicated
- b) Contract number and date
- c) Net and gross weights
- d) Sign showing SIDE UP
- e) Any handling and unpacking instructions, if considered necessary
- f) In case of spare parts, each spare part shall be clearly marked and leveled on the outside of its packing with its description and catalogue/part number

3.2.1.10.4 CLEANING AND PAINTING

All Equipment shall be supplied painted 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 coat of synthetic enamel paint. base-plate / piping supports subject to water exposure to be painted with rubber paint using zinc base primer. All equipment shall be neatly finished in workman-like manner and exposed metal surfaces shall be smooth and free from burrs. Finished surfaces shall be protected against corrosion and mechanical damage.

3.2.1.11 PERFORMANCE GURANTEEE

After successfully commissioning and acceptance of the Cooling Tower, all portions thereof will be in accordance with requirement of this contract and will be perfect as to design, materials, workmanship etc. for minimum period of one year from the date of commissioning and acceptance of the plant. Further the contractor shall guarantee that during the guarantee period he will repair defective equipment and work and replace defective materials furnished or installed under this contract free of cost to the purchaser.

Contractor/vendor shall guarantee that the IDCT shall meet the ratings and performance requirements at operating conditions as indicated in this specification and data sheet. The performance of the IDCT shall be demonstrated by the vendor considering CTI-ATC-105 Tolerances.

Vendor shall guarantee the IDCT performance for the following range of variations of the parameters:

- a) Total Heat Load: +10% of the design heat load
- b) Circulating water flow rate: $\pm 10\%$ of the design flow
- c) Cooling range: 80% to 120% of the design cooling range
- d) Relative humidity: 40% to 100%
- e) Wet bulb temperature: ± 8.5 °C of the design Wet bulb temperature
- f) Power consumption: + 5% of agreed fan HP
- g) Noise level: as per specifications

3.2.1.12 ANNEXURE-1: TECHNICAL DATASHEET

Annexure 1: Induced draft Cooling Tower

(Details to be furnished by bidder)

Sr. No	Details	IPR Requirement	Details to be filled by vendor
1	General data		
	Manufacture name	As per approved list	
	Model no	As per approved manufacturer	
	Type	Induced draft Counter flow	
	No. of cells	Multicell, single side/row installation	
	Total length	Should fit in the space provided	
	Total width	Should fit in the space provided	
	Total height	Should keep as minimum as possible	
	Operating weight	As per manufacturer	
	Dead weight	As per manufacturer	
	Basin dimension	As per manufacturer	
	Storage capacity of basin	Min. 75000 Lit water holding capacity	
	Dimension of sump	As per manufacturer	
2	Cooling tower design performance data		
	Total heat rejection, MW	≥ 15	
	Heat rejection per cell, MW	As per manufacturer	
	Water flow rate (total), kg/s	305	
	Water flow rate per cell, kg/s		
	Design hot water inlet temperature, °C	44	
	Design cold-water outlet temperature, °C	32	
	Design ambient wet bulb temperature, °C	28.7	

	Design maximum ambient temperature, °C	44.2	
	Wind velocity for design of structure, kmph	≥ 130	
	Permissible drift loss	0.2% of circulation flow	
	Permissible Cycle of concentration	4-5	
	Vibration	As per standard	
	Noise level, dB	≤85	
3	General Design data		
A	Inlet Louvers		
	Type	As per Technical specs	
	Thickness, mm		
B	Fills and Fills support	As per Technical specs	
	Type		
	Thickness		
C	Drift Eliminator	As per Technical specs	
	Type		
	Thickness		
D	Frame	As per Technical specs	
	Type		
	Thickness		
E	Hot water distribution system	As per Technical specs	
	Type and no. of nozzles per cell		
	Nozzle size and pressure rating		
F	Fans	As per Technical specs	
	No. of fans per cell		
	Diameter of fan		
	speed		
	Fan motor KW		
G	Drive shaft	As per Technical specs	
	Type		
4	Material of Construction		
	Framework of members of CT	As per Technical specs	
	Casing	As per Technical specs	
	Water Basin	As per Technical specs	
	Inlet louvers	As per Technical specs	
	Fills	As per Technical specs	
	Drift Eliminators	As per Technical specs	
	Hot water Distribution header	As per Technical specs	

	Fan blade	As per Technical specs	
	Drive shaft	As per Technical specs	
	Platform	As per Technical specs	
	Screen and mesh	As per Technical specs	

3.2.2 SCREW CHILLERS (WATER COOLED)

3.2.2.1 SCOPE

This specification establishes technical requirements, selection, procurement of equipment/items, manufacture, assembly, supply, inspection, shop testing, painting, packaging, safe delivery at site, unloading, installation, commissioning, testing and performance guarantee of energy efficient water-cooled screw chiller of nominal capacity of 300 TR with all accessories, control/s, instrumentation, panels etc.

The chiller package shall consist of semi hermetic twin screw compressor, water cooled condenser flooded type, all refrigerant piping and fittings, valves, strainers, liquid moisture indicator, suction line insulation, first charge of gas filled, starter panel and microprocessor panel etc., all the components being mounted on welded steel base frame with primary coating and finished with acrylic paint. The machine shall be mounted on vibration isolators.

The following are the major components of screw chiller package:

- a) Twin screw compressor semi-hermetic type per chiller
- b) Condenser flooded type
- c) Evaporator flooded type
- d) VFD Starter for motor with Harmonic filter
- e) Electronic Thermostatic expansion valves
- f) Safety controls, Valves and instrumentations etc.
- g) PLC based controller panel
- h) Provision for connection with SCADA system and compatible for operation with SCADA
- i) Interconnecting refrigerant piping
- j) Flow switches or mounted Differential Pressure switches for both evaporator and condenser
- k) Rubber pads for vibration isolators

The machine shall also include any other device, equipment and accessory not included above but required for making it a complete package giving the required functionality, performance, safety and reliability etc.

3.2.2.2 APPLICABLE SPECIFICATIONS, STANDARDS AND CODES

The design, material, construction, manufacture, inspection, testing and performance of water screw chiller shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these Specifications shall be construed to relieve the Contractor /Vendor of his responsibility.

- AHRI standards 550/590-2015 : Standard for screw water chilling package.
- AHRI standards 450-2007 : Standard for water-cooled refrigerant condensers

- ARI standards 495-2005 : Standard for refrigerant liquid receiver.
- ASHRAE standard 22.61 : Methods for testing for rating of water-cooled refrigerant condensers.
- ASME Section VIII Div-1 : Unfired pressure vessels
- ASME Section IX : Welders Qualification
- ASTM A 515 Gr. 60 : For carbon steel plates
- ASTM A 53 : For carbon steel pipes
- ASTM A 105 : For forged carbon steel fittings
- ASME E 165 : Specification for Dye penetrant testing
- ASTM A 193 : for alloy steel bolts
- ASTM A 194 : for alloy steel nuts
- ASTM E 1003 : Specification for Hydro testing
- ISO 1940 Gr 2.5 : for Balancing of rotating parts

3.2.2.3 DESIGN DATA AND PERFORMANCE REQUIREMENT

The machine shall meet the following specification:

Sr. No.	Item of Performance	Specification
1	Nominal Capacity of chiller	300 TR
2	Number of chillers	2 nos.
3	COP	≥ 5.5
4	Refrigerant	R134a
5	No. of pass in evaporator	2
6	No. of pass in condenser	2
7	Max. power consumption	Less than or equal to 0.57 IKW/TR
8	IPLV at AHRI condition	≤ 0.56 Kw/TR
9	Evaporator pressure drop	Max. 5 mwc
10	Condenser pressure drop	Max. 5 mwc

3.2.2.4 TECHNICAL REQUIREMENT

3.2.2.4.1 GENERAL DESIGN REQUIREMENT

- a. The chiller shall conform to the data sheets and technical specification requirements.
- b. The offered chiller model shall be from the existing regular production range of the vendor.
- c. Chiller package shall be skid mounted factory assembled with refrigerant charged and internally wired and shall be ready for use at site.
- d. Chiller unit shall be with screw type twin rotors compressor, motor drive, shell and tube type evaporator and condenser, lube oil circuit comprising oil sump pump, oil separator, oil heater, cooler and oil filter, refrigerant piping with suitable isolation valves, liquid line dryer and indicator, refrigerant feed and level control device, first charge of refrigerant & oil, a field programmable microprocessor / PLC based control system and control panel

- with user friendly Human Machine Interface (HMI), power panel, cold surfaces insulation, required vibration isolation
- e. All rotating parts shall be statically and dynamically balanced.
 - f. Air vents and drain points with valves and plugs shall be provided for both condenser and evaporator.
 - g. The equipment supplied shall be suitable for safe and proper operation under all conditions without undue strain, vibrations, corrosion or other operating difficulties. All parts subjected to substantial temperature changes shall be designed and supported so as to permit free expansion or contraction without resulting in leakage, distortion and excessive strains in the equipment. The parts subjected to wear, corrosion or other deterioration or requiring adjustment, shall be accessible and have reasonable convenience for removal, replacement and repair. All such parts shall be of suitable material or suitably lined for keeping maintenance to a minimum.
 - h. Any other additional features required for safe and efficient operation of chiller shall be included in the design and shall be clearly indicated.

3.2.2.4.2 MANUFACTURING/CONSTRUCTION/ASSEMBLY REQUIREMENT

The water-chilling machine shall be a water-cooled Screw type packaged unit of nominal capacity of 300TR.

3.2.2.4.2.1 COMPRESSOR

Each unit shall have a twin rotary screw semi hermetic single compressor. The rotary screw shall be manufactured from forged steel, with profile which are a symmetrical. The profiles of screw shall permit safe operation up to the required speed as per the manufacturer's standard. The compressor shall be horizontal in design.

Compressor capacity control shall be with either a slide valve mechanism or VFD together with micro-computer controlling system, should be able to adjust load output automatically according to the requirement of processing, and achieving 20-100 % stepless of precision variable adjustment with minimum power consumption.

The units shall be complete with capacity stepless control mechanism or with variable frequency drive control, to permit modulation between 20% to 100% of capacity range. An oil separator shall be included to remove oil from the refrigerant. The driving motor shall be squirrel cage type hermetic type refrigerant cooled and as required, protected against damage by means of built in protection devices.

3.2.2.4.2.2 CONDENSER/ EVAPORATOR

The evaporator and condenser shall be shell and tube flooded type. MS Shell and integrally finned Copper Tube type, 2 passes, designed and constructed according to ASME code section VIII / Relevant BIS pressure vessel code and shall be characterized by low pressure drop on

the both gas and water side resulting in high overall heat transfer coefficient and high unit efficiency.

Each unit shall have one shell and tube, water cooled, 2 pass condensers fitted with safety valve, purge valve, and liquid line valve. The shell shall be of welded steel construction, fitted with steel tube sheets on either side. The condenser and evaporator shall be tested with Test pressure of 1.5 times that of design pressure for the period of min. one hour both side when there shall be no drop-in pressure and indicating no any leaks. The tubes shall be individually replaceable and of enhanced finned type seamless copper tubes.

The condenser and evaporator shall be complete in all respects and include supports for mounting, refrigerant isolating valve at inlet and outlet, de-scaling connection, stem thermometer and pressure gauges at water inlet and outlet etc., as required. The condenser and evaporator shall be designed and factory tested as per ASME applicable codes.

Sr. No.	Description	Evaporator	Condenser
1.	Test pressure of tube, kg/cm ²	>10	>21
2.	Max. pressure drop on water side, mwc	5	5
3.	Fouling factor, FPS	0.0001	0.00025
4.	Material of Shell	ASTM A 515 GR. 60/70	ASTM A 515 GR. 60/70
5.	Material of Tube	Copper as per ASTM B111	Copper as per ASTM B111
6.	Cooling water flow rate, kg/sec, max	55	60
7.	Inlet temperature, °C	19	32
8.	Outlet temperature, °C	14	37

3.2.2.4.2.3 REFRIGERANT PIPING

The various component of chiller shall all be interconnected by suitably sized and properly designed heavy class steel pipe and fittings complete with accessories and controls such as valves, liquid line sight glass, strainer, expansion valve etc.

3.2.2.4.2.4 MOTORS AND STARTER

Electric Motor: Suitable for 3 Phase, 400/415 V \pm 10 %, 50 Hz.

The compressor motor shall be Squirrel cage, hermetic sealed type, and refrigerant cooled energy efficient motor. The starting shall be through floor mounted/ free standing VFD. Insulation of motor shall be class F. Motor shall be compatible with the starting method specified and shall comply latest IEC code.

The efficiency and power factor shall be higher at rated voltage and frequency and at the specified loads. The motor shall be capable of successful operation when running at rated load with variations in voltage and frequency. Terminal box of sturdy construction shall provide enough space for terminating, connecting and earthing of PVC / XLPE - insulated copper conductor cable. All terminal boxes shall have terminal and cable glands suitable for cables specified.

The starter shall be:

- a. Equipped with VFD based on latest technology and shall be designed/selected as per the detailed specification provided in VFD-Technical specification chapter forming part of this tender document
- b. The starter shall be coordinated with the chiller package(s) marking all terminals properly according to the chiller manufacturer's wiring diagrams.
- c. There shall be electronic overloads in each phase of motor. The overloads shall be adjustable and selected for mid-range.

Each VFD shall include the following protective devices:

- a. Phase failure, unbalance current, earth fault and reversal protection.
- b. Stall protection.

VFD failure/alarm status comprising of following but not limited to

- a. VFD over heat
- b. VFD cabinet open
- c. Control power failure
- d. Cooling fan failure
- e. VFD controller HMI failure
- f. Motor protections
- g. Over frequency
- h. Panel temperature high
- i. Instantaneous over under speed
- j. Communication failure
- k. Earth fault in VFD/Motor/Cable
- l. Loss of one phase of incoming power/phase unbalance

3.2.2.4.2.5 MICRO COMPUTER CONTROL PANEL

A microprocessor-based control panel with locked enclosure shall be fully wired and factory mounted on the chiller and has the following features:

- a. The display shall have Messages in plain English language. Coded two or three, character displays are not acceptable. Must have OPEN PROTOCOL for integration with all DACS systems and easy operator interface.

- b. The following information shall be available on the display with simple entry on the keypad. Pressure and temperature gauges are not acceptable.

The following temperature sensors, pressure, current, flow transducers shall be provided as monitoring and primary protection devices, as minimum. These devices shall communicate with the controller to monitor following parameters:

- a. Entering and leaving chilled water temperatures.
- b. Entering and leaving condenser water temperatures.
- c. Evaporator, suction, discharge, condenser, and liquid refrigerant temperatures.
- d. Condenser and evaporator refrigerant pressure
- e. Oil feed temperature and pressure
- f. Oil sump temperature and pressure
- g. Oil filter pressure drop
- h. Hours of operation and number of starts, time of last start and stop.
- i. Chilled water set point and reset temperature set point.
- j. Fault history with date and time plus critical sensor values.
- k. Chiller having facility for both remote and manual on / off activity.
- l. Unit status; start up and shut down sequence, operational status.
- m. The microprocessor shall either unload or shut down the compressor during an abnormal condition.
- n. System voltage
- o. Number of compressors start
- p. Compressor amp drawn by each compressor
- q. Compressor elapsed run time of each compressor

The following safeties shall be incorporated in the control system, as minimum:

- a. High and low refrigerant discharge pressure.
- b. Low evaporator refrigerant pressure
- c. High refrigerant discharge temperature.
- d. No evaporator or condenser water flow.
- e. High or low oil feed temperature.
- f. Low oil differential pressure.
- g. High motor temperature, low motor current.
- h. Starter fault, no starter transition.
- i. Sensor failure, specific to sensor.

The controller shall be able to reset chilled water temperature by controlling return chilled water temperature. The amount of reset shall be adjustable. Soft loading shall be provided to prevent the unit from operating at full load during pull down if desired. Indication should be

provided for chiller is ready to start, chiller is operating, chiller is shut down on a safety requiring reset, and chiller is shut down.

Following ON/OFF type safety switches shall also be provided:

- a. Motor winding high temperature
- b. Evaporator water flow DP switch
- c. Condenser water flow DP switch
- d. Mechanical high-pressure switch
- e. Antifreeze system response time shall be of the order of 2 sec.
- f. Vents and drain shall be provided.
- g. Liquid line/expansion valve sight glass
- h. Liquid line strainer
- i. HP, LP, oil pressure cutouts
- j. Provide Pressure/flow switches factory mounted and wired for no operation with no flow.
- k. Moisture indicating sight glass
- l. NRV at discharge side of compressor

The condenser water and chilled water pump electric circuits shall be interlocked with the chilling unit starters, so that the unit cannot start, unless at least one of the pumps of each circuit is operating.

3.2.2.4.3 MATERIAL OF CONSTRUCTION

Sr. No.	Description of items		Material of construction
1	Compressor	Casing	Cast iron/ductile iron
		Helical Twin Screw	Forged Steel
		Bearings	Sleeve bearing (bronze/Babbitt metal) or white metal
2	Evaporator	Shell	HR Carbon Steel SA 516 GR.60/70
		Tube sheets	HR Carbon Steel SA 516 GR.60/70
		Tubes	seamless copper with finned surface
		Tube to tube sheets joints	double-groove expanded joints
3	Condenser	Shell	HR Carbon Steel SA 516 GR.60/70

		Tube sheets	HR Carbon Steel SA 516 GR.60/70
		Tubes	seamless copper with finned surface
		Tube to tube sheets joints	double-groove expanded joints
4	Thermal insulation		As per manufacturer std.
5	Control panel	Control system	Microprocessor based or PLC based
		HMI	Graphic animated-touch screen operated color LCD of size min. 264 mm
		Control panel enclosure class	IP 55

3.2.2.4.4 SPARES AND SPECIAL TOOLS

The Contractor shall include in the scope necessary spares and tool and tackles required for the commissioning and testing of the equipment.

3.2.2.4.5 QUALITY ASSURANCE, INSPECTION AND TESTING

3.2.2.4.5.1 INSPECTION AND TESTING AT MANUFACTURER WORKS

Contractor shall submit QA plan for approval of IPR. Quality surveillance by the purchaser will be carried out at the contractor's works.

The contractor shall ensure his in-house inspection to establish and maintain the quality of workmanship in his and his sub-contractors works to ensure the mechanical accuracy of components compliance with drawings, identify and acceptability of all material, part and equipment. He shall conduct all tests required to ensure that the equipment and the material furnished conform to the requirement of applicable codes.

All tests and tests procedure posed by the manufacturer shall be submitted to the purchaser for his prior approval. Purchaser shall be notified well in advance of the fabrication and major shop tests of the equipment for the purpose of making general inspection and for making progress report. The purchaser's representative shall be given full access to the shop in which equipment is being manufactured or tested. All test records shall be made available to him. A final inspection will be made by the purchaser's representative before the dispatch of the equipment. All the instruments used for conducting the specified shop tests shall be calibrated and calibration certificates shall be furnished from a recognized institution. The calibration shall have been carried out not more than six months prior to the testing date. Final routine and performance tests for the complete units shall be carried out in presence of the purchaser's representative.

3.2.2.4.5.1.1 CASTING

Casting shall be sound clean and free from porosity, blowholes, hot spots, cold shut distortion and other harmful casting defects. No repairs shall be carried out without intimation to and approval of the purchaser. No welding on C.I. parts will be permitted.

Casting material shall be as per Indian standard and shall be free from flaws and shall be DP tested. Testing shall be carried out after machining.

3.2.2.4.5.1.2 FORGING

All forgings shall be DP tested or magnetic particle tested, in addition to physical, visual and chemical tests as per relevant material standards. The testing is to be carried out after the machining operation. Test procedure shall be as per ASME sec. VIII appendix VI. All forgings shall be demagnetized after carrying out the test. Any defect that will not be machined out during the final machining will be gauged out, fully inspected by dye penetrant and / or magnetic particles inspection to ensure that the defect is fully removed and repaired using an approved repair procedure. Any indications which prove to penetrate deeper than 2½ % of the finished thickness of the forging shall be reported to the Purchaser giving location, length width and depth of such defect.

Any other examinations like Ultrasonic or radiographic examination, if specified in the manufacturer's Manufacturing Inspection Plan (MIP) shall be carried out at factory and test reports to be submitted to the purchaser before final acceptance at factory.

3.2.2.4.5.1.3 WELDING

All welding shall be performed in accordance with the ASME code for boiler and pressure vessels. The contractor shall have all welding procedure, welding Equipment and operators qualified in accordance with ASME boiler and pressure vessel code, Sec IX (on welding qualifications) prior to commencing and welding on the works. Filler metal welding electrodes to E-60 series to AWS-ASTM Specification shall be used for welding. The electrodes shall be dried before use to avoid porosity. All welding shall be done by qualified welders only. All the root passes and final passes of the weldments shall be examined by D.P. test in accordance with ASTM Specification E-165. Dye Penetrant examination shall be carried out according to the method outlined in ASME for boiler and pressure vessels Section VIII Div. I

Any procedure for the repair of the defect in the weldments and all other materials shall be submitted to the purchaser for his approval prior to any repair being done.

The root and final passes of all welded joints shall be DP tested according to ASME.

3.2.2.4.5.1.4 HYDROSTATIC TESTS

All parts subjected to water pressure shall be hydro statically tested at greater than 10 kg/cm² for condenser side and greater than 21 kg/cm² for the evaporator side for the minimum period of atleast 30 minutes. No leakage or drop in pressure shall be allowed. Auxiliary piping, if applicable shall be hydrostatically tested. The minimum test pressure shall be 1.5 times the design pressure. All other pressure parts including inter-connecting piping will also be hydrostatically tested.

3.2.2.4.5.1.5 AIR TEST

All parts subjected to gas pressure shall be air tested at 1.2 times the design pressure. No leakage shall be allowed, these parts shall also be vacuum tested to a pressure of 5 mmHg absolute. The vacuum shall be maintained in refrigerator unit for a period of 24 hours without losing more than 5mm of Hg.

3.2.2.4.5.1.6 BALANCING TEST

Dynamic balancing of rotor assembly shall be carried out as per ISO 1940 GR. 2.5. The vibration level shall not exceed a level of 3.5 mm/s as per ISO 10816.

3.2.2.4.5.1.7 VISUAL INSPECTION

All equipment shall be visually inspected before shipment. Chillers shall not be painted before inspection. After inspection, test certificates shall be furnished by the contractor.

3.2.2.4.5.1.8 TESTING FOR CONTROL PANEL AND INSTRUMENTS

- a) All bought out items including electric motors, VFD, control panels etc. shall be shop tested.
- b) All the instruments shall be calibrated and certificate shall be furnished.
- c) The control panels shall be subjected to test to show that the panels have been satisfactorily designed and manufactured in accordance to the relevant IS Standards.
- d) The performance testing shall be carried out with the panel, VFD and motor to be supplied by the contractor along with chiller. Details of testing requirement of electrical system inclusive of motors, VFD, panels etc.

3.2.2.4.5.2 PERFORMANCE TEST

The performance test of unit shall be tested as per AHRI codes 550/590 at contractor works in presence of purchaser representative for a period of not less than 4 hours at design conditions to demonstrate the satisfactorily performance of the machines and certified by AHRI. The performance test procedure shall be laid down by the contractor and get approved before inviting to witness the test. Results of the performance test shall be submitted to the Purchaser for approval.

3.2.2.4.5.2.1 ACCEPTANCE CRITERA

As per AHRI 550/590 Latest edition

3.2.2.4.5.3 INSPECTION AND TESTING AT SITE

3.2.2.4.5.3.1 ENDURANCE TEST

The machine will also be tested at site for capacity, 48 hours endurance test and functional test of all accessories.

3.2.2.4.5.3.1.1 Net capacity

Capacity test at site will be conducted at available load and installed equipment shall be used for making measurements with available accuracy. The capacity of the unit is 300 TR net and it does not include the tonnage required for cooling of the motor, oil etc.

3.2.2.4.6 REPAIRS AND REPLACEMENT

Any procedure for the repair of the defect in the weldments and all other materials shall be submitted to the purchaser for his approval prior to any repair being done.

3.2.2.4.7 PROTECTION DURING SHIPPING AND STORAGE

The contractor shall be responsible for ensuring that all equipment is carefully boxed, crated, or otherwise protected for preventing any possible damage during transportation. All nozzles, which have to be welded, shall be made readily for welding and shall be protected by fitting suitable thin metal caps and by welding them tack to nozzles. Tack welds shall not damage the nozzles prepared for welding in anyway. All openings with instruments shall be plugged with suitable plastic caps to prevent entry of moisture and dirt.

All the equipment shall be neatly finished in a workman ship manner. All exposed metal surfaces shall be smooth and free from burrs. Finished surface shall be protected against corrosion and mechanical damage.

Exterior surface shall be thoroughly cleaned to remove scales dirt etc. by using brushing or sand blasting required and then given one shop of (about 0.15 mm thick) or red or zinc chromate paint.

They shall then be given a final shop coat of approved paint.

Interior surface of all the equipment/materials shall be cleaned of all scales rust and foreign matter by sand blasting. Suitable protective coating shall be applied on it immediately after sand blasting.

Before the equipment are closed, they shall be carefully checked to ensure those all extraneous materials such as rags, tools rubbish foreign matter. Loose scales and dirt's weld rod stubs bolt etc. has been removed. All panels shall be powder coated with standard color code.

3.2.2.4.8 ERECTION AND INSTALLATION

The contractor shall ensure that the chiller shall be erected at site as per the manufacturer's guidelines. Special care should be taken during unloading at site, transfer from storage area to plant room with special handling arrangement and cranes shall be carried out by the

contractor. Contractor shall ensure that no damage during transit. If there is any damage happen during transit, immediately the same should bring notice to the purchase. He should provide detailed installation drawings and follow the plant layout drawing attached herewith the tender.

3.2.2.4.9 INSPECTION, TESTING AND COMMISSIONING

The methodology of testing and commissioning shall be intimated with full procedures, checklists, sequence and any temporary arrangements, needed, list of related agencies involved, and to be intimated, etc. to the purchaser sufficiently in advance (minimum two weeks) for his approval. All measurements, observations shall be taken in the presence of purchaser's representative and shall be certified by the purchaser after his full satisfaction for meeting deigned conditions.

3.2.2.4.10 PERFORMANCE GUARANTEE

The contractor shall guarantee that upon satisfactorily commissioning and acceptance of the plant by the purchaser, all portions thereof will be in accordance with requirement of this contract and will be perfect as to design, materials, workmanship etc. for minimum period of one year from the date of commissioning and acceptance of the plant. Further the contractor shall guarantee that during the guarantee period he will repair defective equipment and work and replace defective materials furnished or installed under this contract free of cost to the purchaser. The guarantee of the equipment shall be extended further to consider such repair and replacement period. If the performance test results deviate from the guaranteed values, the Contractor/vendor shall try to correct the deficiencies and if he fails, the Contractor/vendor shall replace the equipment with one that meets the guaranteed value at no extra cost to the purchaser.

The contractor shall guarantee the following performance of each water chiller package:

- a. Chilled water outlet temperature
- b. Condenser capacity of each machine
- c. Power consumption of each water chiller package
- d. Chilled water flow rate
- e. All controls and annunciations working satisfactorily
- f. Noise level
- g. Vibration level
- h. Unit capacity
- i. Interface between HMI and SCADA

3.2.2.5 Annexure -2: TECHNICAL DATASHEET

Annexure 2: Screw Chillers (Water Cooled)

(Details to be furnished by the details Bidder)

Sr. No	Details	IPR Requirement	Details to be filled by vendor
1	Type	Screw Chiller, water cooled	
2	Make / Model	As per the SECTION VI	
3	Refrigerant	R-134a	
4	Refrigeration Capacity at entering CT water temp. 32 C and leaving chilled water temp. 14°C		
a.	Nominal Cooling capacity in TR		
b.	Actual cooling capacity in TR	300	
5	IPLV	≤ 0.56 Kw/TR @ design condition	
a.			
b.	COP	≥ 5.5	
6	Compressor		
a.	Type/Make	Twin semi hermetic/As per approved make	
b.	Speed (Minimum / Operating / Maximum) RPM		
c.	Type of drive, bearing, coupling		
d.	Capacity control method	Slide valve or VFD	
e.	Steps / Range of Capacity control (% of full Load)		
f.	Safety devices included	Yes	
7	Compressor Motor		
a.	Type	Semi hermetic type	
b.	Manufacturer / make	Approved make	
c.	Type of drive	VFD	
d.	RPM:	≤ 3000	
e.	Electrical supply	400/415 V \pm 10 %, 50 Hz	
f.	Starter Type / manufacturer (to be included in the Package)		
g.	Class of Insulation	F	

h.	Current: Amp		
i.	Full Load Amp / Rated Amp		
j.	Locked Rotor Amp		
8	Evaporator		
a.	Type	Flooded Shell and Tube	
b.	Manufacturer/ make / model		
c.	Shell Material / Dia mm / Length mm		
d.	Tube Material / Gauge – wall thickness mm		
e.	Tube Dia. (OD) mm. / No. of tubes / Length mm		
f.	No. of passes	Two	
g.	Chilled water Temp. in/out °C	19/14	
h.	Water flow rate in kg/sec, max.	55	
i.	Heat rejection capacity in TR		
j.	Pressure drop in mwc	5 Meter max	
k.	Water side design pressure in kg/cm ²	≥ 10	
l.	Refrigerant side design pressure in kg / cm ²		
m.	Safety devices and other accessories included	Yes	
9	Condenser		
a.	Type	Water cooled shell and tube	
b.	Manufacturer/ make / model		
c.	Shell Material / Dia. mm / Length mm		
d.	Tube Material / Gauge – wall thickness mm		
e.	Tube Dia. (OD) mm. / No. of tubes / Length mm		
f.	No. of passes	Two	

g.	Water flow rate in kg/sec., max.	60	
h.	Water Temp. in / out, °C	32/37	
i.	Heat rejection capacity in TR		
j.	Pressure drop in mwc	5 Meter max	
k.	Water side design pressure in kg/cm ²	≥ 21 kg / cm ²	
l.	Refrigerant side design pressure in kg / cm ²		
m.	Safety devices and other accessories included	Yes	
10	Others items		
a.	Qty of Refrigerant and oil per chiller package (Initial charge) :	As per manufacturer's standard	
b.	Thermal insulation material	As per manufacturer's standard	
c.	Control system	Microprocessor based or PLC based	
d.	HMI	Graphic animated-Touch screen operated color LCD of size 264 mm min.	
e.	Enclosure class	IP 55 as per IEC 60529	
f.	Overall dimensions of chiller (Lx W x H) mm.		
g.	Overall Shipping weight in Kg		
h.	Overall Operating weight in Kg. (Max.)		
i.	Noise level in dBA (at 1.0 m)	< 85	
j.	Vibration isolation (overall)	> 90% efficiency	

3.2.3 PUMPS FOR WATER CIRCULATION (CENTRIFUGAL TYPE)

3.2.3.1 SCOPE

This specification covers the minimum technical requirement of design, manufacture, inspection, testing, and guarantees of the Horizontal Centrifugal Pumps Back Pull-out type/ Horizontal split casing and/or In-line Vertical pump in complete with accessories and auxiliaries as specified herein. It is not the intent to completely specify all details of design and construction of these pumps; nevertheless, the equipment shall conform to high standards of engineering, design and workmanship in all respects.

The Contractor/Vendor shall supply the equipment in accordance with this Specification. Compliance to this specification shall not relieve the /Contractor vendor of the responsibility of supplying the equipment and auxiliaries of proper design, material and workmanship to meet the operating requirements specified in this specification. In case any accessories that are necessary to make a complete, operable, safe and dependable operation but not specifically identified herein shall also be in the Contractor's/Vendor's scope of supply.

The scope of supply for each pump unit shall include, but not necessarily be limited to the following:

- a. Pump & Driver
- b. Seals and Seal systems
- c. Flexible couplings, complete with suitable non-sparking guard
- d. Base plate, Foundation bolts, SS shim plates if required
- e. Lubrication System with all necessary ancillary components.
- f. All necessary interconnecting pipe work and valves, including drain connections, terminating at the edge of the base plate
- g. Any additional piping, instrumentation or accessories specified in this specification
- h. First fill of lubricants
- i. All necessary spare parts for start-up and commissioning
- j. List of spare parts recommended for three year's operation along with price

- k. Inspection and testing as called for in this specification and approved MIP.
- l. Painting and preparation for Shipment.

3.2.3.2 APPLICABLE DOCUMENTS, CODES AND STANDARDS

The design, material, construction, manufacture, inspection, testing and performance of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these Specifications shall be construed to relieve the Contractor /Vendor of his responsibility.

- a. ISO 13709 – Centrifugal pumps for petroleum, petrochemical and natural gas industries
- b. IS 5199 Technical specifications for Centrifugal Pumps
- c. IS 5120 Specifications for horizontal centrifugal pumps
- d. IS 2858 Back Pullout End Suction Centrifugal pumps
- e. ASME Standards for Various Tests and Materials.
- f. Instrument Society of American Standards.
- g. ASME - Boiler and Pressure Vessels Code Section VIII, Div.1, Sec. IX and Sec.V.
- h. ASME B 16.5 Standard for Steel Pipe Flanges and Flanged Fittings.
- i. ISO 1940 - Dynamic Balancing.
- j. ISO 9906 – Roto dynamic Pumps – Hydraulic Performance acceptance tests Grade 1,2,3
- k. ISO 10816 Part-3 Mechanical vibration - Evaluation of machine vibration by measurements on non-rotating parts

In case of conflict between specifications, code and standards and data sheet, more stringent requirement will be followed.

3.2.3.3 DESIGN DATA AND PERFORMANCE REQUIREMENTS FOR PRIMARY COOLING LOOPS PUMPS

Table 5: DESIGN DATA FOR PRIMARY COOLING LOOPS PUMPS

Description	Cooling Loops				
	ICECRH	DNBHP	DNBLP	DNBCH	IPRCH
Type of Pumps	BPO*	HSC*/In-line Vertical	HSC*/In-line Vertical	BPO*	BPO*
Operating fluid	DM	DM	DM	DM	DM
Flow rate, kg/s	120	31	66	10 [#]	25 [#]
Diff. Head, meter	90	240	150	70	70
Motor rating, kW(minimum)	150	125	200	22	30
Duty	Continuous	Continuous	Continuous	Continuous	Continuous
Quantity	2 (1W+1S)	2 (1W+1S)	2 (1W+1S)	2 (1W+1S)	2 (1W+1S)

BPO*-Back Pullout Type Centrifugal Pump

HSC*-Horizontal Split Casing Centrifugal Pump

#-The flow is considered for DNBCH Loop in a manner that either DNB system or Cryogenic system shall operate with an optimization approach. Similarly, in IPRCH Loop LCPC system and Divertor system will not operate together.

Note: - 1) HSC pumps shall be preferable single stage type and shall be operated with Variable Frequency Drive (VFD)

2) Design standards is IS-5199

3.2.3.4 DESIGN AND PERFORMANCE DATA FOR SECONDARY AND TERTIARY COOLING LOOPS PUMPS

Table 6: DESIGN FOR SECONDARY COOLING LOOPS PUMPS

Description	Chiller Pumps	Condenser Pumps	Cooling Tower Pumps	Drain Pumps
Type of Pumps	BPO*	BPO*	BPO*	BPO*
Operating fluid	Soft water	Soft water	Soft water	Soft water
Flow rate, kg/s	52	56	94	2
Diff. Head, meter	40	40	40	15

Motor rating, kW(minimum)	45	45	75	1.5
Duty	Continuous	Continuous	Continuous	Continuous
Quantity	2(1W+1S)	2(1W+1S)	4(3W+1S)	2(1W+1S)

BPO*-Back Pullout Type Centrifugal Pump

Note: Design standards is IS-5199

3.2.3.5 GENERAL DESIGN REQUIREMENT

1. The offered pump shall be sourced from a regular and well-established Vendor who has requisite design, manufacturing and testing facilities. The offered pump model shall be from the existing regular production range of the vendor. The offered model should have been designed and manufactured earlier and shall have been operating satisfactorily on a continuous duty basis for which the Contractor /vendor shall furnish reference list.
2. The pumps operating in parallel shall be of identical model from same pump manufacturer and shall be suitable for parallel operation with equal load division over the entire operating range. Components of identical pumps shall be inter-changeable.
3. The pumps and motors shall be free from undue vibrations and shall be capable of withstanding the stresses which may be experienced during start up, normal operation, shutdown and tests.
4. Maximum allowable working pressure of casings/ flanges and its associated parts shall in no case be less than the maximum discharge pressure produced by the pump at shut-off (including tolerances), at the maximum suction pressure, for the maximum impeller diameter and the rated speed.
5. Pumps of a particular category shall be suitable for operating alone or in parallel over the entire operating range
6. Suction and discharge nozzles shall be flanged type. Flanges shall be of standard size and conform to ASME B 16.5.
7. The impeller adjustment shall be such that the impellers run free in any installed condition despite extension of line shaft (caused by hydraulic down-thrust) the weight of shafting and weight of impellers.
8. Anchor bolts, nuts and seating steel work shall be supplied with the equipment. Only hexagonal nuts shall be used for holding down the equipment. All bolts holes shall be spot faced for nuts.

9. The equipment shall be designed to permit interchangeability of parts and ease of access during inspection, maintenance and repair.
10. The wearing parts shall be so designed that they can be easily replaced. Wearing ring clearances shall be as per design codes.
11. All pressure containing components including the casing, stuffing box and seal chamber shall be manufactured in accordance with design standard.
12. All electrical and mechanical equipment shall be designed, manufactured and packed so that no damage will result from inland transportation and storage, installation and operation of the equipment under the climate conditions to which it will be subjected.
13. All materials used shall conform to specifications and shall be new and of best quality in all respects.
14. Castings and forgings shall conform to their respective material specifications and shall be free from flaws and objectionable imperfections and shall be machined true and in a workmanlike manner. There should not be any waviness on the casting.
15. Proposals for repair or any similar operations involving the plugging, welding, boring or addition of metal to the original castings or forgings shall be submitted to the Purchaser and his approval shall be received before any such work is carried out. Drawings showing the details and location of such modification shall be submitted to the Purchaser for his records. No weld is allowed on/for Cast Iron components.
16. Adequate supports for different parts of the pump shall be given for the entire pump installation. Suitable clamps, lifting lugs or eye bolts shall be provided at appropriate places for convenient handling of components. Pump shall be fully assembled at manufacturer's shop and mating parts shall be match-marked for ease of assembly at site. This is applicable for spare rotating assembly also.
17. The separate/ individual components of equipment shall be marked with suitable reference numbers or symbols which shall also be indicated on the assembly drawings to aid in their identification and assembly at site.
18. The pumps shall have stable, rising characteristic head (H) vs capacity (Q) curve from maximum flow to zero-flow (shut-off head) condition. There shall be no inflection point at any partial load in the H vs. Q curve. Besides the actual H vs. Q curve, curves for minimum and maximum impeller diameters shall also be shown. Dropping characteristics curve is not acceptable.

19. The best efficiency point (B.E.P.) for the rated impeller is preferred near the rated point as possible. Rated point shall be in the range of 80% to 110% of B.E.P. However, in no case the rated point shall be beyond 110 % of the B.E.P. of the rated impeller.
20. The pumps for parallel operation shall have characteristics for capacity sharing. The shut off head in such cases shall not be less than 110 % of the rated head. Pump for single operating, shut off head shall not be less than 105% of rated head.
21. The Shut-off head shall be at least 120% of the differential head. Pump shut-off head shall not exceed 130 % of the differential head. Minimum continuous stable flow should be equal or less than 40 % of B.E.P. or else Purchaser's approval is required. The corrosion allowance for pressure parts shall be at least 3 mm.
22. Impeller diameter shall be selected such that minimum 5% increase in head at rated capacity is possible with the same casing by changing impeller. Offered impeller shall in no case be less than the minimum diameter impeller. The impeller offered shall have a non- overloading characteristic curve. Impellers shall be arranged for proper radial clearness and minimum thrust loads
23. Pumps shall run smooth without undue noise and vibration. The noise level of complete unit shall not exceed 85 dBA measured at 1.0 m from the outline of pump set. The overall vibration level shall be as per ISO 10816-3.
24. Stability of hydraulic performance shall be guaranteed over the entire operating range in addition to the duty point as specified in the respective system resistance. Head and power characteristics over the guaranteed range furnished by Contractor /Vendor shall truly represent actual performance.
25. The required NPSH shall be at least one (1) metre less than the available NPSH under all conditions of pump operation. Inducers at suction of pumps to reduce NPSHR are not acceptable.
26. The pump-motor sets shall be capable of withstanding maximum expected reverse rotation arising due to back flow like from full discharge header pressure with fully open discharge valve, without mechanical damage to any component. In any case the reverse rotation capability shall not be less than 125% rated speed.
27. The first critical speed of rotating assembly shall be well away from the operating speed and in no case less than 130% of the rated speed.

28. The equipment shall be designed to permit rapid and economical maintenance. Major parts such as casing component and bearing housings, shall be designed and manufactured to ensure accurate alignment on reassembly. The equipment shall be designed with regard to ease of repair, cleaning and inspection of parts subject to wear or other deterioration requiring adjustment or repair and shall be accessible and capable of convenient removal and replacement when required.
29. The pump outer casing sections shall be provided with suitable lifting lugs/eyes to facilitate handling. In addition, suitable provisions shall be made to facilitate supporting the assembly on the pump floor during lifting operations.
30. The shaft and bearing design shall consider the hydraulic down thrust and the weights of components. The clearance between the impeller and its cover shall be such that the impeller is free to run without decreasing the efficiency of the pump. The clearance shall be adjustable. Necessary devices shall be provided.
31. The number of thrust bearings per pump shall be provided as required. Axial thrust of the pump shall be borne by its own thrust bearing. Motor shall have a separate thrust bearing to take care of its axial thrust.
32. The rotating assembly including impeller, shaft, etc. shall be dynamically balanced (individual component as well as total assembly) at the operating speed in addition to total assembly static balancing. The assembly should include coupling assembly, rotating component of thrust bearing and rotating component of ratchet arrangement. The driver shall be connected directly to the pump through a flexible type coupling. The flexible rotating assembly balancing shall be done at rated speed and for rigid rotating assembly balancing shall be done at reduced speed.
33. Mating parts of coupling of both pump and motor shall be match marked before despatch of the equipment to site.

3.2.3.6 MANUFACTURING/CONSTRUCTION/ASSEMBLY REQUIREMENTS

The pumps shall be of standard fitted construction as indicated in respective data sheet. Following guidelines shall be observed for the manufacturing and assembly stages:

3.2.3.6.1 Pump components

3.2.3.6.1.1 Pump casing

Pump casing shall have drain connection at low point and vent connection at high point with valve. All fluid passages within the pump shall be arranged for complete drainage. Contractor /Vendor shall provide drain piping with gate valve, up to skid edge.

Pump shall be provided with renewable type casing wearing ring and pumps having capacity mention in the table above and shall be provided with impeller wearing ring in addition to casing wearing ring.

The casing shall be supported by feet beneath the casing or a suitable support between the casing and the base plate. The casing shall be designed considering maximum suction head and shut off head. The casing shall be so proportioned that the velocity of liquid is gradually reduced and converted into pressure with minimum of friction and wear.

3.2.3.6.1.2 Impeller

Impellers shall be of single piece construction. The impeller shall be of enclosed type and shall be both statically and dynamically balanced to ensure vibration free operation. Provision for external adjustment without disassembly of pump except for the coupling guard of the impeller axial clearance shall be provided. Impellers shall meet ISO 1940 Gr.6.3 after final machining. Impellers shall be securely fastened to the impeller shaft with keys, taper bushings or locknuts. Shaft threads shall be protected so that they will not be wetted by pumped liquid. The impeller shall be properly machined, with liquid passages hand-finished for best radial balance loads. Impeller vane thickness shall include adequate safety margin to accommodate hydraulic forces due to flow disturbances. The rated impellers shall be at least 5% smaller in diameter than that can be accommodated in the casing. Rotation of impeller shall be marked at casing.

3.2.3.6.1.3 Shaft

The shaft shall be made of material as specified in table and having Brinell hardness number of not less than 200. It shall have surface finish of 0.8 microns or less. The butting faces of the shaft shall be machined square to the axis and the shaft ends shall be chamfered on the edge. Dynamic shaft deflection at the impeller center line shall be as per design code.

3.2.3.6.1.4 Shaft sleeves

Replaceable shaft sleeves shall be provided to protect the shaft where it passes through stuffing box. Shaft sleeves shall be in perfect alignment, concentric with the axis of rotation and highly polished. Suitable arrangement shall be provided to avoid leakage through the clearance between the shaft and sleeves. The shaft sleeves shall be securely locked to the pump shaft to prevent loosening in case of reverse rotation.

3.2.3.6.1.5 Stuffing box

Packed type stuffing boxes of adequate depth shall be provided for minimum leakage and ease of maintenance. Stuffing boxes shall be of such design that they can be repacked without removing

any part other than the gland and lantern ring. Stuffing box housing shall facilitate collection of stuffing box leakage without any spillage.

3.2.3.6.1.6 Coupling

The pump shall be directly coupled to the drive motor shaft through flexible type coupling to take care of usual shaft misalignment. Suitable coupling guard bolted to the base plate shall be provided for the couplings to ensure safety during pump operation. Coupling guard shall be non-sparking and removable type and it shall be sufficiently rigid to withstand minimum 100 kg of dead load without any deflection. Coupling shall be designed for minimum service factor of 1.5 on motor rating.

It shall be the responsibility of the pump Contractor/Vendor to obtain Purchaser's approval for the selected coupling, its make and rating.

3.2.3.6.1.7 Radial & Thrust Bearings

Radial bearings are arranged to carry radial loading and thrust bearings are arranged to carry both radial loading and axial thrust. Bearing housing shall be constructed to protect the bearings from dust, water and other foreign matters.

Antifriction bearings shall be of standard type and shall meet minimum L-10 rating life of 40,000 hours with continuous operation at rated conditions.

Bearing shall be grease-lubricated as specified in Data sheet. Oil lubricated arrangement shall have magnetic plug at power end. Grease fittings shall be provided for grease lubrication.

The rise in bearing grease/oil temperature with continuous running of the pump shall be within the allowance limits which shall not exceed 20°C for grease and 30°C for oil lubricated bearings above ambient. Cooling arrangements shall be provided, if required.

3.2.3.6.1.8 Mechanical seal

Mechanical seal shall be provided to prevent leakage. The mechanical seal shall be of cartridge type, multi spring internally mounted, balanced type. If required, a flushing line shall be furnished, complete with strainer and orifice, from the pump discharge to the sealing face. When pumping liquid is not suitable for this purpose, a flushing connection shall be provided so that it can be connected to an external source. And if it is not allowed, a proper arrangement shall be provided for seal flushing.

The mechanical seal shall be of a reputed make. Seal manufacturers specific recommendation shall be obtained and submitted along with the final design. Seal box shall be sufficiently sized to dissipate heat generated. Seal box drain and vent line with isolation valve shall be provided

All auxiliaries for flushing of mechanical seal shall be in Contractor /Vendor`s scope of supply. The seal material shall be compatible with the given pumping medium.

3.2.3.6.1.9 Wearing Rings

Pumps shall be provided with replaceable type wearing rings. The ring shall be so fitted as to prevent turning. Tack welding is not acceptable.

3.2.3.6.1.10 Base plate

Base plate shall extend under the pump and driver and shall be fully machined for mounting the pump and the motor. Base plate shall be steel fabricated and shall have sufficient rigidity to avoid vibration and distortion. Base plate shall be so designed as to facilitate proper grouting (Vent holes where required shall be provided). The baseplate shall be drain rim or pan type.

Base plate shall be cleaned (sand blasted) inside and outside and coated with suitable anticorrosion paint.

The base plate shall be provided with lifting lugs. Lifting the base plate complete with all equipment mounted shall not permanently distort or otherwise damage the base plate or machinery mounted on it.

3.2.3.6.1.11 Lifting Lugs, Eye Bolts

Clamps, lifting lugs and eye bolts shall be provided for ease of lifting of complete pump as well as the heavy maintenance components of the pump and the motors.

3.2.3.6.1.12 Accessories Required

Each pump set shall be supplied with the required number of foundation bolts, nuts, lock nuts, lock washers, shim plates, etc.

3.2.3.6.2 Electric Motor

Each pump shall be driven electric motor through flexible coupling/ direct coupled. The motor shall be totally enclosed fan cooled (TEFC) weather proof squirrel cage induction motor to the specification as laid down in “Technical Specification for electrical motor”. The motors shall be of approved make as per the list in the tender. Electric motors shall be suitable to operate on A.C. Supply 415 volts 3 phase. Motor shall be suitable in all respects for specified fan duty, outdoor moist and general corrosive environment. The motor rating shall be at least 115% of pump power requirement at design conditions.

3.2.3.6.3 Instruments (As per respective Technical Specification of Instrument)

One temperature element shall be provided for the thrust bearings, if required. One RTD shall be embedded in each bearing for monitoring the bearing temperature for motors as specified in the motor specifications. For thrust bearings, local oil level gauge for the oil reservoir shall be provided, if required. Motors shall be provided with minimum of 2 RTDs per phase suitably distributed in the winding and terminated in a separate terminal box as specified in the motor specifications. Instrument for lubrication and bearing/ gland cooling flow monitoring should be provided, if required. Vibration switches shall be provided. Reverse rotation switch shall be provided.

3.2.3.6.4 DRIVE MOTORS

Motors rating excluding service factors shall be as per the specification given below. The motors driving the pumps shall be designed to suit the site condition. The drive motors shall be selected to suit the operating conditions as described below in this specification and data sheets.

3.2.3.6.4.1 Selection of Motors

The maximum requirement of the following shall be selected for deciding the motor rating.

- a) Shut off power consumption at 50 Hz power frequency but limited to the value arrived in (b) below.
- b) Of the duty point at 50 Hz.

Pump BKW	Motor rating in kW
< 25 BKW	125% of rated pump BKW
25 BKW to 55 BKW	115% of rated pump BKW
> 55 BKW	110% of rated pump BKW

- The maximum power requirement in operating zone (80-120% of rated) at 50.5 Hz power supply frequency.
- Power drawn by the pump motor when one or more of the operating pumps in parallel are tripped with only one pump in operation.

The Contractor /Vendor shall submit the HQ curves superimposed on the system resistance curve, during the detailed design. He shall also submit the motor selection criteria in the tabular form indicating power requirement under above operating conditions at 50 Hz and 51.5 Hz power supply frequency.

In case the shut off power is more than the motor rating, pump will be operated at discharge valve crack open condition. Contractor/Vendor shall indicate the amount of valve opening in this case. The additional torque required to overcome the reverse flow due to valve crack opening with other pumps operating, shall be considered in motor sizing.

3.2.3.7 MATERIAL OF CONSTRUCTION

The material for the various parts of all the pumps shall conform to the specifications or equivalent indicated in the data sheets.

All materials shall be compatible with operating conditions and process fluid as specified herein. Compatible materials shall be used for other components with prior approval of Purchaser. Cast Iron, unless otherwise specified, shall not be used.

All materials used for the fabrication of the pump components shall be of tested quality. Physical and chemical test certificates for the materials of various components shall be furnished, for Purchaser's approval. In case the relevant correlating test certificates are not available, the Contractor /Vendor shall arrange to carry out the necessary tests required by the code at his own cost. As a minimum the components of the pumps shall be subjected to following tests and the test certificates furnished to the Purchaser accordingly:

- 1) Shaft, Impeller, casing : Chemical analysis and physical test.
- 2) Wearing rings sleeves : Chemical analysis, Physical and hardness.
- 3) In addition, tests specified in succeeding clauses shall also be conducted

Summary for material of construction for various items for all primary cooling loops pumps

Table 7: MATERIAL FOR ALL PRIMARY COOLING LOOPS PUMPS

Sr. No.	Items	Grade
1.	Casing	ASTM A 351 Gr.CF8M
2.	Casing bearing rings	ASTM A 351 Gr.CF8M
3.	Impeller	ASTM A 351 Gr.CF8M
4.	Impeller wearing rings	ASTM A 351 Gr.CF8M
5.	Shaft	AISI 410

6.	Shaft sleeves	ASTM A 351 CF3M
7.	Companion flanges	ASTM A 182, F 304L
8.	Base plate	Carbon steel
9.	Shaft coupling	Carbon steel
10.	Stuffing box	ASTM A 351 CF 3M
11.	Fasteners nuts/bolts	SS316

Summary for material of construction for various items for secondary and tertiary cooling loops pumps

Table 8: MATERIAL FOR SECONDARY COOLING LOOPS PUMPS

Sr. No.	Items	Grade
1.	Casing	ASTM A 216 GR WCB
2.	Casing bearing rings	ASTM A 351 Gr.CF3M
3.	Impeller	ASTM A 351 Gr.CF8M
4.	Impeller wearing rings	ASTM A 351 Gr.CF3M
5.	Shaft	AISI 410
6.	Shaft sleeves	ASTM A 351 CF3M
7.	Companion flanges	ASTM A 515 Gr. 60
8.	Base plate	Carbon steel
9.	Shaft coupling	Carbon steel
10.	Stuffing box	ASTM A216 Gr. WCB
11.	Fasteners nuts/bolts	ASTM A193 Gr B7/ ASTM A194 Gr 2H

3.2.3.8 SPARES AND SPECIAL TOOLS

The contractor shall include in the scope necessary spares and tools & tackles required for the commissioning and testing of the equipment.

3.2.3.9 QUALITY ASSURANCE, INSPECTION AND TESTING

3.2.3.9.1 INSPECTION AND TESTING AT MANUFACTURER WORKS

Contractor shall submit QA plan for approval of IPR. Quality surveillance by the purchaser will be carried out at the contractor's works.

The contractor shall ensure his in-house inspection to establish and maintain the quality of workmanship in his and his sub-contractors works to ensure the mechanical accuracy of components compliance with drawings, identify and acceptability of all material, part and equipment. He shall conduct all tests required to ensure that the equipment and the material furnished conform to the requirement of applicable codes.

All tests and tests procedure posed by the manufacturer shall be submitted to the purchaser for his prior approval. Purchaser shall be notified well in advance of the fabrication and major shop tests of the equipment for the purpose of making general inspection and for making progress report. The purchaser's representative shall be given full access to the shop in which equipment is being manufactured or tested. All test records shall be made available to him. A final inspection will be made by the purchaser's representative before the dispatch of the equipment. All the instruments used for conducting the specified shop tests shall be calibrated and calibration certificates shall be furnished from a recognized institution. The calibration shall have been carried out not more than six months prior to the testing date. Final routine and performance tests for the complete units shall be carried out in presence of the purchaser's representative.

3.2.3.9.1.1 Castings

Casting shall be sound clean and free from porosity, blowholes, hot spots, cold shut distortion and other harmful casting defects. No repairs shall be carried out without intimation to and approval of the purchaser. No welding on C.I. parts will be permitted. Casting material shall be as per Indian standard and shall be free from flaws and shall be DP tested. Testing shall be carried out after machining.

3.2.3.9.1.1.1 Dye Penetrant test

The entire surface of the impeller castings (approachable area only) shall be subjected to dye penetrant test as per ASTM Specification E-165. Non-machined surface shall be ground before dye penetrant test. For other castings only, machined surfaces shall be tested by dye penetrant test. Acceptance criteria shall be as per ASME Sec VIII.

3.2.3.9.1.1.2 Material test

The physical and chemical tests as per relevant material codes and same shall be furnished during pre-dispatch inspection.

3.2.3.9.1.2 Shafts and Forgings

Shafts: In addition to the physical and chemical tests as per relevant material codes, shafts of 50 mm dia. and above shall be ultrasonically tested in radial direction. Surface of the shaft shall be examined by dye penetrant test to detect surface defects.

Forgings: In addition to physical, Visual and chemical tests as per relevant material standards, all ferromagnetic forgings shall be subject to magnetic particle testing at the areas of fillet and change of section. The testing is to be carried out after the machining operation. The acceptance standard shall be as per ASME Boiler and pressure vessels code-Section VIII Div. 1 Appendix VI. All forgings shall be demagnetized after carrying out the test. Any defect that will not machine out during the final machining will be gauged out, fully inspected by dye penetrant and / or magnetic particles inspection to ensure that the defect is fully removed and repaired using an approved repair procedure. Any indications which prove to penetrate deeper than 2½ % of the finished thickness of the forging shall be reported to the Purchaser giving location, length width and depth of such defect. Any other examinations like Ultrasonic or radiographic examination, if specified in the manufacturer's Manufacturing Inspection Plan (MIP) shall be carried out at factory and test reports has been submitted to the purchaser before final acceptance at factory.

3.2.3.9.1.3 Weldments

All welding shall be performed in accordance with the ASME code for boiler and pressure vessels. The contractor shall have all welding procedure, welding Equipment and operators qualified in accordance with ASME boiler and pressure vessel code, Sec IX (on welding qualifications) prior to commencing and welding on the works. Filler metal welding electrodes to E-60 series to AWS-STM Specification shall be used for welding. The electrodes shall be dried before use to avoid porosity. All welding shall be done by qualified welders only. All the root passes and final passes of the weldments shall be examined by D.P. test in accordance with ASTM Specification E-165. Dye Penetrant examination shall be carried out according to the method outlined in ASME for boiler and pressure vessels Section VIII Div. I

Any procedure for the repair of the defect in the weldments and all other materials shall be submitted to the purchaser for his approval prior to any repair being done.

The root and final passes of all welded joints shall be DP tested according to ASME.

3.2.3.9.1.4 Visual Inspection

All pumps shall be visually inspected before shipment. Pumps shall not be painted before inspection. Pumps shall be assembled with their spares and shown to be interchangeable. Pumps under each category shall be identical in all respects. After inspection, test certificates shall be furnished.

3.2.3.9.1.5 VARIOUS TESTS AT SHOP

3.2.3.9.1.5.1 Shop Tests:

Shop tests for one pump of each type and every model shall be carried in the presence of purchase's representative to show the intended design parameters as per design code.

3.2.3.9.1.5.2 Hydrostatic Tests:

Hydrostatic test shall be conducted for pressure containing parts at 1.5 times the design pressure and the duration of the test shall not be less than 30 minutes. Auxiliary piping, if applicable shall be hydrostatically tested. The minimum test pressure shall be 1.5 times the design pressure.

3.2.3.9.1.5.3 Performance Test

Performance test shall be conducted at rated speed with water and job motor to ascertain head, power, and efficiency against capacity. Speed variation shall not exceed $\pm 3\%$ of rated speed given on the approved drawing. At least six points on the characteristic curve including shut off, minimum continuous stable flow, midway between minimum continuous stable flow and rated flow, rated point, 120% of rated flow and run out flow shall be plotted. Performance figures at test speed shall be converted to those at rated speed. Permissible/ Acceptable tolerances on rated performance parameters for the test shall be as per the data sheet. Vibration for all pumps measured on the bearing housing during the performance test at rated speed and minimum continuous stable flow and rated flow shall be as per the ISO 10816-3. Prior to testing, Impeller position shall also be recorded. The results of the testing shall be approved by the Purchaser. The rotor assembly including impeller, shaft etc. shall be statically and dynamically balanced by the Contractor /Vendor prior to assembly. The noise level produced by the rotating equipment and vibration level shall not exceed that specified in the Data Sheets. Motors shall be tested in accordance with governing specification. Job-pump-coupling-motor assembly mounted on job base plate shall be continuously run at the rated point atleast for four hours. Bearing oil/grease temperature rise and vibration shall be measured and these shall be within the specified limits. At least one pump of each type and model shall be tested for NPSH required over the entire range from minimum stable flow to run out flow.

3.2.3.9.1.6 INSPECTION AND TESTING AT SITE

The contractor shall ensure the inspection, testing and commissioning at site as per manufacturer's manual and guidelines

3.2.3.10 PROTECTION DURING SHIPPING AND STORAGE

- a. All steel and cast-iron surfaces shall be thoroughly cleaned to remove mill scales, rust etc. by wire brushing or grit blasting as required. All carbon steel exterior surface shall be thoroughly cleaned to remove mil scales, rust, grease etc. by wire brushing or sand blasting, as required and then painted.
- b. The Purchaser will require inspection before the items are dispatched. However, the Contractor/Vendor shall be entirely responsible for ensuring that the packing is suitable for the mode of shipment and such inspection will not exonerate the Contractor/Vendor from any loss or damage due to faulty packing.
- c. All equipment comprising multi part assemblies, e.g. steel frameworks, piping, etc., shall be marked with identifying numbers and/or letters corresponding to those of the approved drawings or material lists. These erection marks shall be clearly readable. Colour banding to an approved code shall be employed to identify members of similar shape or type but of different strengths or grades.

3.2.3.11 ERECTION AND INSTALLATION

The contractor shall ensure that the pump sets shall be erected at site as per the manufacturer's guidelines. Special care should be taken during unloading at site, transfer from storage area to plant room with special handling arrangement and cranes shall be carried out by the contractor. Contractor shall ensure that no damage during transit. If there is any damage happen during transit, immediately the same should bring notice to the purchase. He should provide detailed installation drawings and follow the plant layout drawing attached herewith the tender.

3.2.3.12 INSPECTION, TESTING AND COMMISSIONING

The methodology of testing and commissioning shall be intimated with full procedures, checklists, sequence and any temporary arrangements, needed, list of related agencies involved, and to be intimated, etc. to the purchaser sufficiently in advance (minimum two weeks) for his approval. All measurements, observations shall be taken in the presence of purchaser's representative and shall be certified by the purchaser after his full satisfaction for meeting deigned conditions.

3.2.3.13 PERFORMANCE GUARANTEE

The contractor shall guarantee that upon satisfactorily commissioning and acceptance of the plant by the purchaser, all portions thereof will be in accordance with requirement of this contract and will be perfect as to design, materials, workmanship etc. for minimum period of one year from the date

of commissioning and acceptance of the plant. Further the contractor shall guarantee that during the guarantee period he will repair defective Equipment and work and replace defective materials furnished or installed under this contract free of cost to the purchaser. The guarantee of the equipment shall be extended further to consider such repair and replacement period. If the performance test results deviate from the guaranteed values, the Contractor/vendor shall try to correct the deficiencies and if he fails, the Contractor/vendor shall replace the equipment with one that meets the guaranteed value at no extra cost to the purchaser.

Contractor /Vendor shall specifically guarantee

- a) Capacity at rated head with +2.5% & no negative tolerance
- b) Shut off head as specified
- c) NPSHR @ rated capacity with zero negative tolerance
- d) Pump efficiency with no negative tolerance
- e) Power consumption with max +3% tolerance
- f) Vibration and noise limit as specified

If the performance test results deviate from the guaranteed values, the Contractor/vendor shall try to correct the deficiencies and if he fails, the Contractor/vendor shall replace the equipment with one that meets the guaranteed value at no extra cost to the purchaser.

3.2.3.14 ANNEXURE-3: TECHNICAL DATASHEET

Annexure 3: Centrifugal pumps (ICECRH-Loop)

(Data to be furnished by the bidders)

Sr. No.	Parameters	IPR Requirements	Details to be filled by Vendor
1	System	ICECRH-LOOP	
2	Type of pump	BPO	
3	Make	As per approved list	
4	Model	As per manufacturer	
5	Rated capacity, kg/s	120	
6	Differential head at rated, mwc, minimum	90	
7	Pump efficiency	≥70	
8	Design pressure, Kg/cm ²	12	
9	Design temperature, °C	80	
10	Duty	Continuous	
11	NPSH A, m	Flooded	
12	No of pumps required	2 (1W+1S)	
13	Motor rating required minimum	150 kW, 3 phase	
14	Series/parallel	Parallel	
15	Design std.	IS 5199	
16	Design ambient temp. max./min.	45/10	
17	Pump shut-off head (max.)	As per specification	
18	Maximum driver speed (synchronous), RPM	1500	
19	H-Q Curve characteristic requirement	Continuously Rising stable characteristics	

		towards shut off throughout the Range of Operation	
20	Liquid handled	DM	
21	Orientation	Side Suction Top Discharge	
22	Type of pump	Centrifugal pump, enclosed impeller, single stage, designed for reverse rotation, flexible coupling for pump-motor coupling, shaft sealing mechanical type arrangement	
23	Suction/discharge pipe size	As per P&ID	
24	Casing	ASTM A 351 Gr.CF8M	
26	Impeller	ASTM A 351 CF8M	
27	Shaft	AISI 410	
28	Companion Flange	ASTM A 182, F 304L	
29	Base Plate	Carbon steel	
30	Shaft Coupling	Carbon Steel	
31	Drive motor type	Induction – Horizontal mounted	
32	Requirement of VFD	Yes	
33	DP test req. for	Shaft, shaft sleeves, casing, impeller, weld joints and other mechanical parts	
34	Testing standard	ASTM E165	
35	Acceptance standard	ASME SEC. VIII	
36	Hydrostatic test - Parts to be tested (100%)	Pressure containing parts	
37	Hydrostatic test pressure, kg/cm ² (g)	1.5 times the design pressure	

38	Static & Dynamic Balancing (100%)	Impeller with Shaft as per std. ISO 1940 gr. 6.3	
39	Shop Performance tests (100%)	All the pumps shall be tested between 0-120 % of rated capacity for Head (h) vs Capacity (Q), Power (P) vs Capacity (Q), Efficiency (η) vs Capacity (Q). As specified in specification.	
40	Noise level (1m surround)	85 dBA or less	
41	Vibration level	As per ISO 10816-3	

3.2.3.15 ANNEXURE-4: TECHNICAL DATASHEET

Annexure 4: Centrifugal pumps (DNBLP-Loop)

(Data to be furnished by the bidders)

Sr. No.	Parameters	IPR Requirements	Details to be filled by Vendor
1	System	DNBLP- LOOP	
2	Type	HSC / in-line vertical	
3	Make	As per approved list	
4	Model	As per manufacturer	
5	Rated capacity, kg/s	66	
6	Differential head at rated, mwc, minimum	150	
7	Pump efficiency	≥ 70	
8	Design pressure, Kg/cm ²	18	
9	Design temperature, °C	80	
10	Duty	Continuous	
11	NPSH A, m	Flooded	
12	No of pumps required	2 (1W+1S)	
13	Motor rating required minimum	200kW, 3 phase	
14	Series/parallel	Parallel	
15	Design std.	IS5199	
16	Design ambient temp. max./min.	45/10	
17	Pump shut-off head (max.)	As per specification	
18	Maximum driver speed (synchronous), RPM	1500	

19	H-Q Curve characteristic requirement	Continuously Rising stable characteristics towards shut off throughout the Range of Operation	
20	Liquid handled	DM	
21	Orientation	Side Suction Top Discharge	
22	Type of pump	Horizontal/ in-line vertical centrifugal pump, enclosed impeller, single stage, designed for reverse rotation, flexible coupling for pump-motor coupling, shaft sealing mechanical type arrangement	
23	Suction/discharge pipe size	As per P&ID	
24	Casing	ASTM A 351 Gr.CF8M	
26	Impeller	ASTM A 351 CF8M	
27	Shaft	AISI 410	
28	Companion Flange	ASTM A 182, F 304L	
29	Base Plate	Carbon steel	
30	Shaft Coupling	Carbon Steel	
31	Drive motor type	Induction – Horizontal mounted	
32	Requirement of VFD	Yes	
33	DP test req. for	Shaft, shaft sleeves, casing, impeller, weld joints and other mechanical parts	
34	Testing standard	ASTM E165	
35	Acceptance standard	ASME SEC. VIII	

36	Hydrostatic test - Parts to be tested (100%)	Pressure containing parts	
37	Hydrostatic test pressure, kg/cm ² (g)	1.5 times the design pressure	
38	Static & Dynamic Balancing (100%)	Impeller with Shaft as per std. ISO 1940 gr. 6.3	
39	Shop Performance tests (100%)	All the pumps shall be tested between 0-120% of rated capacity for Head (h) vs Capacity (Q), Power (P) vs Capacity (Q), Efficiency (η) vs Capacity (Q). As specified in specification.	
40	Noise level	85 dBA or less	
41	Vibration level	As per ISO 10816-3	

3.2.3.16 ANNEXURE-5: TECHNICAL DATASHEET

Annexure 5: Centrifugal pumps (DNBHP-Loop)

(Data to be furnished by the bidders)

Sr. No.	Parameters	IPR Requirements	Details to be filled by Vendor
1	System	DNBHP- LOOP	
2	Type	HSC / in-line vertical	
3	Make	As per approved list	
4	Model	As per manufacturer	
5	Rated capacity, kg/s	31	
6	Differential head at rated, mwc, minimum	240	
7	Pump efficiency	≥ 70	
8	Design pressure, Kg/cm ²	30	
9	Design temperature, °C	80	
10	Duty	Continuous	
11	NPSH A, m	Flooded	
12	No of pumps required	2 (1W+1S)	
13	Motor rating required minimum	125kW, 3 phase	
14	Series/parallel	Parallel	
15	Design std.	IS5199	
16	Design ambient temp. max./min.	45/10	
17	Pump shut-off head (max.)	As per specification	
18	Maximum driver speed (synchronous), RPM	1500	
19	H-Q Curve characteristic requirement	Continuously Rising stable characteristics	

		towards shut off throughout the Range of Operation	
20	Liquid handled	DM	
21	Orientation	Side Suction Top Discharge	
22	Type of pump	Horizontal/in-line Vertical centrifugal pump, enclosed impeller, single stage, designed for reverse rotation, flexible coupling for pump-motor coupling, shaft sealing mechanical type arrangement	
23	Suction/discharge pipe size	As per P&ID	
24	Casing	ASTM A 351 Gr.CF8M	
26	Impeller	ASTM A 351 CF8M	
27	Shaft	AISI 410	
28	Companion Flange	ASTM A 182, F 304L	
29	Base Plate	Carbon steel	
30	Shaft Coupling	Carbon Steel	
31	Drive motor type	Induction – Horizontal mounted	
32	Requirement of VFD	Yes	
33	DP test req. for	Shaft, shaft sleeves, casing, impeller, weld joints and other mechanical parts	
34	Testing standard	ASTM E165	
35	Acceptance standard	ASME SEC. VIII	
36	Hydrostatic test - Parts to be tested (100%)	Pressure containing parts	

37	Hydrostatic test pressure, kg/cm ² (g)	1.5 times the design pressure	
38	Static & Dynamic Balancing (100%)	Impeller with Shaft as per std. ISO 1940 gr. 6.3	
39	Shop Performance tests (100%)	All the pumps shall be tested between 0-120% of rated capacity for Head (h) vs Capacity (Q), Power (P) vs Capacity (Q), Efficiency (η) vs Capacity (Q). As specified in specification.	
40	Noise level	85 dBA or less	
41	Vibration level	As per ISO 10816-3	

3.2.3.17 ANNEXURE-6: TECHNICAL DATASHEET

Annexure 6: Centrifugal pumps (DNBCH-Loop)

(Data to be furnished by the bidders)

Sr. No.	Parameters	IPR Requirements	Details to be filled by Vendor
1	System	DNBCH- LOOP	
2	Type	BPO	
3	Make	As per approved list	
4	Model	As per manufacturer	
5	Rated capacity, kg/s	10	
6	Differential head at rated, mwc, minimum	70	
7	Pump efficiency	≥ 70	
8	Design pressure, Kg/cm ²	12	
9	Design temperature, °C	60	
10	Duty	Continuous	
11	NPSH A, m	Flooded	
12	No of pumps required	2 (1W+1S)	
13	Motor rating required minimum	22kW, 3 phase	
14	Series/parallel	Parallel	
15	Design std.	IS5199	
16	Design ambient temp. max./min.	45/10	
17	Pump shut-off head (max.)	As per specification	
18	Maximum driver speed (synchronous), RPM	2900	
19	H-Q Curve characteristic requirement	Continuously Rising stable characteristics	

		towards shut off throughout the Range of Operation	
20	Liquid handled	DM	
21	Orientation	Side Suction Top Discharge	
22	Type of pump	Centrifugal pump, enclosed impeller, single stage, designed for reverse rotation, flexible coupling for pump-motor coupling, shaft sealing mechanical type arrangement	
23	Suction/discharge pipe size	As per P&ID	
24	Casing	ASTM A 351 Gr.CF8M	
26	Impeller	ASTM A 351 CF8M	
27	Shaft	AISI 410	
28	Companion Flange	ASTM A 182, F 304L	
29	Base Plate	Carbon steel	
30	Shaft Coupling	Carbon Steel	
31	Drive motor type	Induction – Horizontal mounted	
32	Requirement of VFD	Yes	
33	DP test req. for	Shaft, shaft sleeves, casing, impeller, weld joints and other mechanical parts	
34	Testing standard	ASTM E165	
35	Acceptance standard	ASME SEC. VIII	
36	Hydrostatic test - Parts to be tested (100%)	Pressure containing parts	
37	Hydrostatic test pressure, kg/cm ² (g)	1.5 times the design pressure	

38	Static & Dynamic Balancing (100%)	Impeller with Shaft as per std. ISO 1940 gr. 6.3	
39	Shop Performance tests (100%)	All the pumps shall be tested between 0-120% of rated capacity for Head (h) vs Capacity (Q), Power (P) vs Capacity (Q), Efficiency (η) vs Capacity (Q). As specified in specification.	
40	Noise level	85 dBA or less	
41	Vibration level	As per ISO 10816-3	

3.2.3.18 ANNEXURE-7: TECHNICAL DATASHEET

Annexure 7: Centrifugal pumps (IPRCH-Loop)

(Data to be furnished by the bidders)

Sr. No.	Parameters	IPR Requirements	Details to be filled by Vendor
1	System	IPRCH- LOOP	
2	Type	BPO	
3	Make	As per approved list	
4	Model	As per manufacturer	
5	Rated capacity, kg/s	25	
6	Differential head at rated, mwc, minimum	70	
7	Pump efficiency	≥70	
8	Design pressure, Kg/cm ²	10	
9	Design temperature, °C	60	
10	Duty	Continuous	
11	NPSH A, m	Flooded	
12	No of pumps required	2 (1W+1S)	
13	Motor rating required minimum	30kW, 3 phase	
14	Series/parallel	Parallel	
15	Design std.	IS5199	
16	Design ambient temp. max./min.	45/10	
17	Pump shut-off head (max.)	As per specification	
18	Maximum driver speed (synchronous), RPM	2900	

19	H-Q Curve characteristic requirement	Continuously Rising stable characteristics towards shut off throughout the Range of Operation	
20	Liquid handled	DM	
21	Orientation	Side Suction Top Discharge	
22	Type of pump	Centrifugal pump, enclosed impeller, single stage, designed for reverse rotation, flexible coupling for pump-motor coupling, shaft sealing mechanical type arrangement	
23	Suction/discharge pipe size	As per P&ID	
24	Casing	ASTM A 351 Gr.CF8M	
26	Impeller	ASTM A 351 CF8M	
27	Shaft	AISI 410	
28	Companion Flange	ASTM A 182, F 304L	
29	Base Plate	Carbon steel	
30	Shaft Coupling	Carbon Steel	
31	Drive motor type	Induction – Horizontal mounted	
32	Requirement of VFD	Yes	
33	DP test req. for	Shaft, shaft sleeves, casing, impeller, weld joints and other mechanical parts	
34	Testing standard	ASTM E165	
35	Acceptance standard	ASME SEC. VIII	
36	Hydrostatic test - Parts to be tested (100%)	Pressure containing parts	

37	Hydrostatic test pressure, kg/cm ² (g)	1.5 times the design pressure	
38	Static & Dynamic Balancing (100%)	Impeller with Shaft as per std. ISO 1940 gr. 6.3	
39	Shop Performance tests (100%)	All the pumps shall be tested between 0-120 % of rated capacity for Head (h) vs Capacity (Q), Power (P) vs Capacity (Q), Efficiency (η) vs Capacity (Q). As specified in specification.	
40	Noise level	85 dBA or less	
41	Vibration level	As per ISO 10816-3	

3.2.3.19 ANNEXURE-8: TECHNICAL DATASHEET

Annexure 8: Centrifugal pumps (Chillers Loop)

(Data to be furnished by the bidders)

Sr. No.	Parameters	IPR Requirements	Details to be filled by Vendor
1	System	CHILLERS PUMP	
2	Type	BPO	
3	Make	As per approved list	
4	Model	As per manufacturer	
5	Rated capacity, kg/s	52	
6	Differential head at rated, mwc, minimum	40	
7	Pump efficiency	≥70	
8	Design pressure, Kg/cm ²	8	
9	Design temperature, °C	5	
10	Duty	Continuous	
11	NPSH A, m	Flooded	
12	No of pumps required	2 (1W+1S)	
13	Motor rating required minimum	45kW, 3 phase	
14	Series/parallel	Parallel	
15	Design std.	IS5199	
16	Design ambient temp. max./min.	45/10	
17	Pump shut-off head (max.)	As per specification	
18	Maximum driver speed (synchronous), RPM	2900	

19	H-Q Curve characteristic requirement	Continuously Rising stable characteristics towards shut off throughout the Range of Operation	
20	Liquid handled	Soft water	
21	Orientation	Side Suction Top Discharge	
22	Type of pump	Centrifugal pump, enclosed impeller, single stage, designed for reverse rotation, flexible coupling for pump-motor coupling, shaft sealing mechanical type arrangement	
23	Suction/discharge pipe size	As per P&ID	
24	Casing	ASTM A 216 GR WCB	
26	Impeller	ASTM A 351 CF3M	
27	Shaft	AISI 410	
28	Companion Flange	ASTM A 515 Gr. 60	
29	Base Plate	Carbon steel	
30	Shaft Coupling	Carbon Steel	
31	Drive motor type	Induction – Horizontal mounted	
32	Requirement of VFD	No	
33	DP test req. for	Shaft, shaft sleeves, casing, impeller, weld joints and other mechanical parts	
34	Testing standard	ASTM E165	
35	Acceptance standard	ASME SEC. VIII	
36	Hydrostatic test - Parts to be tested (100%)	Pressure containing parts	

37	Hydrostatic test pressure, kg/cm ² (g)	1.5 times the design pressure	
38	Static & Dynamic Balancing (100%)	Impeller with Shaft as per std. ISO 1940 gr. 6.3	
39	Shop Performance tests (100%)	All the pumps shall be tested between 0-120 % of rated capacity for Head (h) vs Capacity (Q), Power (P) vs Capacity (Q), Efficiency (η) vs Capacity (Q). As specified in specification.	
40	Noise level	85 dBA or less	
41	Vibration level	As per ISO 10816-3	

3.2.3.20 ANNEXURE-9: TECHNICAL DATASHEET

Annexure 9: Centrifugal pumps (Cooling Tower-Pumps)

(Data to be furnished by the bidders)

Sr. No.	Parameters	IPR Requirements	Details to be filled by Vendor
1	System	CT-PUMPS	
2	Type	BPO	
3	Make	As per approved list	
4	Model	As per manufacturer	
5	Rated capacity, kg/s	94	
6	Differential head at rated, mwc, minimum	40	
7	Pump efficiency	≥70	
8	Design pressure, Kg/cm ²	8	
9	Design temperature, °C	60	
10	Duty	Continuous	
11	NPSH A, m	Flooded	
12	No of pumps required	4 (3W+1S)	
13	Motor rating required minimum	75kW, 3 phase	
14	Series/parallel	Parallel	
15	Design std.	IS5199	
16	Design ambient temp. max./min.	45/10	
17	Pump shut-off head (max.)	As per specification	
18	Maximum driver speed (synchronous), RPM	2900	
19	H-Q Curve characteristic requirement	Continuously Rising stable characteristics	

		towards shut off throughout the Range of Operation	
20	Liquid handled	Soft water	
21	Orientation	Side Suction Top Discharge	
22	Type of pump	Centrifugal pump, enclosed impeller, single stage, designed for reverse rotation, flexible coupling for pump-motor coupling, shaft sealing mechanical type arrangement	
23	Suction/discharge pipe size	As per P&ID	
24	Casing	ASTM A 216 GR WCB	
26	Impeller	ASTM A 351 CF3M	
27	Shaft	AISI 410	
28	Companion Flange	ASTM A 515 Gr. 60	
29	Base Plate	Carbon steel	
30	Shaft Coupling	Carbon Steel	
31	Drive motor type	Induction – Horizontal mounted	
32	Requirement of VFD	No	
33	DP test req. for	Shaft, shaft sleeves, casing, impeller, weld joints and other mechanical parts	
34	Testing standard	ASTM E165	
35	Acceptance standard	ASME SEC. VIII	
36	Hydrostatic test - Parts to be tested (100%)	Pressure containing parts	
37	Hydrostatic test pressure, kg/cm ² (g)	1.5 times the design pressure	

38	Static & Dynamic Balancing (100%)	Impeller with Shaft as per std. ISO 1940 gr. 6.3	
39	Shop Performance tests (100%)	All the pumps shall be tested between 0-120 % of rated capacity for Head (h) vs Capacity (Q), Power (P) vs Capacity (Q), Efficiency (η) vs Capacity (Q). As specified in specification.	
40	Noise level	85 dBA or less	
41	Vibration level	As per ISO 10816-3	

3.2.3.21 ANNEXURE-10: TECHNICAL DATASHEET

Annexure 10: Centrifugal pumps (Condenser-Pumps)

(Data to be furnished by the bidders)

Sr. No.	Parameters	IPR Requirements	Details to be filled by Vendor
1	System	CONDENSER-PUMPS	
2	Type	BPO	
3	Make	As per approved list	
4	Model	As per manufacturer	
5	Rated capacity, kg/s	56	
6	Differential head at rated, mwc, minimum	40	
7	Pump efficiency	≥70	
8	Design pressure, Kg/cm ²	8	
9	Design temperature, °C	60	
10	Duty	Continuous	
11	NPSH A, m	Flooded	
12	No of pumps required	2 (1W+1S)	
13	Motor rating required minimum	37kW, 3 phase	
14	Series/parallel	Parallel	
15	Design std.	IS5199	
16	Design ambient temp. max./min.	45/10	
17	Pump shut-off head (max.)	As per specification	
18	Maximum driver speed (synchronous), RPM	2900	
19	H-Q Curve characteristic requirement	Continuously Rising stable characteristics	

		towards shut off throughout the Range of Operation	
20	Liquid handled	Soft water	
21	Orientation	Side Suction Top Discharge	
22	Type of pump	Centrifugal pump, enclosed impeller, single stage, designed for reverse rotation, flexible coupling for pump-motor coupling, shaft sealing mechanical type arrangement	
23	Suction/discharge pipe size	As per P&ID	
24	Casing	ASTM A 216 GR WCB	
26	Impeller	ASTM A 351 CF3M	
27	Shaft	AISI 410	
28	Companion Flange	ASTM A 515 Gr. 60	
29	Base Plate	Carbon steel	
30	Shaft Coupling	Carbon Steel	
31	Drive motor type	Induction – Horizontal mounted	
32	Requirement of VFD	No	
33	DP test req. for	Shaft, shaft sleeves, casing, impeller, weld joints and other mechanical parts	
34	Testing standard	ASTM E165	
35	Acceptance standard	ASME SEC. VIII	
36	Hydrostatic test - Parts to be tested (100%)	Pressure containing parts	
37	Hydrostatic test pressure, kg/cm ² (g)	1.5 times the design pressure	

38	Static & Dynamic Balancing (100%)	Impeller with Shaft as per std. ISO 1940 gr. 6.3	
39	Shop Performance tests (100%)	All the pumps shall be tested between 0-120 % of rated capacity for Head (h) vs Capacity (Q), Power (P) vs Capacity (Q), Efficiency (η) vs Capacity (Q). As specified in specification.	
40	Noise level	85 dBA or less	
41	Vibration level	As per ISO 10816-3	

3.2.3.22 ANNEXURE-11: TECHNICAL DATASHEET

Annexure 11: Centrifugal pumps (Drain Pumps)

(Data to be furnished by the bidders)

Sr. No.	Parameters	IPR Requirements	Details to be filled by Vendor
1	System	DRAIN PUMPS	
2	Type	Monoblock	
3	Make	As per approved list	
4	Model	As per manufacturer	
5	Rated capacity, kg/s	2	
6	Differential head at rated, mwc	15	
7	Pump efficiency	≥70	
8	Design pressure, Kg/cm ²	2	
9	Design temperature, °C	60	
10	Duty	Intermittent	
11	No of pumps required	2 (1W+1S)	
12	Motor rating required minimum	2HP, single phase	
13	Series/parallel	Parallel	
14	Design std.	IS5199	
15	Design ambient temp. max./min.	45/10	
16	Pump shut-off head (max.)	As per specification	
17	Maximum driver speed (synchronous), RPM	2900	
18	Liquid handled	Soft water	

19	Orientation	Side Suction Top Discharge	
20	Type of pump	Centrifugal pump, enclosed impeller, single stage	
21	Casing	ASTM A 216 GR WCB	
22	Impeller	Gunmetal/Bronze	
23	Shaft	AISI 410	
24	Base Plate	Carbon steel	
25	Shaft Coupling	Carbon Steel	
26	Drive motor type	Induction – Horizontal mounted	
27	Noise level	85 dBA or less	
28	Vibration level	As per ISO 10816-3	

3.2.4 PLATE TYPE HEAT EXCHANGER (PHE)

3.2.4.1 Scope

This specification covers the minimum technical requirement of design, manufacture, inspection, testing, and guarantees of Plate Type Heat Exchanger (PHE) complete with accessories and auxiliaries as specified herein. It is not the intent to completely specify all details of design and construction of these PHEs; nevertheless, the equipment shall conform to high standards of engineering, design and workmanship in all respects.

The Contractor/Vendor shall supply the equipment in accordance with this Specification. Compliance to this specification shall not relieve the Contractor/vendor of the responsibility of supplying the equipment and auxiliaries of proper design, material and workmanship to meet the operating requirements specified herein.

The scope of supply for each PHE unit shall include, but not necessarily be limited to the following:

- a. Gasketed/welded heat transfer plate pack.
- b. Movable cover and fixed cover with integral built in nozzles.
- c. Guide rail and carrying bar.
- d. Tie bolts & nuts, Foundation bolts, SS shim plates, Template, etc....
- e. Supporting column and mounting feet.
- f. All necessary spare parts for start-up and commissioning
- g. Mandatory (essential) spares
- h. Painting, packing and preparation for Shipment.

The Contractor/Vendor shall be responsible for the complete design, engineering, testing, packing, loading and proper functioning of the equipment, notwithstanding any omissions in this specification.

The design, material, construction, manufacture, inspection, testing and performance of PHE shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed.

3.2.4.2 LIST OF APPLICABLE CODES AND STANDARDS

The design, material, construction, manufacture, inspection, testing and performance of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these Specifications shall be construed to relieve the Contractor /Vendor of his responsibility.

The equipment supplied should comply with the latest applicable codes and standards as on the date of award of contract and given below:

- a. API 662 - Plate Heat Exchangers for General Refinery Services.
- b. ASME Sec VIII Div.1 – Rules for Construction of Pressure Vessel
- c. ASME Sec. V - Non-Destructive Examination
- d. ASME Sec II – Material Specification
- e. ASTM Standards for Various Tests and Materials
- f. ASME Sec IX - Qualification Standard for Welding and Brazing procedures, Welders, Brazes and Welding and Brazing Operators
- g. ASME B 16.5 - Standard for Steel Pipe Flanges and Flanged Fittings
- a. In case of conflict between specifications, code and standards and data sheet, more stringent requirement will be followed.
- h. HTRI Manual

3.2.4.3 DESIGN DATA AND PERFORMANCE REQUIREMENT

Table 9: ICECRH LOOP

ICECRH LOOP				
Sr. No.	PARAMETERS		PRIMARY SIDE	SECONDARY SIDE
1	Type of PHE		GASKETED	
2	Design pressure, Kg/cm ²		12	
3	Operating temperature range °C		10 to 60	10 to 60
4	Design temperature °C		90	70
5	Design Differential pressure for plates, Kg/cm ²		as per manufacturer standard design	
6	Heat load, MW		9.0	
7	Total liquid mass flow rate, Kg/sec		120	136
8	Fouling factor , m ² × hr × K/ Kcal		0.00001	0.00004
9	Max. allowable pressure drop including nozzles (Kg/cm ²)		0.3	0.3
10	Temperature, °C	Inlet	As per P&ID	
11		Outlet	As per P&ID	
12	Nozzles Flange class		Class 150/ASME B16.5	Class 150/ASME B16.5
13	Type of nozzle flange		RF with serration	RF with serration

Table 10: DNBHP LOOP

DNBHP LOOP			
Sr. No.	PARAMETERS	PRIMARY SIDE	SECONDARY SIDE
1	Type of PHE	WELDED	
2	Design pressure, Kg/cm ²	30	
3	Operating temperature range °C	10 to 60	10 to 60
4	Design temperature °C	90	70
5	Design Differential pressure for plates, Kg/cm ² (g)	as per manufacturer standard design	
6	Heat load, MW	2.0	
7	Total liquid mass flow rate, Kg/sec	31	34
8	Fouling factor , m ² × hr × K/ Kcal	0.00001	0.00004
9	Max. allowable pressure drop including nozzles (Kg/cm ²)	0.1	0.1
10	Temperature, °C	Inlet	As per P&ID
11		Outlet	As per P&ID
12	Nozzles Flange class	Class 150/ASME B16.5	Class 150/ASME B16.5
13	Type of nozzle flange	RF with serration	RF with serration

Table 11 : DNBLP LOOP

DNBLP LOOP			
Sr. No.	PARAMETERS	PRIMARY SIDE	SECONDARY SIDE
1.	Type of PHE	WELDED	
2.	Design pressure, Kg/cm ²	23	
3.	Operating temperature range °C	10 to 60	10 to 60
4.	Design temperature °C	90	70
5.	Design Differential pressure for plates, Kg/cm ²	as per manufacturer standard design	
6.	Heat load, MW	2.0	
7.	Total liquid mass flow rate, Kg/sec @ 31°C	66	66
8.	Fouling factor , m ² × hr × K/ Kcal	0.00001	0.00004

9.	Max. allowable pressure drop including nozzles (Kg/cm ²)	0.1	0.1
10.	Temperature, °C	Inlet	As per P&ID
11.		Outlet	As per P&ID
12.	Nozzles Flange class	Class 150/ASME B16.5	Class 150/ASME B16.5
13.	Type of nozzle flange	RF with serration	RF with serration

Table 12 : DNBCH LOOP

DNBCH LOOP			
Sr. No.	PARAMETERS	PRIMARY SIDE	SECONDARY SIDE
1	TYPE	GASKETED	
2	Design pressure, Kg/cm ² (g)	10	
3	Operating temperature range °C	10 to 60	10 to 60
4	Design temperature °C	90	60
5	Design Differential pressure for plates, Kg/cm ² (g)	as per manufacturer standard design	
6	Heat load, MW	1.0	
7	Total liquid mass flow rate, Kg/sec @ 31°C	10	30
8	Fouling factor , m ² × hr × K/ Kcal	0.00008	0.00008
9	Max. allowable pressure drop including nozzles (Kg/cm ²)	0.1	0.1
10.	Temperature, °C	Inlet	As per P&ID
11.		Outlet	As per P&ID
12.	Nozzles Flange class	Class 150/ASME B16.5	Class 150/ASME B16.5
13.	Type of nozzle flange	RF with serration	RF with serration

Table 13 : IPRCH LOOP

IPRCH LOOP			
Sr. No.	PARAMETERS	PRIMARY SIDE	SECONDARY SIDE
1	TYPE	GASKETED	
2	Design pressure, Kg/cm ² (g)	10	
3	Operating temperature range °C	10 to 60	10 to 60

4	Design temperature °C	90	60
5	Design Differential pressure for plates, Kg/cm2(g)	as per manufacturer standard design	
6	Heat load, MW	1.0	
7	Total liquid mass flow rate, Kg/sec @ 31°C	20	30
8	Fouling factor , m ² × hr × K/ Kcal	0.00008	0.00008
9	Max. allowable pressure drop including nozzles (Kg/cm2)	0.1	0.1
10	Temperature, °C	Inlet	As per P&ID
11		Outlet	As per P&ID
12	Nozzles Flange class	Class 150/ASME B16.5	Class 150/ASME B16.5
13	Type of nozzle flange	RF with serration	RF with serration

3.2.4.4 TECHNICAL REQUIREMENTS

3.2.4.4.1 GENERAL DESIGN REQUIREMENTS

The general design requirements are listed below: -

1. The PHE shall conform to the technical specification requirements. The offered PHE model shall be from the existing regular production range of the vendor. The offered model designed and manufactured earlier shall have been operating satisfactorily on a continuous duty basis for which the Contractor/vendor shall furnish reference list.
2. PHE shall be designed for at least 25 years of operation life and trouble-free plant service.
3. The design conditions for the PHEs shall be as specified in technical specification.
4. PHE selections shall be verified by the manufacturer to provide the required heat transfer area for the operating conditions and pressure drops as specified on the data sheets.
5. The unit shall be designed for future expansion to accommodate a minimum of ten (10) % additional plates. This will also allow ease in disassembly and cleaning of the unit as furnished. Frame, tie bolts, and supports shall permit the future installation of ten (10) % additional plates.
6. The equipment supplied shall be suitable for safe and proper operation under all conditions without undue strain, vibrations, corrosion or other operating difficulties. All parts subjected to substantial temperature changes shall be designed and supported so as to permit free expansion or contraction without resulting in leakage, distortion and excessive strains in the equipment. The parts subjected to wear, corrosion or other deterioration or requiring adjustment, shall be accessible and have reasonable convenience for removal, replacement and repair. All such parts shall be of suitable material or suitably lined for keeping maintenance to a minimum.

7. Any other additional features required for safe and efficient operation of PHE shall be included in the design and shall be clearly indicative.
8. The PHE shall be counter current flow arrangement unless otherwise as specified in data sheet. The design of PHE shall be such that numbers of cold flow channels are more than the numbers of hot flow channels by one and head and tail plate side channel shall be cold flow channel.
9. All inlet and outlet connections shall be located in fixed cover. Same side flow pattern is preferable. The design of the plates must permit metal to metal contact between adjacent plates. Designs which do not have metal to metal contact are not acceptable.
10. Connection shall be of flanged / studded end type connection in accordance with ASME B 16.5.
11. Plate design shall be adequate to withstand a hydro test pressure of minimum 1.5 times the design pressure. Each flow channel shall be pressurized independently during testing.
12. Gaskets shall be designed so that when the plates are tightened, the gaskets will be compressed to a minimum of 20 to 25 percent.
13. Fouling margin of 15% or as specified below shall be applied, to compensate the fouling.

Fluid	Fouling factor (m ² hr°C /kcal)
DM water	0.00001
Soft water	0.00002
Cooling tower water	0.00004
Process fluids general	0.00001 to 0.00006

14. Fixed and moveable covers shall be able to withstand the given design pressure without added reinforcement or stiffeners.
15. Stainless steel plates pressed with a herringbone corrugation to optimize heat transfer shall be provided. Heat transfer Plate Thickness shall not be less than 0.5 mm. The plate nozzle connections shall be arranged to force each fluid across the plate surface in a diagonal path. This arrangement will insure proper fluid distribution.
16. The materials of the gaskets shall allow longer operating time without replacement. In case of failure of a gasket mixing of liquids in circulation on primary and secondary side shall be avoided. A one piece moulded elastomer gasket compatible with the fluids shall be provided. Gaskets shall be made of Nitrile Rubber (NBR) or Ethylene Propylene Diene Monomer (EPDM).
17. All inlet and outlet nozzles shall be of studded type unless otherwise specified complete with counter flanges and studs. Number of studs, pitch circle diameter, bolt hole diameter and other dimensional details shall be such that it matches with drilling standard of ASME B 16.5, and rating.
18. All material shall be compatible with circulating fluid and also suitable for operating conditions of equipment.
19. Hydrostatic test shall be conducted to a pressure of one and half times of the design pressure for a period of 30 minutes in the presence of the Purchaser or his representative. No leakage shall be allowed. Hydrostatic testing shall be in line with the specified code.

20. The Contractor/vendor shall ensure their performance guarantee that the equipment and accessories supplied by him under this specification meets the guaranteed parameters as per this specification, applicable codes, standards and statutes and regulations in the locality where the equipment will be installed. The contractor shall ensure to meet atleast the following performance parameters:
- Heat transfer capacity
 - Hot water outlet temperature with no positive tolerance in different operating conditions
 - Cold water flow rate with no positive tolerance
 - Pressure drop across PHE of cold and hot side with no positive tolerances

The Contractor/Vendor shall guarantee for safe loading of equipment specified in this specification avoiding any damage.

3.2.4.4.2 PROCESS FLUID DATA

The expected quality of water to be circulated through PHE is given below in Table 14

Table 14: PROCESS FLUID DATA

Sr. No.	Parameters	Primary Side	Secondary Side
1	Liquid handled	Demineralized Water	Soft Water
2	Specific Gravity	1	1
3	Sp. Conductivity, μ Siemens/cm	0.1 for all loops except (0.01 for DNBHP)	-
4	pH	6.5-7.5	7.5-8.3
5	Dissolved oxygen, ppb	0.1 for all loops except (0.01 for DNBHP)	-

3.2.4.5 MANUFACTURING/CONSTRUCTION/ASSEMBLY REQUIREMENT

3.2.4.5.1 Covers

Fixed and moveable covers shall be able to withstand the given design pressure without added reinforcement or stiffeners. The moveable cover shall be provided with a heavy-duty roller bearing assembly. All nozzle connections shall be located on the fixed head for single pass arrangements. If the PHE is multi-pass, the fixed head connections shall be located on the bottom. Fixed cover shall be designed to withstand nozzles loads.

3.2.4.5.2 Plates

Stainless steel plates pressed with a herringbone corrugation to optimize heat transfer shall be provided. Thickness shall not be less than 0.5 mm. If 0.5 mm thickness is not adequate for the design & hydrotest pressure, the contractor has to select plates with higher thickness. The plate nozzle connections shall be arranged to force each fluid across the plate surface in a diagonal path. This arrangement will insure proper fluid distribution.

The first and last plates of the plate pack shall be designed to prevent fluid contact with the fixed or movable heads.

All the plate shall be absolutely free from all types of defects such as crack, pin holes etc. after pressing. This shall be ascertained by subjecting each plate (including spare plates) to any one of the NDT technique approved by Purchaser.

3.2.4.5.3 Gaskets

The materials of the gaskets shall allow longer operating time without replacement. A one piece moulded elastomer gasket compatible with the fluids shall be provided. Gaskets shall be made of Nitrile Rubber (NBR) or Ethylene Propylene Diene Monomer (EPDM). The material's compressibility, recovery, adhesive to metal, hardness etc. shall be consistent with design of the equipment to provide a leak tightness barrier between the two streams. Any lubricant or surface treatment given to gaskets shall be halogen free.

3.2.4.5.4 Carrying Bars

Each plate shall be supported and guided by a top & bottom carrying bar, which accurately locates the plates within the frame assembly. Carrying bar surfaces that are in contact with the heat transfer plates shall be machined stainless steel surface that provides ease of movement of the plates. Upon opening of the unit, the carrying bar's design shall permit removal of any one plate within the plate pack without removing adjacent plates.

3.2.4.5.5 Supports

The upper and lower carrying bars shall be supported and held apart by fixed frame at one end and supporting column at the other end. Necessary anchor bolts shall be supplied by the contractor.

3.2.4.5.6 Nozzles

All inlet and outlet nozzles shall be of studded type unless otherwise specified complete with counter flanges and studs. Number of studs, pitch circle diameter, bolt hole diameter and other dimensional details shall be such that it matches with drilling standard of ASME B 16.5. Nozzles openings shall be reinforced as per the rules of applicable ASME boiler and pressure vessel code sub sections.

3.2.4.5.7 Holding Down Bolts & Lifting Device

Holding down bolts shall be provided for the heat exchangers. Suitable lifting lugs and eye bolts or similar device shall be provided to ensure safe and easy handling of the equipment. The design of the lifting device shall be based on the twice the maximum mass of the plate type heat exchanger.

3.2.4.6 MATERIALS OF CONSTRUCTION

Material of construction of plates, covers, rods, etc. shall be as specified in Table 15 below. Contractor/Vendor may offer equivalent or better materials, provided such materials are approved by the Purchaser.

All materials shall be compatible with circulating fluid and also suitable for operating conditions of equipment as specified herein. Anchor bolts, nuts, bolts and seating steel work if required shall be supplied with the equipment. Only hexagonal nuts shall be used for holding down the equipment. All bolts holes shall be spot faced for nuts. In special cases where necessary, spot facing may be omitted.

Table 15: MATERIALS OF CONSTRUCTION

Sr. No.	Items	Materials	Specification
1	Heat transfer plates	SS 316	ASTM A 240 TYPE 316
2	Plate Gaskets	Nitrile Rubber/EPDM	NBR
3	Flanged Gaskets	Spiral wound with SS304 Inserted Graphite	
4	Carrying Bars	CS Box profile with SS 304 'T' profile	ASTM A36 & SS 304
5	Plate to carry bars Attachment Component	SS	ASTM A 240 TYPE 304
6	Tie bar	Low alloy steel	ASTM A 193 GRADE B 7
7	Frame Plate	CS	ASTM A 516 Gr 60/70
8	Supporting Column/Beam	CS	
9	Pressure plate	CS	ASTM A 516 Gr 60/70
10	Nuts	Low alloy steel	ASTM A 194 GRADE 2H

11	Bolts/Foundation Bolts	Low alloy steel	ASTM A 193 GRADE B-7
12	Guiding bar	SS	ASTM A 240 TYPE 304
13	Nozzles	SS 304L	ASTM A 312
14	flanges and counter flanges	SS 304L	ASTM A 182
15	Lining Sleeve	SS 316 or better	ASTM A 240 TYPE 316
16	Roller for Pressure Plate	SS	ASTM A -479-TP-410
17	Earthing Boss	Low alloy steel	BS-970-PART 3 080 M40
18	Name Plate	SS 304/304L	

3.2.4.7 SPARES AND SPECIAL TOOLS

The bidder shall include in the scope necessary spares and tool and tackles required for the commissioning of the equipment.

3.2.4.8 QUALITY ASSURANCE, INSPECTION AND TESTING

3.2.4.8.1 INSPECTION AND TESTING AT MANUFACTURING WORKS

1. All heat exchanger shall be tested at manufacturer's works prior to their dispatch to determine their compliance with the specifications with respect to dimensions, materials, workmanship and all other requirements of the specifications.
2. All test procedures along with time schedule proposed by the manufacturer shall be submitted for the purchaser's approval prior to testing. The contractor shall make necessary arrangements to carry out the tests as mentioned in this specification
3. All the material test reports and internal inspection reports shall be submitted for purchase's review prior to final inspection.
4. Checking of heat exchanger plates, end plates, pipes etc. and identifying the same with mill test reports submitted.
5. Pressed stainless steel plates shall be checked for dimensional checks and minimum plate thickness.
6. 100% of the plates shall be inspected for dimension and surface defect for light box test.
7. 10% of the plates (preferably from each lot of pressed plates) shall be tested by liquid dye penetrant test as per ASTM E-165 using water washable liquid dye penetrant. No defect shall be acceptable. If any defect is detected in a plate in 10% of the plates the whole lot shall be tested

with DP test. Plates without any defects only shall be accepted and the temperature of test plates shall be between 20 to 40°C while carrying out the test. All traces of penetrant and developer shall be removed after completion of inspection. All material used for inspection shall be halogen free.

8. All weld joints shall be 100% DP tested as per ASTM E-165
9. All nozzles shall be checked for the edge preparation, fit up and orientation
10. Plates and gaskets fixed in proper position in the frame along with carrying bar shall be checked for proper alignment.

3.2.4.8.2 Dimensional Check

Assembled heat exchanger shall be offered for final dimensional check and surface finish check. The equipment shall be in complete dry condition

3.2.4.8.3 Hydro Test

The heat exchanger shall be hydro tested as per the requirements of ASME Sec. VIII Div.1. Each flow channel shall be pressurized independently during testing. The test pressure shall be at 1.5 times the design pressure. Clean and filtered water shall be used for the test.

3.2.4.9 PROTECTION DURING SHIPPING AND STORAGE

1. All equipment shall be neatly finished with good workmanship. All exposed metal surfaces shall be smooth and free from burrs. Finished surface shall be protected against corrosion and mechanical damage.
2. All steel and cast-iron surfaces shall be thoroughly cleaned to remove mill scale rust etc. Exterior surfaces shall be given one coat of red or Zinc Chromate primer and minimum two coats of final enamel paint the color of which shall be approved before hand by purchaser.
3. After cleaning all interiors all openings shall be properly closed with blank flanges caps etc. to prevent entry of water dirt etc. All parts shall be properly boxed and protected to prevent all possible damage during transportation.
4. The Equipment shall be delivered in clean, grease, oil or dirt free condition. All shipments shall be tropically packed, suitably boxed and protected from damage in transit. These shall then be delivered safely to the IPR Site Facility, Bhat Ahmedabad.

3.2.4.10 ERECTION AND INSTALLATION

The contractor shall ensure that the PHEs shall be erected at site as per the manufacturer's guidelines. Special care should be taken during unloading at site, transfer from storage area to

plant room with special handling arrangement and cranes shall be carried out by the contractor. Contractor shall ensure that no damage during transit. If there is any damage happen during transit, immediately the same should bring notice to the purchase. He should provide detailed installation drawings and follow the plant layout drawing attached herewith the tender.

3.2.4.11 INSPECTION, TESTING AND COMMISSIONING

The methodology of testing and commissioning shall be intimated with full procedures, checklists, sequence and any temporary arrangements, needed, list of related agencies involved, and to be intimated, etc. to the purchaser sufficiently in advance (minimum two weeks) for his approval. All measurements, observations shall be taken in the presence of purchaser's representative and shall be certified by the purchaser after his full satisfaction for meeting deigned conditions.

3.2.4.12 PERFORMANCE GUARANTEE AND WARRANTEE

The contractor shall guarantee that upon satisfactorily commissioning and acceptance of the plant by the purchaser, all portions thereof will be in accordance with requirement of this contract and will be perfect as to design, materials, workmanship etc. for minimum period of one year from the date of commissioning and acceptance of the plant. Further the contractor shall guarantee that during the guarantee period he will repair defective Equipment and work and replace defective materials furnished or installed under this contract free of cost to the purchaser. The guarantee of the equipment shall be extended further to consider such repair and replacement period. If the performance test results deviate from the guaranteed values, the Contractor/vendor shall try to correct the deficiencies and if he fails, the Contractor/vendor shall replace the equipment with one that meets the guaranteed value at no extra cost to the purchaser.

3.2.4.13 ANNEXURE-12: TECHNICAL DATASHEET

Annexure 12: Plate Type Heat Exchangers (ICECRH-Loop)

(Data to be filled by the Bidder)

Sr. No.	ITEM	DESCRIPTION	
A.	GENERAL DATA		
1.	System Name	ICECRH -LOOP	
2.	No of PHE Required		
3.	Design Ambient Temperature Max. / Min., °C	45/5	
4.	Design Standard	ASME Section VIII, Div-1, API 662	
B.	PERFORMANCE DATA	PRIMARY SIDE	SECONDARY SIDE
1.	Water Quality	D M Water	Soft Water
2.	Flow rate, kg/s		
3.	Inlet temperature °C		
4.	Outlet temperature °C		
5.	Pressure drop, Kg/cm ²		
6.	Fluid velocity between plates, m/s		
7.	Fluid velocity at nozzles, m/s		
C.	DESIGN DATA		
1.	Heat exchanged, MW		
2.	Overall fouling factor		
3.	Overall heat transfer coefficient		
	a) Clean		
	b) Fouled		
4.	L.M.T.D °C		
5.	Heat transfer area required, m ²		
6.	Heat transfer area available, m ²		
7.	% excess area, m ²		
8.	Heat transfer area of each unit, m ²		
9.	Heat transfer area per plate, m ²		
D.	CONSTRUCTION DETAILS		
1.	Design temperature, °C		
2.	Design pressure		
3.	Max. allowable pressure, Kg/cm ²		

Sr. No.	ITEM	DESCRIPTION
4.	Max. diff. pressure between hot and cold fluid, Kg/cm ²	
5.	Hydrostatic test pressure, Kg/cm ²	
6.	Flow pattern	
7.	No. of passes per unit	
8.	No. of plates per unit	
9.	Area per plate, Kg/cm ²	
10.	Plate corrugation type	
11.	Fluid hold up volume, m ³	
12.	Heat transfer plate Dimensions	
	a) Length, mm	
	b) Width, mm	
	c) Pitch, mm	
	d) Thickness, mm	
13.	Overall dimension (LxWxD), mm	
14.	Fixed plate thickness, mm	
15.	Compression plate thickness, mm	
16.	Max. no. of plates that can be accommodated in the offered model	
17.	Gaskets	
	a) Type	
	b) Thickness of gasket, mm	
18.	Carrying Bars	
	a) Type of construction	
	b) Size	
	c) Number	
19.	Fixed and movable cover	
	a) Type of construction	
	b) Size (LxW), mm	
20.	Nozzles	
	a) Inlet/ Outlet- ND, mm	
21.	Weight	
	a) Empty	
	b) Flooded	
	c) Weight of each plates	
E.	MATERIAL OF CONSTRUCTION	As per Table 15 of Technical specification

3.2.4.14 ANNEXURE-13: TECHNICAL DATASHEET

Annexure 13: Plate Type Heat Exchangers (DNBHP-Loop)

(Data to be filled by the Bidder)

Sr. No.	ITEM	DESCRIPTION	
A.	GENERAL DATA		
1.	System Name	DNBHP-LOOP	
2.	No of PHE Required		
3.	Design Ambient Temperature Max. / Min., °C	45/5	
4.	Design Standard	ASME Section VIII, Div-1, API 662	
B.	PERFORMANCE DATA	PRIMARY SIDE	SECONDARY SIDE
5.	Water Quality	D M Water	Soft Water
6.	Flow rate, kg/s		
7.	Inlet temperature °C		
8.	Outlet temperature °C		
9.	Pressure drop, Kg/cm ²		
10.	Fluid velocity between plates, m/s		
11.	Fluid velocity at nozzles, m/s		
C.	DESIGN DATA		
12.	Heat exchanged, MW		
13.	Overall fouling factor		
14.	Overall heat transfer coefficient		
	c) Clean		
	d) Fouled		
15.	L.M.T.D °C		
16.	Heat transfer area required, m ²		
17.	Heat transfer area available, m ²		
18.	% excess area, m ²		
19.	Heat transfer area of each unit, m ²		
20.	Heat transfer area per plate, m ²		
D.	CONSTRUCTION DETAILS		
21.	Design temperature, °C		
22.	Design pressure		
23.	Max. allowable pressure, Kg/cm ²		

Sr. No.	ITEM	DESCRIPTION
24.	Max. diff. pressure between hot and cold fluid, Kg/cm ²	
25.	Hydrostatic test pressure, Kg/cm ²	
26.	Flow pattern	
27.	No. of passes per unit	
28.	No. of plates per unit	
29.	Area per plate, Kg/cm ²	
30.	Plate corrugation type	
31.	Fluid hold up volume, m ³	
32.	Heat transfer plate Dimensions	
	e) Length, mm	
	f) Width, mm	
	g) Pitch, mm	
	h) Thickness, mm	
33.	Overall dimension (LxWxD), mm	
34.	Fixed plate thickness, mm	
35.	Compression plate thickness, mm	
36.	Max. no. of plates that can be accommodated in the offered model	
37.	Gaskets	
	c) Type	
	d) Thickness of gasket, mm	
38.	Carrying Bars	
	d) Type of construction	
	e) Size	
	f) Number	
39.	Fixed and movable cover	
	c) Type of construction	
	d) Size (LxW), mm	
40.	Nozzles	
	b) Inlet/ Outlet- ND, mm	
41.	Weight	
	d) Empty	
	e) Flooded	
	f) Weight of each plates	
E.	MATERIAL OF CONSTRUCTION	As per Table 15 of Technical specification

3.2.4.15 ANNEXURE-14: TECHNICAL DATASHEET

Annexure 14: Plate Type Heat Exchangers (DNBLP-Loop)

(Data to be filled by the Bidder)

Sr. No.	Item	Description	
A.	GENERAL DATA		
1.	System Name	DNBLP -LOOP	
2.	No of PHE Required		
3.	Design Ambient Temperature Max. / Min., °C	45/5	
4.	Design Standard	ASME Section VIII, Div-1, API 662	
B.	PERFORMANCE DATA	PRIMARY SIDE	SECONDARY SIDE
5.	Water Quality	D M Water	Soft Water
6.	Flow rate, kg/s		
7.	Inlet temperature °C		
8.	Outlet temperature °C		
9.	Pressure drop, Kg/cm ²		
10.	Fluid velocity between plates, m/s		
11.	Fluid velocity at nozzles, m/s		
C.	DESIGN DATA		
12.	Heat exchanged, MW		
13.	Overall fouling factor		
14.	Overall heat transfer coefficient		
	e) Clean		
	f) Fouled		
15.	L.M.T.D °C		
16.	Heat transfer area required, m ²		
17.	Heat transfer area available, m ²		
18.	% excess area, m ²		
19.	Heat transfer area of each unit, m ²		
20.	Heat transfer area per plate, m ²		
D.	CONSTRUCTION DETAILS		
21.	Design temperature, °C		
22.	Design pressure		
23.	Max. allowable pressure, Kg/cm ²		

Sr. No.	Item	Description
24.	Max. diff. pressure between hot and cold fluid, Kg/cm ²	
25.	Hydrostatic test pressure, Kg/cm ²	
26.	Flow pattern	
27.	No. of passes per unit	
28.	No. of plates per unit	
29.	Area per plate, Kg/cm ²	
30.	Plate corrugation type	
31.	Fluid hold up volume, m ³	
32.	Heat transfer plate Dimensions	
	i) Length, mm	
	j) Width, mm	
	k) Pitch, mm	
	l) Thickness, mm	
33.	Overall dimension (LxWxD), mm	
34.	Fixed plate thickness, mm	
35.	Compression plate thickness, mm	
36.	Max. no. of plates that can be accommodated in the offered model	
37.	Gaskets	
	e) Type	
	f) Thickness of gasket, mm	
38.	Carrying Bars	
	g) Type of construction	
	h) Size	
	i) Number	
39.	Fixed and movable cover	
	e) Type of construction	
	f) Size (LxW), mm	
40.	Nozzles	
	c) Inlet/ Outlet- ND, mm	
41.	Weight	
	g) Empty	
	h) Flooded	
	i) Weight of each plates	
E.	MATERIAL OF CONSTRUCTION	As per Table 15 of Technical specification

3.2.4.16 ANNEXURE-15: TECHNICAL DATASHEET

Annexure 15: Plate Type Heat Exchangers (DNBCH-Loop)

(Data to be filled by the Bidder)

Sr. No.	Item	Description	
A.	GENERAL DATA		
1.	System Name	DNBCH -LOOP	
2.	No of PHE Required		
3.	Design Ambient Temperature Max. / Min., °C	45/5	
4.	Design Standard	ASME Section VIII, Div-1, API 662	
B.	PERFORMANCE DATA	PRIMARY SIDE	SECONDARY SIDE
5.	Water Quality	D M Water	Soft Water
6.	Flow rate, kg/s		
7.	Inlet temperature °C		
8.	Outlet temperature °C		
9.	Pressure drop, Kg/cm ²		
10.	Fluid velocity between plates, m/s		
11.	Fluid velocity at nozzles, m/s		
C.	DESIGN DATA		
12.	Heat exchanged, MW		
13.	Overall fouling factor		
14.	Overall heat transfer coefficient		
	g) Clean		
	h) Fouled		
15.	L.M.T.D °C		
16.	Heat transfer area required, m ²		
17.	Heat transfer area available, m ²		
18.	% excess area, m ²		
19.	Heat transfer area of each unit, m ²		
20.	Heat transfer area per plate, m ²		
D.	CONSTRUCTION DETAILS		
21.	Design temperature, °C		
22.	Design pressure		
23.	Max. allowable pressure, Kg/cm ²		

Sr. No.	Item	Description
24.	Max. diff. pressure between hot and cold fluid, Kg/cm ²	
25.	Hydrostatic test pressure, Kg/cm ²	
26.	Flow pattern	
27.	No. of passes per unit	
28.	No. of plates per unit	
29.	Area per plate, Kg/cm ²	
30.	Plate corrugation type	
31.	Fluid hold up volume, m ³	
32.	Heat transfer plate Dimensions	
	m) Length, mm	
	n) Width, mm	
	o) Pitch, mm	
	p) Thickness, mm	
33.	Overall dimension (LxWxD), mm	
34.	Fixed plate thickness, mm	
35.	Compression plate thickness, mm	
36.	Max. no. of plates that can be accommodated in the offered model	
37.	Gaskets	
	g) Type	
	h) Thickness of gasket, mm	
38.	Carrying Bars	
	j) Type of construction	
	k) Size	
	l) Number	
39.	Fixed and movable cover	
	g) Type of construction	
	h) Size (LxW), mm	
40.	Nozzles	
	d) Inlet/ Outlet- ND, mm	
41.	Weight	
	j) Empty	
	k) Flooded	
	l) Weight of each plates	
E.	MATERIAL OF CONSTRUCTION	As per Table 15 of Technical specification

3.2.4.17 ANNEXURE-16: TECHNICAL DATASHEET

Annexure 16: Plate Type Heat Exchangers (IPRCH-Loop)

(Data to be filled by the Bidder)

Sr. No.	Item	Description	
A.	GENERAL DATA		
1.	System Name	IPRCH -LOOP	
2.	No of PHE Required		
3.	Design Ambient Temperature Max. / Min., °C	45/5	
4.	Design Standard	ASME Section VIII, Div-1, API 662	
B.	PERFORMANCE DATA	PRIMARY SIDE	SECONDARY SIDE
5.	Water Quality	D M Water	Soft Water
6.	Flow rate, kg/s		
7.	Inlet temperature °C		
8.	Outlet temperature °C		
9.	Pressure drop, Kg/cm ²		
10.	Fluid velocity between plates, m/s		
11.	Fluid velocity at nozzles, m/s		
C.	DESIGN DATA		
12.	Heat exchanged, MW		
13.	Overall fouling factor		
14.	Overall heat transfer coefficient		
	i) Clean		
	j) Fouled		
15.	L.M.T.D °C		
16.	Heat transfer area required, m ²		
17.	Heat transfer area available, m ²		
18.	% excess area, m ²		
19.	Heat transfer area of each unit, m ²		
20.	Heat transfer area per plate, m ²		
D.	CONSTRUCTION DETAILS		
21.	Design temperature, °C		
22.	Design pressure		
23.	Max. allowable pressure, Kg/cm ²		
24.	Max. diff. pressure between hot and cold fluid, Kg/cm ²		

Sr. No.	Item	Description
25.	Hydrostatic test pressure, Kg/cm ²	
26.	Flow pattern	
27.	No. of passes per unit	
28.	No. of plates per unit	
29.	Area per plate, Kg/cm ²	
30.	Plate corrugation type	
31.	Fluid hold up volume, m ³	
32.	Heat transfer plate Dimensions	
	q) Length, mm	
	r) Width, mm	
	s) Pitch, mm	
	t) Thickness, mm	
33.	Overall dimension (LxWxD), mm	
34.	Fixed plate thickness, mm	
35.	Compression plate thickness, mm	
36.	Max. no. of plates that can be accommodated in the offered model	
37.	Gaskets	
	i) Type	
	j) Thickness of gasket, mm	
38.	Carrying Bars	
	m) Type of construction	
	n) Size	
	o) Number	
39.	Fixed and movable cover	
	i) Type of construction	
	j) Size (LxW), mm	
40.	Nozzles	
	e) Inlet/ Outlet- ND, mm	
41.	Weight	
	m) Empty	
	n) Flooded	
	o) Weight of each plates	
E.	MATERIAL OF CONSTRUCTION	As per Table 15 of Technical specification

3.2.5 PRESSURIZERS AND WATER TANK

3.2.5.1 SCOPE

This specification covers the minimum technical requirement of design, supply of material, preparation of fabrication drawings, manufacture, inspection, testing, painting and guarantees of pressurizer as well as outdoor water storage tank along with all components and accessories as specified in the tender document. It is not the intent to completely specify all details of design and construction of these Pressurizer and Tanks; nevertheless, the equipment shall conform to high standards of engineering, design and workmanship in all respects.

3.2.5.2 APPLICABLE CODE AND STANDARD

Vendor shall be responsible for the co-ordination of all Sub-Vendors. It is the specific responsibility of the Vendor to invoke all applicable referenced specifications to each Sub-Vendor's Purchase Order.

The design, material, construction, manufacture, inspection, testing and performance of pressuriser and Vessels shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. The Equipment supplied should comply with the latest applicable codes and standards along with all addenda, mentioned below

- a. ASME Sec VIII Div.1 – Rules for Construction of Pressure Vessel
- b. ASME Sec. V - Non-Destructive Examination
- c. ASME Sec IX - Qualification Standard for Welding and Brazing procedures, Welders, brazes and Welding and Brazing Operators
- d. ASME B 16.5 - Standard for Steel Pipe Flanges and Flanged Fittings
- e. ASTM standards for materials and various tests
- f. IS standard for materials
- g. IS 4049 for dished ends

Note: In case of conflict between specifications, code and standards or drawings, more stringent requirement will be followed.

3.2.5.3 DESIGN DATA AND PERFORMANCE REQUIREMENT

Sr. No.	Parameters required	Values
1	Storage tank capacity for chilled water, m ³	50 m ³

2	Chilled water temperature, °C	14
3	Thickness of chilled water storage tank 'shell	16 mm min.
4	Orientation of chilled water storage tank	Horizontal
5	Pressurizer capacity for all primary loops	1 m ³
6	Thickness of pressurizer shell	Min. 6 mm
7	Orientation of pressurizer	Vertical
8	Storage fluid in pressurizer	DM water
9	Construction type	Welded
10	Operating temperature for storage tank °C	14
11	Operating temperature for pressurizer °C	40
12	Design inlet pressure, Kg/cm ²	12
13	Design temperature °C	Min. 5
14	Design ext. pressure,	1 atm.
15	Design code	ASME Sec. VIII Div. 1
16	Hydro test pressure	1.5 times design pressure

3.2.5.4 TECHNICAL REQUIREMENT

3.2.5.4.1 GENERAL DESIGN REQUIREMENT

1. Pressurizer and storage tank shall be designed as per ASME Boiler and Pressure Vessel Codes, Section VIII Div.1.
2. Steel plates, sections to be used in the fabrication of tank, shell, bottom head and supporting structure shall be new, tested quality conforming to material as specified in Data Sheet. Design of pressurizer and storage tank is in Vendor's scope. Stiffeners and other structural framings for supporting the tanks shall be as per detailed design and same shall be submitted for purchaser's approval before proceeding for manufacturing.
3. Nozzles of pressurizer and storage tank shall be provided as per detailed design. Unless otherwise specified, nozzles shall be provided with flanged connections, drilled to ASME B-16.5, 150-lbs. rating RF.
4. Tanks shall be designed for at least 25 years of operation life and trouble-free plant service.
5. Appropriate insulation on water storage tank shall be provided.
6. All welding procedures shall be submitted to the purchaser for prior approval. Only those electrodes which are approved by the purchaser shall be used.

7. Weld repairs shall be carried out as per procedures approved by the purchaser.
8. An inspection platform of suitable dimension shall be provided surrounding the water storage tank.

3.2.5.5 MANUFACTURING/CONSTRUCTION/ASSEMBLY REQUIREMENT

1. The vessels shall be fabricated as per the codes and the design data furnished in the technical specification and data sheet. Nozzles, if required, shall be provided with reinforcement pads. The edges for the weld end nozzles shall be prepared as per ANSI B16.5, unless otherwise mentioned, after the hydro test.
2. Suitable lifting and handling arrangement
3. Suitable supporting arrangement with anchor bolts, nuts and washers for the vessel
4. Suitable insulation cleats for tank of cold application e.g. chilled water tank.
5. Suitable earthing boss
6. Nuts, bolts, foundation bolts and gaskets as required
7. Ladders and platforms if required on the basis of detailed engineering after award of the contract.
8. Prior to any welding on the job, the welding procedures, welders and operators shall be qualified as per ASME Section IX.
9. All welding procedures shall be submitted to the Purchaser for his approval.
10. TOLERANCES
 - a) Straightness: Outside surface of the shell may be out of alignment by not more than 1 mm/meter at any point along straight line.
 - b) Out of Roundness: The difference between the maximum and minimum inside diameters at any cross section shall not be more than 1%.
 - c) Length: The length on straight of the vessels shall not vary more than $\pm 1.5\%$ or ± 6 mm whichever is lower.
 - d) Shape Deviation: The inner surface of head shall deviate neither outside of specified shape by more than 1.25% of inner diameter of vessel nor inside the specified shape by more than 0.625% of inner diameter of vessel.
 - e) Circumference: The outside circumference of the finished ends shall not depart from circumference calculated from outside diameter by $\pm 0.25\%$ of circumference. Such deviations shall be measured perpendicular to specified shape and knuckle radius shall not be less than that specified.
 - f) Nozzle projection: Finished nozzle projection shall not be more than ± 3 mm than that shown in the drawings. Tolerance on distance between nozzles for level gauges shall be within ± 1 mm.
 - g) Formed heads: Tolerance on formed heads shall be as per ASME Section VIII Div.1
 - h) Inspection of welds shall be as per ASME Section IX 'Welding and Brazing qualification'.
 - i) Radiographic examination of all butt welded joints on pressure vessel and nozzles shall be carried out as per relevant codes mentioned in the drawings. The acceptance will be as per the design standard

3.2.5.6 MATERIAL OF CONSTRUCTION

Sr. No.	Items	MOC	
		Storage tank and Chiller secondary loop's Pressurizer	Pressurizer of ICECRH, DNBHP, DNBLP, DNBCH and IPRCH Cooling Loop
1.	Shell	SA 515 GR. 70	SA 240 GR. 304L
2.	Nozzles	SA 53 GR. B	SA 312 TP 304L
3.	Frame structure	Carbon steel	304L
4.	Bracing/stiffeners	Carbon steel	304L
5.	Nuts	ASTM 193 Gr. B7	ASTM 193 Gr. B7
6.	Bolts	ASTM 194 Gr. 2H	ASTM 194 Gr. 2H
7.	Lifting lugs/eye bolts	Forged steel	Forged steel
8.	Flanges	SA 105	SA 182 GR. F 304L
9.	Welding consumable	Section II part C	Section II part C

3.2.5.7 SPARES AND SPECIAL TOOLS

The bidder shall include in the scope necessary spares and tool and tackles required for the commissioning of the equipment.

3.2.5.8 QUALITY ASSURANCE, INSPECTION AND TESTING

All materials and fabrication work shall be subjected to stage wise inspection and testing. The scope of inspection shall comprise of, but not be limited to the following: -

1. The manufacturer shall provide inspection program/procedure to establish and maintain quality of workmanship to ensure mechanical accuracy, compliance with drawings, identity and acceptability of all materials.
2. All the materials used for the manufacturing of tanks shall be tested quality. Relevant test certificates shall be made available to the purchaser before final shop inspection.
3. Following inspection shall be carried out as a minimum:
 - a. Plates: All tests as required by the relevant material standard/code.
 - b. Pipes, flanges, fittings: - All tests as required by relevant material standard shall be carried out.
 - c. Edge preparation of plate joint, fit-up, dimensional and alignment check at tack weld stage.
 - d. Final dimensional check-up.

- e. Dye penetrant examination of pressure vessels shall be carried out at the following stages as per ASME Section VIII Div.1,
 - i. Root run of full penetration joint if welded from one side.
 - ii. Back chipped area before welding on the other side of double welded full penetration joint.
 - iii. Final surfaces of all welds.
 - iv. Finished joints and dished ends.
4. Radiographic examination of all butt welded joints on pressure vessel and nozzles shall be carried out as per relevant codes mentioned in the tender.
5. The acceptance will be as per the design standard.
6. Hydrostatic/Pneumatic Testing: Each vessel shall be hydrostatically tested at a pressure of 1.5 times its design pressure for a minimum period of 30 minutes. No leakage shall be allowed. Pneumatic test (at a pressure of 1.2 times its design pressure) as and if specified shall be performed for 30 minutes minimum. No leakage shall be allowed.
7. Tanks shall not be dispatched unless the same has been finally inspected and tested successfully and shipping release issued by the Purchaser.
8. All nozzle reinforcements shall be tested pneumatically for tightness with soap solution at a pressure of 2.5 kg/cm² on attachment of welds.

3.2.5.9 PROTECTION DURING SHIPPING AND STORAGE

1. All equipment shall be neatly finished in workmanship like manner. All exposed metal surfaces shall be smooth and free from burrs. Finished surface shall be protected against corrosion and mechanical damage.
2. All steel and cast-iron surfaces shall be thoroughly cleaned to remove mill scale rust etc. Exterior surfaces shall be given one coat of red or Zinc Chromate primer and minimum two coats of final enamel paint the color of which shall be approved before hand by purchaser.
3. After cleaning all interiors all openings shall be properly closed with blank flanges caps etc. to prevent entry of water dirt etc. All parts shall be properly boxed and protected to prevent all possible damage during transportation.
4. The Equipments shall be delivered in clean, grease, oil or dirt-free condition. All shipments shall be tropically packed, suitably boxed and protected from damage in transit. These shall then be delivered safely to the IPR Site Facility, Bhat Ahmedabad.

3.2.5.10 ERECTION AND INSTALLATION

The contractor shall ensure erection and installation at site as per manufacturer's manual and guidelines. All necessary tools and tackles required for the erection and installation at site shall be made available by the contractor.

3.2.5.11 INSPECTION, TESTING AND COMMISSIONING

The contractor shall ensure the inspection, testing and commissioning at site as per manufacturer's manual and guidelines. All necessary tools, tackles and instruments required for at site shall be made available by the contractor

3.2.5.12 PERFORMANCE GUARANTEE AND WARRANTEE

1. All the Equipments shall be guaranteed to meet the performance required by these specific conditions. The contractor guarantees that each piece of equipment and any accessories furnished shall be entirely suitable for the service conditions indicated, shall conform to the requirements of all applicable codes and regulations and shall meet safely and completely all conditions of performance and design specified herein.
2. The tests shall be conducted at manufacturer's works in presence of the purchaser's representative and in accordance with this specification and rectification to all defects shall be satisfactorily
3. Contractor shall give performance guarantee for the complete unit operating under the specified condition and shall replace any part in the event of failure due to design and manufacturing faults for a minimum period of one year from the date of installation or 18 months from the date of supply, whichever is earlier.

3.2.5.13 ANNEXURE-17: TECHNICAL DATASHEET

Annexure 17: Pressurizer for Primary Cooling Loops

(Data to be filled by the Bidder)

	IPR Requirements	Details to be filled by Vendor
Tank type	Pressurizer for ICECRH, DNBHP, DNBLP, DNBCH and IPRCH Cooling Loops	
Volume of each, m ³	1	
Qty. to deliver, Nos.	5	
Design temp, °C	Min. 7 and max. 80	
Design pressure, Kg/cm ²	12	
Radiography	10%	
Hydro test p	1.5 times design pressure	
Dimension of tank (Diameter*straight length)	As per detailed design	
Construction	Welded	
Inspection by	As per spec.	
Fluid stored	DM Water	
Design code	ASME SEC. VIII DIV. 1	
Visual & Dimension, %	100	
Plates MOC	SA 240 GR. 304L	
Pipes MOC	SA 312 TP 304L	
Flanges MOC	SA 182 GR. F 304L	
Plate thickness of dished end, mm	As per detailed design	
Plate thickness of shell, mm	Min. 8	
Weight of tank		

3.2.5.14 ANNEXURE-18: TECHNICAL DATASHEET

Annexure 18: Pressurizer for Chiller Cooling Secondary Loop

(Data to be filled by the Bidder)

	IPR Requirements	Details to be filled by Vendor
Tank type	Pressurizer for Chiller loop	
Volume, m3	1	
No. of tanks	1	
Design temp	40	
Design pressure	12	
Radiography	10%	
Hydro test p	1.5 times design pressure	
Size of tank (Diameter*straight length)	As per detailed design	
Construction	Welded	
Inspection by	As per spec.	
Fluid stored	DM Water	
Design code	ASME SEC VIII DIV 1	
Visual & Dimensions, %	100	
Plates MOC	SA 515 GR. 70	
Pipes MOC	CS Sch-40	
Flanges MOC	SA 105	
Plate thickness of dished end, mm	As per detailed design	
Plate thickness of shell, mm	Min. 8	
Primer type	Enamel based	
Primer make	As per approved list	
No. of coats	2	
Thermal insulation	As per detailed specification in Thermal insulation section	
Weight of tank		

3.2.5.15 ANNEXURE-19: TECHNICAL DATASHEET

Annexure 19: Storage Tank of Chilled Water-Cooling Loop

(Data to be filled by the Bidder)

	IPR Requirements	Details to be filled by Vendor
Tank type	Chilled water storage	
Volume, m ³	50	
No. of tank	1	
Design temp	Min.5	
Design pressure, Kg/cm ²	12	
Radiography	10%	
Hydro test p	1.5 times design pressure	
Size of tank (Diameter*straight length)		
Construction	Welded	
Inspection by	As per spec.	
Fluid stored	Soft water	
Design code	ASME SEC VIII DIV 1	
Visual & DIMENSION, %	100	
Plates MOC	SA 515 GR. 70	
Pipes MOC	CS Sch-40	
Flanges MOC	SA 105	
Plate thickness of dished end, mm	As per detailed design	
Plate thickness of shell, mm	Min. 16	
Type of surface preparation before painting		
Primer type		
Primer make		
No. of coats		
Type of insulation	NBR/PUF	
Min. thickness of insulation, mm	25	
Min. density of insulation, Kg/m ³	36	
Thermal insulation	As per detailed specification in Thermal insulation section	
Weight of tank		

3.2.6 PIPING AND FITTINGS

3.2.6.1 SCOPE

This specification covers technical requirements and essential information for supply, fabrication, inspection, erection, testing, cleaning and painting of the piping of CWS system. This document also covers the Piping Material Specification (PMS) to be considered for pipe and fittings based on the fluid and water chemistry to be maintained in each of the system loops.

3.2.6.1.1 GENERAL DESIGN SCOPE

3.2.6.1.1.1 Piping design

1. Piping and support design shall be as per ASME B31.3 and prevailing good engineering/ industrial practices.
2. The minimum requirement of pipe thickness for piping is as per PMS for all sizes.
3. Adequate supports shall be provided in horizontal and vertical runs of pipe to avoid failure and excessive bending. Apart from this, support shall be provided near concentrated weights like, valves, strainers etc. Design of pipe bridge outside plant room for cross road between plant room and ITER-India Lab. The piping bridge shall be having multiple pipe runs.
4. Support scheme shall provide adequate lateral & axial stiffness to the piping without compromising the flexibility.
5. U-clamps/ bolts shall be provided on straight runs to restrict lateral movement of pipe.
6. Appropriate pipe supports (rest, guide, anchors, limit stops) shall be used to control pipe stresses & deflections and loads on the terminal equipment.
7. Preliminary line size calculation of CWS will be provided by the purchaser, contractor shall review and provide final line size as per detailed design carried out by contractor.
8. All chilled water lines with associated in-line components shall be cold insulated with appropriate thickness as per detailed design carried out by contractor.
9. Pipe Material Specification (PMS) is to be referred as mentioned in below tables.

Table 16: PIPE MATERIAL SPECIFICATION (PMS)

SERVICE: SOFT WATER FOR SECONDARY COOLING LOOP AND SOFT WATER FOR HRS LOOP													
DESIGN CODE : ASME B 31.3													
CORROSION ALLOWANCE			1.6 mm										
DESIGN			TESTING										
LIMITS	TEMP. °C	REFER SPEC		HYDROTEST PRESSURE			1.5 X DESIGN PRESSURE						
	DESIGN PRESSURE	REFER SPEC		PNEUMATIC TEST PR.			NA						
NOMINAL PIPE SIZE:	15	25	40	50	65	80	100	150	200	250	300	350	
OUTSIDE DIA.:	21.3	33.4	48.3	60.3	73	88.9	114.3	168.3	219.1	273.0	323.9	355.6	
THICKNESS:	2.77	3.38	3.68	3.91	5.16	5.49	6.02	7.11	8.18	9.27	9.53	9.53	
NOMINAL PIPE SIZE:	400	450	500	550	600								
OUTSIDE DIA.:	406.4	457.2	508	558.8	610								
THICKNESS:	9.53	9.53	9.53	9.53	9.53								
LINE JOINT		≤ DN 50	SOCKET WELDED TO ANSI B 16.11										
		≥ DN 65	BUTT WELDED TO ANSI B 16.25										

ITEM		DN (mm)	MATERIAL SPECIFICATION	DIM. STANDARD	REMARKS
PIPES		≤ 50	ASTM A 53 Gr. B	ANSI B 36.10, SCH- STD	SMLS PE (REFER NOTE-4)
		65-350	ASTM A 53 Gr. B	ANSI B 36.10, SCH- STD	ERW BE (REFER NOTE-4)
		400 - 600	ASTM A 672 Gr B 60 CL-12 FROM ASTM A 515 GR 60 plates	ANSI B 36.10, SCH – STD	BE (REFER NOTE-4)
ELBOWS		≤ 50	ASTM A 105	ANSI B 16.11, 3000#	SW END, LR, SEE NOTE-1
		65 - 300	ASTM A 234 Gr. WPB	ANSI B 16.9	SMLS, BW ENDS, LR, SCH- TO MATCH PIPE THK.
		350 - 600	ASTM A-234 Gr.WPB, Welded	ANSI B 16.9	ERW, BW ENDS, LR, SCH- TO MATCH PIPE THK.
BRANCH CONN. (Ref. Sheet 5 of 5)	HALF COUPLING	≤ 50	ASTM A 105	ANSI B 16.11, 3000#	SW ENDS
	WELDOLET	65 - 300	ASTM A 105	AS PER BONNYFORGE CATALOUGE	BW ENDS
	TEES	≤ 50	ASTM A 105	ANSI B 16.11, 3000#	SW END
		65 – 300	ASTM A 234 Gr.WPB	ANSI B 16.9	SMLS, BW ENDS, SCH- TO MATCH PIPE THK.
	STUB-IN / NOZZLES	150 - 600	SAME AS PARENT PIPE	STUB-IN WITH REINFORCEMENT	BW ENDS, SEE NOTE-2
REDUCERS		65 – 300	ASTM A 234 Gr.WPB	ANSI B 16.9	BW ENDS, SCH- TO MATCH PIPE THK.

		≥ 350	ROLLED FROM ASTM A 515 GR 60 PLATES. REFER NOTE-3	ANSI B 16.9	WITH LONGITUDINAL WELDS
FLANGES		≤ 65	ASTM A 105	ANSI B 16.5, 150#	SW, RF, SERRATED FINISH
		65 - 400	ASTM A 105	ANSI B 16.5, 150#	SO, RF, SERRATED FINISH
		≥ 450	FABRICATED FROM ASTM A 515 GR 60 SINGLE PLATE	AWWA C-207, CLASS- D	HUB FLANGE WITH 3.2 mm SERRATED RAISED FACE.
BLIND FLANGES		≤ 400	ASTM A 105	ANSI B 16.5, 150#	RF, SERRATED FINISH,
		≥ 450	FABRICATED FROM ASTM A 515 GR 60 SINGLE PLATE	AWWA C-207, CLASS- D	WITH 3.2mm SERRATED RF
GASKET		≤ 400	EPDM- Durometer Hardness Shore-A 60 + 5	ANSI B 16.21	3 mm THK
		≥ 450	EPDM- Durometer Hardness Shore-A 60 + 5	AWWA C-207	3.18 mm THK
CAPS	SCREWED	≤ 50	ASTM A 105	ANSI B 16.11, 3000#	FOR SCREWED NIPPLES
	SW END	≤ 50	ASTM A 105	ANSI B 16.11, 3000#	
	BW ENDS	65 - 600	ASTM A 234 GR.WPB	ANSI B 16.9	BE, SCH- TO MATCH PIPE THK.
PLUG		≤ 50	ASTM A 105	ANSI B 16.11, 3000#	SQUARE HEAD NPT THREADS
ELBOLETS, LATROLETS & THREDOLETS		≤ 50	ASTM A 105	AS PER BONNYFORGE CATALOUGE	NPT THREADS
COUPL	FULL SCREWED	≤ 50	ASTM A 105	ANSI B 16.11, 3000#	FOR INSTRUMENT CONNECTIONS

	FULL, SW ENDS	≤ 50	ASTM A 105	ANSI B 16.11, 3000#	SW ENDS
	REDUCING SW ENDS	≤ 50	ASTM A 105	ANSI B 16.11, 3000#	SW ENDS
	NIPPLE	≤ 50	SAME AS PIPE	SAME AS PIPE, 150 mm LONG	ONE END SCREWED AND OTHER END PLANE OR BOTH ENDS PLANE
	BOLTS	ALL SIZES	ASTM A 193 Gr. B7	ANSI B 18.2.1	HEX. HEAD
	NUTS	ALL SIZES	ASTM A 194 Gr. 2H	ANSI B 18.2.2	HEAVY HEX. HEAD

NOTES:

1. Reinforcement pad for branch connection shall have same thickness as that of run and width equal to outer radius of branch.
2. Reducers shall be manufactured using plate of thickness equivalent to pipe thickness by rolling. Reducers shall not be manufactured using parent pipe with multi-weld joints.
3. BE- Bevel ends, PE- Plain ends.
4. SW- Socket Weld, BW- Butt Weld
5. All dimensions are in mm.
6. Branch connections
H- Half Coupling
W-Weldolet
t -SW Tee
T -BW Tee
R- Stubin with reinforcement
7. Thickness of tee shall match pipe thickness,

SERVICE: DM WATER FOR PHTS COOLING LOOPS													
DESIGN CODE : ASME B 31.3													
CORR. ALLOWANCE				N.A.									
DESIGN				TESTING									
LIMITS	TEMP. °C	REFER SPECS	HYDROTEST PRESSURE :	1.5 X DESIGN PRESSURE									
	DESIGN PRESSURE:	REFER SPECS	PNEUMATIC TEST PRESSURE:	NA									
NOMINAL PIPE SIZE:	15	25	40	50	65	80	100	150	200	250	300	350	
OUTSIDE DIA.:	21.3	33.4	48.3	60.3	73	88.9	114.3	168.3	219.1	273.0	323.9	355.6	
THICKNESS:	2.77	3.38	3.68	3.91	5.16	5.49	6.02	7.11	8.18	9.27	9.53	9.53	
NOMINAL PIPE SIZE:	400	450	500										
OUTSIDE DIA.:	406.4	457.2	508										
THICKNESS:	9.53	9.53	9.53										
LINE JOINT	≤ND 50	SOCKET WELDED TO ANSI B 16.11											
	≥ND 65	BUTT WELDED TO ANSI B 16.25											
ITEM	ND (mm)	MATERIAL SPECIFICATION	DIM. STANDARD				REMARKS						
PIPES	≤ 50	ASTM A 312 TP 304L, SMLS	ANSI B 36.19, SCH –40S				PE (REFER NOTE-2)						
	65 - 200	ASTM A 312 TP 304L, SMLS	ANSI B 36.19, SCH – 40S				BE (REFER NOTE-2)						
	250 – 500	ASTM A 358 GR 304L CL1, EFW	ANSI B 36.19, PIPE WALL THICKNESS AS PER ABOVE TABLE				BE (REFER NOTE-2)						
ELBOWS	≤ 50	ASTM A 182 F 304L	ANSI B 16.11, 3000#				SW END, LR, NOTE-1						

		65 - 200	ASTM A 403 WP 304L-S	ANSI B 16.9	BE, LR, SCH- TO MATCH PIPE THK.
		250 - 500	ASTM A 403 WP 304L-WX	ANSI B 16.9 / MFG STD	LR UNLESS NOTED. BE, SCH- TO MATCH PIPE THK.
BRANCH CONN. (Ref. Pg. 4 of 4)	HALF COUPLING	≤ 50	ASTM A 182 F 304L	ANSI B 16.11, 3000#	SW ENDS
	WELDOLET	65 – 200	ASTM A 182 F 304L	AS PER BONNYFORGE CATALOUGE	BW ENDS
	TEES	≤ 50	ASTM A 182 F 304L	ANSI B 16.11, 3000#	SW ENDS
		65 - 200	ASTM A 403 WP 304L-S	ANSI B 16.9	BW ENDS, SCH – TO MATCH PIPE THK.
	STUB-IN / NOZZLES	100 - 500	SAME AS PARENT PIPE	STUB-IN WITH REINFORCEMENT PAD	REFER NOTE-3
REDUCERS	≤ 50	ASTM A 182 F 304L	ANSI B 16.11, 3000#	SW ENDS	
	65 - 200	ASTM A 403 WP 304L-S	ANSI B 16.9	BW ENDS, SCH – TO MATCH PIPE THK.	
	250 - 500	ASTM A 403 WP 304L-WX	ANSI B 16.9 / MFG STD	BW ENDS, SCH – TO MATCH PIPE THK.	
FLANGES	≤ 50	ASTM A 182, F 304L	ANSI B 16.5, 150#	SWRF SERRATED FINISH	
	65 - 500	ASTM A 182, F 304L	ANSI B 16.5, 150#	SORF SERRATED FINISH	
WELDNECK FLANGES	ALL SIZES	ASTM A 182 F 304L	ANSI B16.5, 300#	WNRF, SERRATED FINISH FOR FLOW ELEMENT	
BLIND FLANGES	ALL SIZES	ASTM A 182, F 304L	ANSI B16.5, 150#	RF, SERRATED FINISH	
BOLTS	ALL SIZES	ASTM A 182, F 304L	ANSI B 18.2.1	HEXAGONAL HEAD	

NUTS		ALL SIZES	ASTM A 182, F 304L	ANSI B18.2.2	HEAVY HEXAGONAL
GASKETS		ALL SIZES	SPIRAL WOUND WITH SS 304 INSERTED GRAPHITE	ANSI B 16.20	3 mm THK
CAPS		≤ 50	ASTM A 182 F 304L	ANSI B 16.11	SCREWED (NPT) FOR VENT & DRAIN LINES
		≤ 50	ASTM A 182 F 304L	ANSI B 16.11	SW ENDS (EXCEPT VENTS & DRAINS)
		65 - 200	ASTM A 403 WP 304L-S	ANSI B 16.9	BW ENDS, SCH – TO MATCH PIPE THK.
		250 - 500	ASTM A 403 WP 304L-WX	ANSI B 16.9 / MFG STD	BW ENDS, SCH – TO MATCH PIPE THK.
COUPLINGS	FULL, SCREWED	≤ 50	ASTM A 182 F 304L	ANSI B 16.11, 3000#	FOR INSTRUMENT CONNECTIONS
	FULL, SW ENDS	≤ 50	ASTM A 182 F 304L	ANSI B 16.11, 3000#	SW ENDS
	REDUCING SW ENDS	≤ 50	ASTM A 182 F 304L	ANSI B 16.11, 3000#	SW ENDS
NIPPLE		≤ 50	SAME AS PIPE	SAME AS PIPE, 150 mm LONG	ONE END SCREWED & OTHER END PLANE OR BOTH ENDS PLANE
PLUG		≤ 50	ASTM A 182 F 304L	ANSI B 16.11, 3000#	SQUARE HEAD NPT THREADS
ELBOLETS, LATROLETS AND THREDOLETS		≤ 50	ASTM A 182 F 304L	AS PER BONNY FORGE CATALOGUE	NPT THREADS
SPECTACLE BLIND / FLANGE		ALL SIZES	ASTM A 182 F 304L	ANSI B16.48, 150#	RF SERRATED FINISH

NOTES:

1. Reinforcement pad for branch connection shall have same thickness as that of run & width equal to outer radius of branch.
2. BE- Bevel ends, PE- Plain ends.
3. SW- Socket Weld, BW- Butt Weld
4. All dimensions are in mm.
5. Branch connections:
 - H- Half Coupling
 - W-Weldolet
 - t -SW Tee
 - T -BW Tee
 - R Stubin with reinforcement
6. Thickness of tee shall match pipe thickness,

															R	500	BRANCE (DN)	
															R	R		450
													R	R	R	R		400
												R	R	R	R	R		350
											R	R	R	R	R	R		300
										R	R	R	R	R	R	R		250
									T	R	R	R	R	R	R	R		200
								T	T	R	R	R	R	W	W	W		150
							T	T	T	R	R	W	W	W	W	W		100
						T	T	T	W	W	W	W	W	W	W	W		80
					T	T	T	W	W	W	W	W	W	W	W	W		65
				t	H	H	H	H	H	H	H	H	H	H	H	H		50
			t	t	H	H	H	H	H	H	H	H	H	H	H	H		40
		t	t	t	H	H	H	H	H	H	H	H	H	H	H	H		25
	t	t	t	t	H	H	H	H	H	H	H	H	H	H	H	H		20
t	t	t	t	t	H	H	H	H	H	H	H	H	H	H	H	H	15	
15	20	25	40	50	65	80	100	150	200	250	300	350	400	450	500	MM		
RUN PIPE (DN)																		

3.2.6.1.1.2 Piping Layout

- a) The contractor shall develop equipment layout drawing based on P&ID and purchaser's inputs and generate piping layout drawing along with supports and get approval of the purchaser.
- b) Following guidelines, but not limited to, shall be considered for finalizing of the piping layout:
 1. Head room
 2. Interference with other piping, equipment, structures, cable trays, ducting etc.
 3. Large diameter piping shall be laid first. Small bore piping (40 NB and below) shall be routed after the large pipe are laid, as per the space availability.
 4. The layout shall follow good engineering/ industrial practices so as to optimize the material requirement.
 5. The layout shall have change in directions to impart adequate flexibility wherever required.
 6. All piping shall be supported from the floor as much as possible. The piping layout shall facilitate adequate support to pipe, fittings and components to avoid excessive stresses, deflections.
 7. Layout shall not restrict the space for man & material movements. Pipes shall not be routed in operating area of crane, monorail, other material handling equipment and designated maintenance space.
 8. Sufficient clearance as recommended by OEM around all the equipment shall be provided for man, material movement and maintenance activities.
 9. Sufficient gap between two pipes shall be provided to facilitate welding of pipes during fabrication/ maintenance and to accommodate, / operate, remove valves, tightening of bolts of flanges etc.
 10. Manually operated valves shall be installed at convenient height for ease of operation and maintenance.
 11. All instruments, display panels, gauges etc. shall be provided at convenient height and locations for observations, operations/ maintenance.

3.2.6.1.2 SUPPLY SCOPE

1. The scope of supply in general, includes the procurement, fabrication and supply of all the pipe, fittings and supports required to make CWS operable in efficient and safe manner. After the completion of detailed design by the contractor, the fabrication shall be initiated.
2. It is the responsibility of the contractor to prepare the fabrication drawings as per the detailed design carried out by the contractor. All the drawings prepared by the contractor shall need approval by the purchaser prior to taking up actual manufacturing/ fabrication work.
3. All the necessary arrangement required like nipple, half coupling, tubing, manifold etc. for installation of instruments, gauges, display panels shall be procured and deliver at site by the contractor.

3.2.6.1.3 ERECTION SCOPE

1. The contractor at site shall erect all piping procured and fabricated by him.

2. All valves, strainers, orifices, orifices plate assemblies, flow meters, instruments and other in-line components which form a part of the piping system shall be installed and erected by the Contractor to render the systems complete within his terminal points.
3. To maintain the conductivity and dissolved oxygen content of the water, a centralized water-polishing plant (located in the same plant room of CWS equipment) will be provided by the purchaser for all primary loops. After carrying out the detailed design, the contractor shall define the interface between WPU and CWS which is finalized by the IPR. The contractor shall interconnect with necessary pipe, inline components and supports. Procurement and erection of above interconnecting piping, inline components and supports shall be under scope of this tender.
4. All the supports required for piping system as per detailed design shall be fabricated and erected at site by the contractor. Contractor shall provide base plate with HILTI anchor fasteners or equivalent, size and type approved by the purchaser

3.2.6.1.4 INSTALLATION AND TESTING SCOPE

The contractor has to arrange the following at his cost which are required for fabrication, erection, cleaning, painting, testing and commissioning of the piping system.

1. Welding machines and all welding consumables like welding electrodes, filler rods and wires, gases like Oxygen, Acetylene, Argon, Carbon dioxide, Panes etc.
2. Dye penetrant and other required non-destructive testing materials and equipment.
3. All machinery, crane, equipment tools and tackles as required for transportation, handling, fabrication and erection. Unloading, storage at site and internal transfer of material shall be in the scope of the contractor.
4. All scaffolding materials and false work.
5. All painting equipment, paints, primer and other consumable required to carry out the painting works.
6. Pumps, blanks, flanges, etc. for carrying out hydrotest

3.2.6.2 Applicable Codes and Standards

The design, material, construction, manufacture, inspection, testing and performance of piping shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Piping will be installed. The piping supplied should comply with the latest applicable codes and standards along with all addenda, mentioned below:

ASME B31.3	: Process Piping
ASME B16.5	: Pipe Flange and Flanged Fittings
ASME B16.9	: Factory-Made Wrought Steel Butt Welding Fittings
ASME B16.11	: Forged Fittings Socket-Welding and Threaded
ASME B16.20	: Metallic Gaskets for Pipe Flanges
ASME B16.21	: Non-Metallic Gaskets for Pipe Flanges
ASME B16.25	: Butt welding Ends

ASME B16.47	: Large diameter steel flanges
ASME B16.48	: Steel Line Blanks
ASME B18.2.1	: Square and HEX Bolts and Screws (Inch Series)
ASME B18.2.2	: Square and HEX Nuts (Inch Series)
ASME B31.3	: Process Piping
ASME B36.10	: Welded and Seamless Wrought Steel Pipe
ASME B36.19	: Stainless Steel Pipe
ASTM A53	: Carbon steel pipes
ASTM A105	: Carbon steel, forging for piping application
ASME A182	: Specification for Forged or Rolled Alloy Steel Pipe flanges, Flanged Fittings & Valves and Parts for High Temperature Service.
ASTM A193	: Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	: Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A234	: Piping fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures.
ASTM A262	: Standard Procedure for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steel.
ASME A312	: Seamless and Welded Austenitic Stainless-Steel Pipes
ASTM A358	: Specification for electric fusion – welded austenitic chromium nickel alloy steel pipe for high temperature service
ASME A403	: Specification for Wrought Austenitic Stainless Steel Fittings
ASTM A515	: Carbon Steel pressure vessel plates for intermediate and high temperature service.
ASTM A577	: Standard Specification for Ultrasonic Angle-Beam Examination of Steel Plates
ASME A578	: Specification for Straight Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications
ASTM A672	: Electric fusion welded steel pipe for high pressure service at moderate temperatures
ASME A262	: Standard Procedure for Detecting Susceptibility to Intergranular attack in Austenitic Stainless Steel.
AWWA C207	: Specification for Steel Flange for Water works Service

3.2.6.3 DESIGN DATA AND PERFORMANCE REQUIREMENT

All pipes and pipe fittings shall be new and of high quality. The thickness of pipe and fittings shall not be less than that of indicated in this specification/PMS. The circulating water for Primary Loop is DM water and for secondary and tertiary loop is DM/soft water respectively. All primary loop system shall have stainless steel (SS) piping due to stringent requirement of water quality. Secondary and tertiary system shall have carbon steel (CS) piping.

3.2.6.3.1 Piping Material for Cooling Loops

The details about the pipe material and fitting such as elbow, tees, reducers, flanges, weldolets, end caps etc. provided in respective table of Pipe Material Specifications (PMS)

3.2.6.3.2 Piping Supports

Piping supports shall be fabricated out of MS angles, channels, beam sections of suitable sizes, plates, straight flats etc. as per approved manufacturing drawings.

3.2.6.4 GENERAL DESIGN CONSIDERATION FOR PIPING

1. All joints in the piping system shall be generally welded type, unless otherwise mentioned specifically or directed at site. All welding shall be done by qualified welders and shall strictly conform to ASME Code of practice for Shielded Metal Arc Welding (SMAW) and Gas Tungsten Arc Welding (GTAW) or a combination of the two. Before welding of pipes, make proper 'V' notch at the joints by chamfering the end of pipes and fittings with surface grinder. All electrodes shall be selected to match the mechanical and chemical properties of the parent material.
2. All the SS pipes and fittings shall be delivered in pickled and passivated conditions.
3. Tender drawings indicate schematically the size and location of pipes. The Contractor, on award of the work, shall prepare detailed shop drawings, details of fittings, locations of isolating valves, drain and air vent with valves, and all pipe supports. The contractor must keep in view the specific openings in buildings and other structures through which pipes are designed to pass.
4. Piping shall be properly supported with proper support and clamps, or stands clamps, as specified in SOQ and the same will be finalized during detailed design. The Contractor shall adequately design all the secondary & tertiary supports system, brackets, saddles, clamps and hangers and be responsible for their structural sufficiency.
5. Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from terrace floor, suitable flashing shall be provided to prevent water leakage. Pipe shall have a suitable clean out at the lower point and air vent at the highest point.
6. All piping work shall be carried out in a workman like manner, causing minimum disturbance to the existing services, buildings, roads 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.

7. Pipe sleeves at least 3 mm thick, 50 mm / 100 mm larger in diameter than condenser chilled water pipes respectively shall be provided wherever pipes pass through wall and slabs. Annular space shall be filled with sufficient thick insulating material.
8. Piping shall be supported in such a manner as not to put undue pressure on the insulation. 20 gage metal sheets shall be provided between the insulation and the clamp, saddle or roller, extending at least 15 cm both sides of the clamp, saddles or roller.
9. All piping work shall be carried out in a workman like manner, causing minimum disturbance to the existing services, buildings, roads 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. Cut-outs in the floor slabs for installing the various pipes are indicated in the Drawings. Contractor shall carefully examine the cut-outs provided and clearly point out where the cut-outs shown in the Drawings do not meet with the requirements.
10. The Contractor shall make sure that the clamps, brackets, clamp saddles and etc. provided (at no extra cost) for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints wherever required.
11. All pipes shall be accurately cut to the required size in accordance with relevant ASME Codes and burrs removed before laying. 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.
12. Insulation shall be applied as per the details provided in section "Insulation".
13. Auto purge valves shall be provided at all high points in the piping system for venting. Air valves shall be 15 mm pipe size valves with screwed joints. Discharge from the air valves shall be piped through an equal sized mild steel or galvanized steel pipe to the nearest drain or sump. These pipes shall be pitched towards drain points.

3.2.6.4.1 FABRICATION AND WELDING

3.2.6.4.1.1 Fabrication

1. Contractor shall prepare necessary fabrication drawings based on layout drawings for these systems. Contractor's fabrication drawings shall consider the requirement of the specification as

per applicable codes and standards. Fabrication and erection of pipe system shall be as per Contractor's fabrication drawings and layout drawings/isometrics approved by the purchaser.

2. The workmanship shall be in accordance with high grade industrial practice adequate to ensure satisfactory operation and service life. The manufacturing area of carbon steel and stainless steel shall be different to avoid the cross contamination. Pipes and fittings shall be free from injurious imperfections, burrs, loose scale and sliver which might become dislodged in usage and all other defects which might affect their serviceability.
3. All welded attachment on pipeline shall be of the same materials as that of parent pipeline and shall be subjected to the same fabrication and welding procedures as that of parent piping.
4. Where welded pipe or fitting are used, longitudinal welds in adjoining section shall be staggered to a minimum of 90° during fabrication.
5. All piping fabrication true to lines and elevation as indicating in the piping drawings/isometrics.
6. All machined surfaces shall be protected from dirt and mechanical damage.
7. All welded branch connections shall be of suitable structural adequacy by virtue of the intrinsic weld connection, reinforcing plates or rings of material inherent in the branch. It is the Contractor's responsibility to provide reinforcement wherever necessary for branch connections.

3.2.6.4.1.2 WELDING

1. The welding methods used for pipe fabrication shall be Shielded Metal Arc Welding (SMAW) and Gas Tungsten Arc Welding (GTAW) or a combination of the two. Welding for all the passes and joints shall be in accordance with Section-IX of the ASME code. Welding procedure, weld materials and welders shall be qualified in accordance with ASME Section-IX code and shall be approved by the purchaser before commencement of fabrication of piping. Welds shall be free from undercuts, overlaps and porosity etc.
2. All surfaces to be joined shall be thoroughly cleaned by steel brush at least at a distance of 15 mm from every joint to prevent weld contamination. The surface of the welding shall be free of scale, rust, oil, grease or other foreign material. The work and weld material shall be protected from rain and wind during welding. No welding shall be performed on wet surfaces. The fabricator is responsible for control of welding materials, which are used in the fabrication of EP's. Suitable identification, storage and handling of welding materials shall be maintained. Peening shall not be permitted.
3. All welds on the surface of the pipes shall be finished smooth and flush with the parent metal. Any scratch, dent or mark which occurs during fabrication or shipment shall be repaired to the satisfaction of the purchaser. No permanent marking or stamping shall be permitted. The general

surface finish shall be good. All scale, oxide, oil and other foreign material shall be completely removed from pipes. All surfaces that will not permit internal cleaning after complete fabrication and assembly shall be cleaned of all foreign material visible to the naked eye prior to assembly. Adequate precautions such as the fitting of temporary covers to all external ends of pipes shall be taken to ensure that this state of cleanliness is maintained till the completion of work. Particular care should be taken to ensure that all piping for pipes are kept clean and free from any matter which could obstruct the flow. All precautions necessary shall be taken to protect the surface from any damage.

3.2.6.5 QUALITY ASSURANCE, INSPECTION AND TESTING

1. The qualification of welding procedures shall be in accordance with latest edition of ASME Section-IX Boiler and Pressure Vessel Code.
2. All welders shall have to pass the performance qualification test in accordance to Section IX of the ASME Boiler and Pressure Vessel Code. All welding including tack welding shall be carried out by approved welders only. Any weld made by other than an approved welder shall be cut out and re-welded.
3. All the materials supplied under this contract shall be subjected to all shop tests as per applicable materials standards.
4. The purchaser's representatives shall also have access to the Contractor's heat treatment records and magnetic particles, fluorescent particle records, reports of repair etc.
5. Only calibrated test gauges should be used.
6. All weld passes shall also be examined by the dye penetrate test as per ASTM E 165. All defects shall be repaired and re-tested. 10% of each lot of piping shall tested with radiography as per the Codes. If the radiographs from that lot are approved, the entire lot is approved. The piping lot shall be decided with mutual agreement between the contractor and Engineer in charge. If the inspector/ Purchaser's representative rejects a radiograph of one weld from a lot, radiographs of two more welds must be done. Rejection of one of these two radiographs requires radiographs of two more welds. If one of these two radiographs are rejected, radiographs of all the welds in the lot must be done
7. All piping system shall be tested hydro statically to 1.5 times the Design Pressure by the Contractor, after erection. The test pressure shall be maintained until all welded/flanged joints are inspected for leakage or at least for 30 minutes.
8. After hydro tests, lines shall be drained thoroughly. When draining the fluid, the pipelines should be vented slowly to avoid excessive vacuum. Lines for the process service and stainless-steel lines shall be air-dried.
9. After pressure test, any leaky joints shall be cut out and repaired or completely replaced and tested repeated until the test has been satisfactory passed.

3.2.6.6 CLEANING AND PAINTING

1. After Piping has been erected and successfully commissioned and tested, all carbon steel piping shall be painted with 1 coat of inorganic zinc silicate primer then 2 coat of epoxy paint. No

primer and painting is required on Stainless Steel piping. Before paint is applied, the surface shall be dry and free from rust, dirt, scale and grease. Blasting of SS and CS piping shall be done to SA 2.5. If not practical, manual/mechanical cleaning to ST2/ST3 shall be done.

2. The insulated carbon steel piping shall only require primer coating. After that cold insulation shall be done as per specification mentioned in the scope.

3.2.6.7 EXECUTION OF PIPING WORK

1. The Contractor shall report the Purchaser/Engineer- in charge regarding the progress of procurement /inspection/dispatch of materials at site on regular basis.
2. Before commencement of fabrication/erection of piping system, the Contractor shall ensure that the drawings available with him are the latest issues as on date and shall obtain approval of the purchaser for proceeding ahead for the fabrication of piping.
3. No work shall be carried out in areas indicated as 'Hold' by the Purchaser in the drawings and documents until such time the 'Hold' is cleared by the Purchaser.
4. The Contractor shall prepare detailed bills of piping materials based on his isometric and fabrication drawings. After completion of work, the Contractor shall submit the final bills of materials to the Purchaser along with as built markup of the drawings prepared by him.
5. Unloading, site fabrication, storage and, shifting at site shall be carried out by the contractor safely by observing rules and regulations as applicable.

3.2.7 VALVES AND ACTUATORS**3.2.7.1 VALVES****3.2.7.1.1 SCOPE**

1. This specification covers the minimum technical requirements of design/selection, construction, manufacture, assembly, inspection, testing, performance guarantee, and supply of various types of Manual and Power Operated Valves of CWS.
2. It is not the intent to completely specify all details of the design and construction of valves; nevertheless, the valves shall conform to high standards of engineering, design, and workmanship.
3. Compliance with this specification shall not relieve the contractor of his responsibility of supplying the valves of proper design, construction, material and workmanship meeting the safe and efficient operating requirements. In case any accessories that are necessary to operate but not specifically identified herein shall also be in contractor's scope of supply.
4. The Contractor shall supply valves in accordance with the valve specification sheet along with auxiliaries if any, like locking arrangement, holding arrangement, drain etc.
5. Balancing valves are used for dual purpose of isolation and flow control which are indicated in the respective cooling loops P&ID

3.2.7.1.2 APPLICABLE CODES AND STANDARDS

- | | | |
|----|----------------|---|
| a. | ASME B31.3 | : Process Piping |
| b. | ASME B16.34 | : Valves-Flanged, Threaded, and Welding End |
| c. | ASME B16.5 | : Pipe Flanges and Flanged Fittings |
| d. | ASME B16.10 | : Face-to-Face and End-to-End Dimensions of Valves |
| e. | ASME B16.11 | : Forged Steel Fittings, Socket-Welding and threaded |
| f. | ASME B16.20 | : Metallic Gaskets for Pipe Flanges |
| g. | ASME B16.21 | : Non-metallic Flat Gaskets for Pipe Flanges |
| h. | ASME B16.25 | : Buttwelding Ends |
| i. | ASME B16.47 | : Large Diameter Steel Flanges: NPS 26 through NPS60 |
| j. | AWWA C207 01 | : Standard for Steel Pipe Flanges for waterworks service sizes 100 mm through 3600mm |
| k. | ANSI B1.1 | : Unified Screw Threads |
| l. | API 594 | : Check Valves: Flanged, Lug, Wafer and Butt-welding |
| m. | API 598 | : Valve inspection and testing |
| n. | BS 1868 | : Specification for steel check valves (flanged and Butt-welding ends) for the petroleum, petrochemical and allied industries |
| o. | ANSI/MSS SP-55 | : Quality standards for steel castings for valves, Flanges and fittings and other piping components |
| p. | ANSI/MSS SP-91 | : guidelines for manual operation of valves |

In case of conflict between specification, codes and standards, and VSS (Valve Specification Sheet), the stringent among them shall govern.

3.2.7.1.3 DESIGN REQUIREMENT

3.2.7.1.3.1 General Design requirements

1. All manual and power operated valves (Gate, Globe, Butterfly, Check, Ball, Needle etc.) shall meet the requirements as specified in respective VS. The MOC of all valves shall be as per VSS. Materials which are not specified in VSS shall be subject to approval of the Purchaser.
2. The valve design shall conform to the requirements of codes/specifications mentioned in the VSS.
3. All valves shall be of full bore design. The rating of the valves shall be as specified in the appropriate VSS and shall be in accordance with the pressure rating classification of ASME B16.34 or the applicable specification mentioned in the VSS.
4. Valve body internals should be designed for streamlined flow and low pressure drop.
5. The body shall be free of pockets or stress concentration points. Valve body minimum wall thickness shall be governed by the Design Standard specified in the VSS.
6. All materials designated in accordance with ASME/ASTM standards and shall be compatible with the CWS piping, shall be subject to mill tests for chemical and physical properties as required by such standards.
7. All Carbon Steel or Stainless Steel castings shall be examined by Radiography. The procedure and extent of radiographic examination and acceptance shall be in accordance with ANSI B16.34.
8. All valves after assembly shall be hydrostatically tested for body, back seat and seat closure at the pressures as indicated in standard.
9. End-to-end dimensions and face-to-face dimensions for butt welding-end valves and for flanged-end valves shall be in accordance with ASME B16.10.
10. The design of the valve shall be suitable for installation in any orientation (Horizontal/vertical).
11. All valves shall be supplied with position indicator.
12. The design and material for valve trim shall provide maximum protection against the effect of corrosion, erosion, galling, and leakage.
13. Swing check valve shall be spring loaded swing type with hinge stopper and positioner.
14. Lift type check valve shall be preferably of ball type with spring loading. Body seat ring shall be renewable.
15. For manually operated valves, hand-wheels shall be of spoke design preferably with not more than six spokes. Valves of sizes DN300 and above shall be provided with gear operation. A hand wheel with hand/auto lockable lever shall be provided for manual operation.
16. Actuators shall have the facility to select between remote and local operation with the help of local/remote selection switch.
17. The Electric Actuators shall be provided with integral controls including control and switching elements, all electrical components such as limit switches, torque switches, thermostat switches,

selector switches (Local-Remote-Off), and all monitoring elements, indicators, position transmitters etc. as a self-contained unit.

18. All flanged valves shall have flanges integral (except forged valves) with the valve body.
19. All butt welded type valves end shall match thickness of the connecting pipes.
20. Valve body/bonnet shall be forged/cast as specified. Forgings are acceptable in place of casting but not vice-versa.
21. Stem shall be forged or machined from forged/rolled bar. No casting is permitted.
22. Valves shall be dry, clean, rust, corrosion, and any mechanical damage during storage, handling and shipping and free from moisture, dirt and loose foreign material of any kind.
23. Each end of valves shall be protected with plastic cap or any other suitable material.
24. All SS valves shall be in solution heat treated and pickled condition.
25. The leak tightness of the valves stem seal shall follow the requirements of class 'A' of ISO 15848 or class VI of API 598 or equivalent standards.
26. Heavy components of valves shall be provided with a method of handling like lugs or eye-bolts.

3.2.7.1.4 INSPECTION AND TESTING

3.2.7.1.4.1 General

1. The Contractor shall be responsible for performing all inspections necessitated to establish and maintain the quality of workmanship in his works and that of his subcontractors in order to ensure mechanical accuracy of components, compliance with drawings, identity and acceptability of all materials, parts and equipment. He shall also conduct all tests required to ensure that the equipment and material furnished conforms to the requirements of applicable codes, this specification and the datasheets (VSS).
2. All valves after assembly shall be hydrostatically tested for body, back seat and seat closure at the pressures as indicated in VSS.
3. The Purchaser and/or his authorized agencies shall have full access to Vendor's premises at all reasonable times to the extent necessary to assess the compliance with the provisions of this specification. All tests and their procedures shall be notified well in advance.
4. Instruments used for conducting tests shall be calibrated. Calibration certificates shall be furnished from a recognized institution. The calibration shall have been carried out not more than six months prior to the testing date.
5. In the event of failure of a valve or any part thereof to meet fully the examination or test requirements specified herein, the Contractor shall obtain permission from the Purchaser before repair or subsequent use of such valve or part. If the repair including redesign are likely to affect the results of tests or work previously completed, appropriate reexamination and re-testing shall be conducted.
6. All components machined or fabricated from plate, sheet or stock shall meet the material requirements of ASTM or Material Specification approved by the Purchaser.
7. Each actuator must be performance tested and individual test certificates shall be supplied. The test equipment shall simulate a typical valve load and the various parameters including actuator output speed, operating time etc. shall be recorded.

8. Torque tests shall be carried out on all actuators and test report shall be provided to the purchaser before shipment.

3.2.7.1.4.2 Material Test

1. All materials designated in accordance with ASME/ASTM standards, shall be subject to mill tests for chemical and physical properties as required by such standards.
2. Certificates (test reports) showing that required tests have been carried out at the source should be submitted; and if such certificates are not available, the check tests shall be performed by the contractor at his own cost.
3. All components machined or fabricated from plate, sheet or stock shall meet the material requirements of ASTM or Material Specification approved by the Purchaser.

3.2.7.1.5 PERFORMANCE GUARANTEE

1. The Contractor shall guarantee that the valves shall meet the ratings and performance requirements at operating conditions as indicated in this specification and data sheet.
2. The performance of the valves shall be demonstrated by the vendor considering API 598 standard and their tolerances.
3. The Contractor shall obtain similar guarantees from each of his sub-contractors. However, the overall responsibility shall lie with the contractor.

3.2.7.1.6 CLEANING, PROTECTION AND PAINTING

1. All valves shall be free of mill scale. The inside surface of the valve shall be degreased and then flushed with clean filtered water (preferably demineralized). It shall be visibly clean, free of sand, dirt and any other foreign matter.
2. A sack containing silica gel desiccant shall be firmly attached to the inner surface on the cover of one end of each valve.
3. For the valves having welded ends, the ends should be properly cleaned and treated with a suitable rust preventive other than grease and then securely fitted with plastic or wooden caps.
4. For power operated valves, actuators and positioners shall be painted to protect them against corrosion.
5. All carbon steel exterior surfaces shall be thoroughly cleaned to remove mill scales, rust, grease etc. by wire brushing or sand blasting, as needed and then painted.
6. The paint shall be applied in accordance with manufacturer's instruction for surface preparation, intervals, curing and application. The surface preparation quality and workmanship shall be ensured

Table 17: Valve Specification Sheet (VSS)

S.No	TYPE	CLASS	MOC (MENTIONED OR BETTER EQUIVALENT)					
			TYPE	BODY	BONNET	DISC	SEAT	STEM
1	GATE	300	SS	A 182 F 304L or better			EPDM	
2	GATE	150	SS					
3	GLOBE	300	SS					
4	GLOBE	150	SS					
5	BALL	300	SS					
6	BUTTERFLY	150	SS	A 182 F 304L or better			EPDM	ASTM A 564 GR. 630 H1075-(17-4-PH)
8	NRV	150	SS					
7	PRV	150	SS					
9	GATE	300	CS	A 216 GR. WCB+13% CR.			EPDM	A 182 GR. F6A
10	GATE	150	CS					
11	GLOBE	300	CS					
12	GLOBE	150	CS					
13	BALL	300	CS					
14	BUTTERFLY	150	CS					
15	PRV	150	CS					
16	NRV	150	CS					
								ASTM A 479 TP 410 or Better

3.2.7.1.7

Table 18: Valve Data sheet

S. No.	Details	IPR Requirement
1.	Make	As per List of Makes
2.	Type	As per VSS
3.	Model	As per manufacturer
4.	Location	As per GA/P&IDs
5.	Qty.	Refer SOQ
6.	Size, DN	Refer respective loops of P&IDs and SOQ
7.	Operation	Manual, few with actuators
8.	Ambient temperature Max./Min.°C	45/5
9.	Fluid	DM water/ soft water
10.	Pressure rating	150# and 300#
11.	Temperature Range	5 to 80 °C
12.	Flow range	Refer P&IDs
13.	Design Code/Standard	ASME B16.34 & API 609(B)
14.	Design Pressure	Detailed design
15.	Design Temperature	Detailed design
16.	Pressure Rating	150 # ,300#
17.	End Connection and Standard	SORF Flanged Confirming to ASME B 16.5
18.	Opening Type	Quick Opening (not less than 30 sec.)
19.	Bolted	Yes
20.	Material of Construction	Refer VSS
21.	Materials	Mill test certificates from Manufacturer
22.	Seat type	Replaceable
23.	Shaft Seals	As per VSS
24.	Cv	Higher
25.	Pressure drop	Prefer Minimum
26.	Hydro test pressure for body, seat & disc	1.5 times design pressure for Body till 30 minutes or API 598
27.	Dimensional checks	Manufacturer certificate
28.	Leakage class	Bubble tight shut off, class VI

3.2.7.2 ELECTRIC ACTUATORS**3.2.7.2.1 SCOPE**

1. This specification covers the minimum technical requirements of design, construction, manufacture, assembly, inspection, testing, packing, and guarantee of various sizes of actuators of CWS.
2. Compliance with this specification shall not relieve the Vendor of his responsibility of supplying the valves of proper design, construction, material and workmanship meeting the

safe and efficient operating requirements mentioned in VSSs. In case any accessories that are necessary to operate but not specifically identified herein shall also be in Vendor's scope of supply.

3.2.7.2.2 DESIGN REQUIREMENT

1. The Electric Actuators shall be provided with integral controls including control and switching elements, all electrical components such as limit switches, torque switches, thermo switches, selector switches (Local-Remote-Off), and all monitoring elements, indicators, position transmitters etc. as a self-contained unit.
2. The Electric Actuator shall include a motor, reduction gearing and limit switches. The motor shall have a low inertia high torque design, class F insulated with a class B temperature rise, giving a time rating of 15 minutes at 40°C at an average load of at least 33% of maximum valve torque. The temperature shall be limited by thermostats embedded in the motor end windings and integrated into its control. The unit shall be so designed that a torque impulse is imparted to the stem nut in both opening and closing direction to start the disc in motion. The motor shall attain full speed before the stem load is encountered.
3. A hand wheel with hand/auto lockable lever shall be provided for manual operation. The hand wheel shall not rotate during electric operation. The motor shaft shall not rotate during manual operation. When in manual operation the hand wheel shall be automatically disengaged if the motor is energised simultaneously from control panel. Clockwise rotation of the hand-wheel shall give closing movement of the valve unless otherwise stated in the VSS. The actuator hand-wheel drive must be mechanically independent of the motor drive and should be such as to permit valve operation in a reasonable time with a manual force not exceeding 400N through stroke and 800N for seating/unseating of the valve.
4. The minimum torque rating of the actuator shall be selected at 1.25 times the maximum required valve torque. The actuator shall be capable of operating the valve at 80% of the supply voltage and the maximum seating or unseating torque required by the valve shall not exceed the rated torque. The design basis of rating of motor and calculations justifying torque and kW rating of the motors in tabular form shall be submitted by the Vendor.
5. A means for automatic 'torque switch bypass' shall be provided to inhibit torque-off during valve unseating and latching to prevent torque switch hammer under maintained or repeated control signals.
6. The operating speed shall be such as to give valve closing and opening time at approximately 300 mm per minute unless otherwise stated. Opening/closing time shall not be less than 30 seconds for valves of sizes 100 mm and above, and 20 seconds for valves of sizes below 100 mm.
7. The motors shall be of the high torque, low inertia, and squirrel cage induction type suitable for direct-on-line starting and intermittent duty. The electric supply to the motors shall be of 400 V, 3 Phase, 50 Hz. In addition, these motors are required to meet the following variations.
 - a. Voltage variation: $\pm 8\%$
 - b. Frequency variation: $\pm 1\%$
 - c. Combined voltage and frequency variation: $\pm 8\%$
8. During valve operation, it is possible that reverse voltages may be applied even before the rotor rotating in the forward direction has come to a stop. In the worst case the sum of the applied (reverse) voltage and induced voltage (due to continued forward motion) and residual

magnetism may be 150% to 200% of rated voltage. The motor shall be designed to withstand this condition.

9. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It shall have the necessary tapings and be adequately rated to provide power for following functions
 - a. Energization of the contactor coils
 - b. 24V DC output power for remote controls
 - c. Supply for all internal electrical circuits
10. All motors shall be of 'Totally Enclosed Non-Ventilated' (TENV) type and of IP68 protection as per IEC 529. Enclosure must allow for temporary site storage without the need for an electrical supply connection. Motor rotor shall preferably of die-cast aluminium and, if brazed, shall be free from phosphorous.
11. The actuator gearing shall be totally enclosed within the oil-filled gear case suitable for operation at any angle. Grease lubrication is not permissible. The structural design and the lubricating scheme of the actuators shall be suitably designed to meet this requirement.
12. All main drive gearing must be of metal construction. The actuator drive shall incorporate a lost-motion hammer blow feature. The output shaft shall be hollow to accept a rising stem, and incorporate thrust bearings of the ball or roller type at the base of the actuator. The design shall be such as to permit the gear case to be opened for inspection or disassembled without releasing the stem thrust or taking the valve out of service.
13. Each actuator shall be provided with adjustable torque switches with one *make* and one *break* contact for limiting the amount of thrust exerted on the valve in both the opening and closing operations
14. Adjustable limit switch contacts which are electrically separate shall also be provided as follows
 - a. One set of changeover contacts to operate at fully closed position (for use in motor starter circuit) and one set to operate other than fully closed position i.e. intermediate and open position
 - b. One set of changeover contacts to operate at fully open position (for use in motor starter circuit) and one set to operate other than fully open position i.e. intermediate and close position
15. Two earthing terminals each of M6 shall be provided on the actuator body for solidly grounding the actuator including the motor.
16. The internal power wiring shall be of 1.1 KV grade and control wiring shall be of 660V grade. The size of conductor shall not be less than 1.5 mm² copper. Each wire shall be clearly identified at each end.
17. All wiring supplied as part of the actuator shall be contained within the main enclosure for physical and environmental protection. External conduit connections between components will not be accepted.
18. Each actuator shall be supplied with a start-up kit comprising installation instruction, electrical wiring diagram and sufficient start-up spare cover screws and seals.

3.2.7.2.3 TESTS ON ACTUATORS

1. For power operated valves, type tests on actuators as per IEC 382 shall be carried out as specified in specifications.

2. Each actuator must be performance tested and individual test certificates shall be supplied. The test equipment shall simulate a typical valve load and the following parameters shall be recorded.
 - a. Current at maximum torque setting
 - b. Torque at maximum torque setting
 - c. Test voltage and frequency
 - d. Flash test voltage
 - e. Actuator output speed or operating time
3. Actuator shall be tested for capability to start at 80% of rated voltage with full load.

Each valve shall be tested along with its actuator to check valve seat leakage, and proper functioning of the valve. Opening and closing times shall be recorded. For motor operated valves, current drawn by the motor shall be measured during opening and closing. Functioning of limit switches shall be checked.

3.2.7.2.3.1 FUNCTIONAL TESTING

Before testing all power, operated valves shall be fully calibrated including setting of limit switches, mechanical stoppers, position indication etc. as applicable. During valve operation, the limit switch setting shall also be checked. Power operated valves shall be operated with actuator with the help of motive power and performance to be checked. The opening and closing time of valves shall be recorded.

3.2.7.3 ANNEXURE-20

Annexure 20: Data Sheet for Electric Actuators

Sr. No.	Item	Details to be filled by Vendor
1.	General	
a.	Make	
b.	Type/Model	
c.	Rating	
d.	Input Power Supply	
2.	Torque Rating	
a.	Motor Rating	
b.	Basic Actuator Rating	
c.	Final Stage Output, kW	
3.	Actuator output speed, rpm	
4.	Maximum Thrust and Direction	
5.	Base Plate Details	
6.	Motor to Valve Stem Gear Ratio	
7.	Hand wheel to Valve Stem Gear Ratio	
8.	Hand wheel Diameter	
9.	Hand wheel Mechanical Advantage	
10.	Limit Switches	
a.	Numbers Provided	
b.	Type	
c.	Manufacturer	
d.	Rating	
e.	Range of setting	
f.	Location	
11.	Torque Switches	
a.	Numbers Provided	

Sr. No.	Item	Details to be filled by Vendor
b.	Type	
c.	Manufacturer	
d.	Rating	
e.	Range of setting	
f.	Location	
12.	Details of Local Position Indicator	
13.	Speed	
a.	Valve Opening Time, sec	
b.	Valve Closing Time, sec	
14.	Gearing	
a.	Type of reduction	
b.	Gear Ratio	
c.	Lubrication of Gearing	
d.	Force required for Operation	
e.	Mechanical Stop Provided or Not?	
15.	Materials of Construction	
a.	Casing	
b.	Gears	
c.	Shaft	
d.	Bushes	
e.	O-ring	
f.	Fasteners	
16.	Weight, kg	
a.	Valve	
b.	Actuator	
c.	Complete Assembly	

3.2.8 BELLOWS AND STRAINERS

3.2.8.1 BELLOWS

3.2.8.1.1 SCOPE

This specification is to cover design, construction features, material, manufacture, inspection and testing, packing, supply, delivery and guarantee of non-metallic expansion bellows.

The purpose of expansion bellow is to absorb vibrations at equipment nozzle and thermal expansion of the installed pipe.

3.2.8.1.2 CODES AND STANDARDS:

The design, materials, construction and manufacture of expansion joints shall comply with all the currently applicable statutes, regulations and safety codes as indicated in the respective specification/datasheet. The expansion joints shall also conform to the latest editions of the following codes and standards as applicable. The vendor may also offer units as per alternate standards for purchaser's consideration, if they are established to be equal or superior to the indicated standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility.

1. EJMA : Expansion Joint Manufacturer's Association Standards
2. ASME B 31.3 : Process Piping
3. ASME B 16.5 : Pipe Flanges and Flanged Fittings
4. AWWA C 207 : Specification for Steel Flange for Water works Service
5. ASME B 16.25 : Butt welding Ends
6. ASME Section-IX : Welding and Brazing Qualifications
7. ASTM A 240/240M : Specification for Heat Resisting Chromium Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessel.

3.2.8.1.3 DESIGN AND CONSTRUCTION FEATURES

1. All parts of the expansion joint shall be amply proportioned to take care of all stresses that will occur during continuous operation under the design parameters and minimum fatigue life (number of cycles) specified in the datasheet. Allowable stresses shall be based on the codes and standards listed in this specification. Calculations to indicate conformity with the requirements of EJMA standards and the applicable code of design shall be provided during detailed design.
2. Contractor shall submit detailed drawing of expansion bellow to IPR for their approval.
3. End connections are to match with the adjust piping as specified in data sheet
4. Expansion joint shall have rated movements sufficient to accommodate the maximum deflections as required by the system.

3.2.8.1.4 Fabrication Requirement

1. The longitudinal weld in the bellow shall be butt- type full penetration weld.
2. Other than attachment welds, no circumferential welds are permitted to the bellow element.
3. Weld repairs shall not be permitted on parent material of bellows elements.

3.2.8.1.5 INSPECTION AND TESTING

3.2.8.1.5.1 General

The inspection, testing and ensuring conformance to the technical requirements shall be responsibility of the contractor in accordance with this specification as well as EJMA standard.

The contractor shall perform all inspection and testing specified in this specification to the satisfaction of the IPR and as per the procedure approved by them. The contractor shall arrange and / or provide all testing and inspection facilities required during manufacture. The contractor shall get the inspection jobs done by qualified personnel.

3.2.8.1.5.2 Thickness Measurement

The wall thinning shall be checked on sample pieces of identical convolution for each size of bellow, due to forming of convolution. The strain (wall thinning) shall be limited to 5%.

3.2.8.1.5.3 Structural Tests

3.2.8.1.5.3.1 Pneumatic Pressure Test and Leak Test

Flexible joint shall be fixed in a suitable fixture to prevent any axial extension of bellows while it is under the pneumatic pressure. With the flexible joint assembly ready for the test and suitably supported with its axis horizontal it shall be tested at 1.1 times design pressure. This pressure shall be held for not less than 10 minutes. The bellow shall leak tested by applying soap solution to the entire outside surface and all weld joints. The pitch of the bellows convolutions shall be measured and recorded before and during testing. In addition to inspecting the expansion joint for any leaks and general structural integrity, the bellows shall be visually inspected for any meridional yielding.

3.2.8.1.5.3.2 Deflection Test

The flexible joints shall be subjected to compressive deflection test at atmospheric pressure. The flexible joints supported with its axis horizontal shall be tested for axial deflection and lateral deflection as specified in bellow datasheet. The contractor shall determine actual spring rates (axial & lateral) or force required to deflect the bellow during the test. Permanent set exceeding 2 percent of bellow length shall not be acceptable.

3.2.8.1.5.3.3 Combined Pressure and Deflection Test

The above two tests shall be carried out simultaneously on the flexible joints so that it shall experience a maximum axial (compression/extension) & lateral deflection as specified in Bellow datasheet and a maximum pressure of 1.1 x design pressure simultaneously. Test may be performed by subjecting the bellow to equivalent compression/extension as per EJMA.

3.2.8.1.6 IDENTIFICATION, PACKING AND MARKING

1. Each bellow shall be identified with pipe size, bellow tag no. as indicated in approved fabrication drawing by suitable paint or engraved on bellow flange / weld ends.
2. Each expansion joint assembly shall be completely pre-assembled and packaged as an individual unit. There are to be no loose pieces.
3. When the expansion joint is supplied with a flow liner or sleeve, a flow arrow showing the direction of flow shall be plainly visible on the outside of the expansion joint.
4. Each assembly shall be identified with its tag number on a stainless steel tag plate.
5. All components required for completion of any assembly shall be packed and dispatched together.
6. Where the expansion joints are pre-stretched or pre-compressed in the manufacturer's shop, necessary installation expedients shall be supplied with detailed marking and instructions for their removal after installation.

3.2.8.1.7 PAINTING AND CORROSION PROTECTION

Unless specified otherwise in datasheet, expansion joints shall not be painted except for the carbon steel protection cover and the installation expedients. Other carbon steel parts shall be given a light coat of rust preventive.

3.2.8.1.8

Table 19: Non-Metallic Bellows Data Sheet

SR. NO.	PARAMETER	DATA	
1.0	General		
1.1	Type	Non-Metallic Expansion Bellow	
1.3	Service	Raw Water (HRS)	
1.4	Pipe Size / Thickness (mm) / Bellow Quantity (nos.)	Pump's - Inlet and outlet nozzles of all Primary, Cooling Loops	Pump's - Inlet and outlet nozzles of all Secondary and Tertiary Cooling Loops
1.5	Pipe Material	ASTM A 672 Gr B 60 CL-12	
1.6	Installation	Horizontal	
2.0	Design requirement		
2.1	Design Pressure (kg/cm ²)	a-18 for all pumps b-30 (DNBHP/ DNBLP)	7.0
2.2	Max. Operating Pressure (Mpa)	a- 1.5 for all pumps b- 2.4(DNBHP)	7.0
2.3	Design Temperature (deg. C)	78	
2.4	Max. Operating Temperature (°C)	50	45

2.5	Max. Operating Flow (kg/s)	As per detail design
2.6	End Connection	SO, RF, Serrated Finish as per AWWA C 207 Class-D
2.7	Design Standard	EJMA
3.0	Design Parameters	
3.1	Axial Movement (mm)	20 *
3.2	Lateral Movement (mm)	12 *
3.3	Angular Rotation (deg.)	2.5 *
3.4	Torsional Rotation (deg.)	2 *
3.5	Required min. Cycle life	7000
3.6	Expansion Joint Length	Not to exceed 300mm
3.7	Wall thickness of bellows	Vendor to specify
3.8	Number of Arch / Corrugations	Vendor to specify
4.0	Material	
4.1	Bellows	Abrasion resistant rubber compound with adequate reinforcement of canvas and rayon piles with neoprene inner and outer cover
4.2	Steel Retaining Ring and Stretcher Bolt Plate	CS (Galvanized)
4.3	Bolts, Studs and Limit rods	ASTM A 193 GR. B7
4.4	Nuts	ASTM A 194 GR. 2H
4.5	Gasket	EPDM-Durometer Hardness Shore-A 60+5
5.0	Tests	
5.1	Hydrostatic Test Pressure (MPa)	1.5 X Design Pressure
5.2	Vacuum Test Pressure	N.A.
5.3	Type Test	For all types of movements
5.4	Visual and Dimensional Inspection	100%

5.5	Bellow material test	Tensile, Elongation and other movements, Shore Hardness, Adhesion test of fabric to rubber, Compression set test, Accelerated ageing test
-----	----------------------	---

Notes:

1. Final bellow drawing with design calculations shall be submitted by Vendor for approval before fabrication.
2. All other tests mentioned in bellow datasheet as well as specification needs to be carried out by vendor as per applicable code.
3. Vendor shall furnish Physical and Chemical test certificate of raw materials.
4. Control rod is required to guide axial compression / elongation of bellow.

‘*’ indicates contractor shall check the adequacy of the movement values based on equipment nozzle movement.

3.2.8.2 STRAINERS**3.2.8.2.1 SCOPE**

Strainers shall be ‘Y’ or ‘T’ type (pot/basket) strainers as shown on the piping and instrumentation drawings. Strainers shall be provided on the inlet side of each suction of each pump, and where shown on the P&IDs Drawings.

3.2.8.2.2 MOC for Primary loops

Body, Cover, Strainers and wetted parts A 182 F 304L; Seat should be replaceable (along with any bush/bearing/O-ring) EPDM or better.

3.2.8.2.3 MOC for secondary and tertiary loops

Body and Cover shall be of ASTM A 515 GR. 60, screens shall be of type Dutch plain woven type and of SS304L with 10 Mesh size; Seat should be replaceable (along with any bush/bearing/O-ring) EPDM or better. Bubble tight shut off (class VI tightness).

Type of Strainer		Face to Face	Testing	End Connection	Mesh Size	Design Pressure
Bucket/pot/T type	\geq DN250	ASME1 6.10	API 598	ASME B16.5	100	As per P&ID
Y-type	\leq DN200					

3.2.8.2.4 Y- Strainer / T-Type Strainer for Primary Cooling Loops

S. No.	Details	IPR Requirement
1.	Make	As per List of makes
2.	Type	Y & T type based on Size of Pipe

3.	Model	As per manufacturer
4.	Qty.	ICECRH Loop: 2 nos. DNBLP Loop: 2nos. DNBHP Loop: 2nos. DNBCH Loop: 2nos. IPRCH Loop: 2nos.
5.	Size, DN	Refer P&ID of respective loop
6.	Ambient temperature Max./Min., °C	45/10
7.	Fluid	DM water
8.	Flow Rate	As per P&ID
9.	Operation Temperature, °C	Max. 40
10.	Sp. Gr.	1
11.	Viscosity	1 cp
12.	Limiting pressure drop @50% Clogging	2 mwc
13.	Design Code/Standard	ASME SEC VIII DIV 1
14.	Design Pressure	As per P&ID and Loop requirement
15.	Design Temperature	90 °C
16.	BODY:	
17.	Pressure Rating	150 # As per ASME B 16.34
18.	End Connection and Standard	SORF Flanged Confirming to ASME B 16.5
19.	Cover Type	Quick Opening (Optional)
20.	Bolted	Yes
21.	Material of Construction	
	a) Body	ASTM A351 CF8M/or equivalent
	b) Cover	ASTM A351 CF8M/ or equivalent
	c) Gaskets	Spiral Wound with SS 304 Inserted Graphite
	d) Nuts & Bolts	ASTM A 194 GR.8 & ASTM A 193 GR. 7
22.	Screen type & material	Dutch plain woven & SS 316 L
23.	Mesh size	10 mesh (0.84 mm opening linear)
24.	Flow area	Min. 2 times pipe area
25.	Hydro test pressure	1.5 times design pressure for Body till 30 minutes

3.2.8.2.5 Y- Strainer / T-Type Strainer for Chiller and HRS Cooling Loop

Sr. No.	Details	IPR Requirement
1.	Make	As per List of Makes
2.	Type	As per P&IDs
3.	Model	As per manufacturer
4.	Qty.	Chiller loop: 2 nos. HRS loop: 3nos.
5.	Size, DN	Refer respective loops of P&IDs

6.	Ambient temperature Max./Min., °C	45/5
7.	Fluid	Soft water
8.	Flow Rate,	As per P&ID
9.	Operation Temperature, °C	Max. 40, min 5
10.	Sp. Gr.	1
11.	Viscosity	1 cp
12.	Limiting pressure drop @50% Clogging	2 mwc
13.	Design Code/Standard	ASME SEC VIII DIV 1
14.	Design Pressure	As per P&ID and Loop requirement
15.	Design Temperature	90 °C
16.	BODY:	
17.	Pressure Rating	150 # As per ASME B 16.34
18.	End Connection and Standard	SORF Flanged Confirming to ASME B 16.5
19.	Cover Type	Quick Opening (Optional)
20.	Bolted	Yes
21.	Material of Construction	
	a) Body	ASTM A 515 GR. 60
	b) Cover	ASTM A 515 GR. 60
	c) Gaskets	EPDM– Dura meter Hardness SHORE – A 60 ± 5
	d) Nuts & Bolts	ASTM A 194 GR. 2H & ASTM A 193 GR. B7
22.	Screen type & material	Dutch plain woven & SS 316 L
23.	Mesh size	10 mesh
24.	Flow area	Min. 2 times pipe area
25.	Hydro test pressure	1.5 times design pressure for Body till 30 minutes

3.2.9 THERMAL INSULATION

3.2.9.1 SCOPE

The specification covers the minimum technical requirements for materials, inspection, testing, supply, application methods and guarantee of “Thermal Insulation” for piping and equipment.

Thermal insulation is provided on piping and Equipment to avoid heat transfer (outward/inward) through their exposed surfaces. Piping and equipment shall be insulated for the purposes of maintenance of process temperatures during variations in ambient temperatures, conservation of heat, conservation of cold, condemnation prevention and physical protection of personnel.

Compliance with this specification, however, shall not relieve the Vendor/ Contractor of his responsibility of supplying insulations of proper materials and workmanship meeting general insulating purpose.

Piping and equipment operating with fluid temperatures more than 60°C or less than 10°C shall be insulated for physical protection.

The vendor shall work out the necessary of insulation for piping and equipment which will likely be exposed to temperatures less than 10°C and higher than 60°C.

3.2.9.2 MATERIAL

Insulation material shall be new and fresh, incombustible, odorless, fire retardant, rot proof, chemically inert, non-corrosive to steel and Aluminium, pre-formed shapes and flexible and completely free from all forms of asbestos. Thickness of the insulation shall be as specified for the individual application. Each lot of insulation material delivered at site shall be accompanied with manufacturer’ test certificate for thermal conductivity values and density. Adhesive used for setting the insulation shall be non-flammable, vapour proof adhesive, Shalimar CPR compound, or approved equal, cold setting compound. Insulating material shall be suitable for the specified application and operation and shall be easy formed during application according to piping and equipment to make ease of installation and application on the piping, fittings and equipment. Sealants and adhesive shall be supplied in factory-sealed containers.

3.2.9.2.1 Nitrile Butyl Rubber (NBR)

Material of construction shall be fiber-free elastomeric nitrile rubber foam with closed cell structure and materials and their properties shall conforms to ASTM D2000 M. The density of the same shall be min. 36 Kg/m³ at a mean temperature. The material should have a thermal conductivity not exceeding 0.02 W/mK. The maximum surface temperature the material should withstand is 60° C and minimum temperature should be 5°C. The material should conform to Class 1 rating for surface spread of Flame as per BS 476 Part -7. The material and installation methodology should be in accordance with the specifications. Hardness of material shall be 70 shore (A).

3.2.9.2.2 Polyurethane Foam

Following types of Polyurethane Foam shall be used for piping and equipment operating at temperatures up to 20°C:

1. Preformed or foamed-in-place polyurethane for sizes up to and including DN350
2. Polyurethane blocks, segments or foamed-in-place sections for sizes greater than DN350

Polyurethane foam shall conform to ASTM C591. Thermal conductivity when determined in accordance with ASTM C518 shall not exceed the 0.02 W/m-K at a mean temperature of 20°C. Slabs and pipe sections shall have a min. density of 36 kg/m³. Flame spread rating shall not exceed 25 in accordance with BS 476 Part 7. Hardness of material shall be 70 shore (A).

3.2.9.2.3 Vapour Barrier

Vapour barriers are designed and selected to retard the passage of moisture vapour from the atmosphere to the insulated surface.

3.2.9.2.4 Cladding

Jacketing material for piping and equipment shall be Aluminium sheets conforming to ASTM B209 and IS-737 on insulating materials. All the ancillaries required for applying the insulation over the piping and equipment shall be provided by the vendor like screws, fasteners, clips, lacing wires, metals bands etc.

- a. 0.025 Inches (0.635 mm) for insulation outside diameters less than 150mm
- b. 0.040 Inches (1.016 mm) for insulation outside diameters between 150mm to 450mm

3.2.9.2.5 Piping/Storage Tank/Pressurizer Insulation:

All chilled water piping/Chilled water storage tank/pressurizer (chiller loop) shall be insulated in the manner specified herein. Before applying insulation, all pipe work, surfaces and fittings shall be brushed and cleaned, and dust, dirt, mortar and oil removed. All piping surfaces and fittings shall be provided with a coat of zinc chromate primer, followed by two coats of cold setting adhesive compound. Thermal insulation shall then be applied as follows:

Pipe size (mm)	Thickness for Insulation (in mm)	
	PUF	NBR
10 to 40	25	12
50 to 125	50	20
150 & Above	50	40

3.2.9.3 ERECTION AND INSTALLATION

1. Pre-moulded pipe sections shall be placed over the pipes, the longitudinal joints of this pipe section shall be sealed with the adhesive compound. The traverse joints shall also be sealed with adhesive compound. The insulation shall be continuous over the entire run of piping, fittings and valves. Insulation shall be applied only after the piping system has been

satisfactorily tested for leaks. All insulated pipes shall be covered with layer of thick polythene sheet as vapour barrier. PVC/steel straps at 400 mm center shall be used to hold insulation and vapour barrier together. Insulation material shall be covered with a continuous sheet of thick polyethylene (for protection from water and moisture), Aluminum cladding will be provided over vapour barrier.

2. Skilled workmen specially trained in this kind of work shall carry out all insulation work. All insulated pipes shall be labeled supply run (SR) or return run (RR) and provided with 300 mm wide band of paint along the circumference at every 1200 mm distance for color coding. Direction of fluid shall also be marked.
3. Pump Insulation: For all chilled water pumps lower volute of pumps shall be insulated in the same manner as the chilled water pipes and provided Aluminum cladding as per detailed mentioned above.
4. Valve and fittings Insulation: all valves associated with chilled line with in-line components shall be insulated in accordance with the manufacturer's standards.
5. Chilled Water storage tank and pressurizer Insulation: Chilled water tank, and chilled water pressurizer tank shall be insulated as per chilled water piping specification and same shall be cladded with aluminium sheet as per the detailed given above for relevant piping insulation paragraph

3.3 ELECTRICAL ITEMS

3.3.1 THREE PHASE INDUCTION MOTORS

3.3.1.1 SCOPE

Three phase squirrel cage induction motors operating on variable voltage, variable frequency source shall be having features as listed in the chapter. The ac motors shall be selected suitably as per system requirement and compatible with pumps/fans. High energy efficient motor shall only be selected for our various application. All pumps of Primary cooling loops namely, ICECRH, DNBHP, DNBLP, DNBCH, IPRCH shall be equipped with Variable Frequency Drive (VFD) suitable to respective pump set.

3.3.1.2 SITE CONDITIONS

The following shall constitute normal site conditions for the purpose of this standard:

Ambient Temperature – 50°C.

Relative Humidity – 100%

Ambient Air – Ambient air may contain fair amount of conductive dust.

However, maximum ambient temperature and 100% relative humidity may not occur simultaneously.

3.3.1.3 CODES AND STANDARDS APPLICABLE

The motors shall conform to following codes and standards:

1. IS 12615: 2018-Energy Efficient Induction Motors-Three Phase Squirrel Cage
2. IS 1231: Rotating Electrical machines- Dimensions foot mounted
3. IS 2223: Rotating Electrical machines- Dimensions flange mounted
4. IS 1271:2012-Electrical Insulation – Thermal evaluation and Designation
5. IS 6362: Designation of methods of cooling of rotating electrical machines
6. IS 12065:1987 `Permissible limits of noise level for rotating electrical machines`
7. IS 12075:2008 `Mechanical vibration of rotating electrical machines`

3.3.1.3.1 TYPE OF ENCLOSURE

The degree of protection to be provided by the enclosure shall be IP 55 of IS 4691:1985 `Degrees of protection provided by enclosures for rotating electrical machinery (first revision)` or better as required by the purchaser. The provisions of the terminal box shall be in accordance with clause 5 of IS -1231:1974. It shall be possible to turn the terminal box to any of the four positions at 90° intervals to permit cable entry from any of these four positions. The motor of Cooling tower shall be selected for outdoor working condition and shall be provided with water resistant canopy made of suitable material.

3.3.1.3.2 METHOD OF COOLING

The method of cooling used shall be fan cooled in accordance with IS 6362:1995 `Designation of methods of cooling of rotating electrical machines. The motor of Chiller shall be refrigerant cooled as specified by the manufacture of chiller.

3.3.1.3.3 MOUNTING

The mounting shall conform to any one of the designations IMB 3, IMB 5, IM 1001, IM3001 specified in IS 2253:1974 `Designations for types of construction and mounting arrangement of rotating electrical machines (first revision)'. If specified, hollow shaft extension may be provided according to the drawing provided by the purchaser.

3.3.1.3.4 RATED VOLTAGE, FREQUENCY AND PERFORMANCE VALUES

3.3.1.3.4.1 Voltage and Frequency Variation

The motors shall be capable of delivering the rated output with

1. The terminal voltage differing from its rated value by not more than $\pm 10\%$ in general cases but in special cases if desired by the purchaser.
2. The frequency differing from its rated value by not more than $\pm 3\%$
3. Any combination of (1) and (2). In the case of continuous operation at extreme voltage limits, the temperature-rise limits specified in Table-1 of IS 325:1996 shall not exceed by more than 10°C . Motors, when operated under the extreme conditions of voltage and frequency variation, may not necessarily have their performance in accordance with this standard.
4. The motor shall be suitable for operating in the frequency range as per requirement with corresponding voltage variation for obtaining rated torque when used for variable speed application.
5. The motor shall be suitable for direct-on-line starting for non-inverter application.
6. The starting current shall be limited to max. six times the full load current.

3.3.1.4 Performance Values

1. The performance values shall be as per below table:

Table 20: Performance requirement

Parameters	Remarks
Frame Size	To be furnished by manufacturer / As per Purchaser's requirement.
Voltage level	Voltage level from 220 V to 415 V with variation $\pm 10\%$
Output KW	As per customer requirement

Dimensional Standard	As per relevant IS
Degree of Protection	Minimum IP55
Mounting	As per application & relevant IS
Cooling	As per relevant IS however in case of fan cooled at lower RPM than rated the cooling should be sufficient to take care of temperature rise limited to Class B. In case of separately forced cooling motor, the motor speed is to be limited to 1500 rpm(synch).
Peak Voltage	Peak Voltage 1.6 KV/ Min. For 415-volt motor- Both Drive and Motor shall comply with NEMA MG1 section 30.40.4.2 which specifies these limits at a maximum peak voltage of 1600 Volts and a minimum rise time of .1 microseconds.
Carrier switching frequency	As guided by the inverter drive specification
Voltage rise time	0.1 micro seconds
Distortion	To be specified by the purchaser
Suitable for up to supply voltage and frequency	To be furnished by manufacturer
Duty	S1- Continuous operation
Insulation	Minimum F Class with temp rise limited to class B
Cooling arrangement	To be furnished by manufacturer
Grade of wire	For wire wound motors, the grade of winding wire must be dual coat high grade enameled wire or Inverter grade wire to be furnished by the manufacturer,
Vacuum Impregnation	Winding must be vacuum impregnated
Maximum permissible RPM for each frame size	To be furnished by manufacturer
Any special series indicated for VFD application motor on name plate	Name plate must indicate that it is suitable for VFD application
Stalled Rotor Withstand Time	Motor stalled rotor withstand time is to be furnished by the manufacturer

2. Correction Factors for temperature shall be as per below details:

Ambient temperature (°C)	Output correction factor (%)
55	80

60	75
----	----

3. DIMENSIONS

The basic dimensions of foot-mounted and flange mounted ac roller table motors and their shaft extensions shall correspond to IS 1231:1974 'Dimensions of three phase foot-mounted induction motors (third revision)' and IS 2223:1983 'Dimension of flange-mounted ac induction motors (first revision)' respectively.

3.3.1.5 SPECIAL CONSTRUCTIONAL FEATURES

3.3.1.5.1 Material of Body

Material of the motor body shall be cast iron grade FG-260 conforming to:

1. IS 210:2009 'Specification for grey iron castings or
2. IS 1865:1991 'Specification for iron castings with spheroidal or nodular graphite or fabricated steel conforming to
3. IS-2062:2011 'Hot rolled medium & high tensile structural steel'.

Nonferrous material for motor body is not acceptable. For foot-mounted motors with cast iron / Spheroidal Graphite iron body, the feet shall be integrally cast with the body. Separately screwed eyebolts or lifting lugs of suitable sizes shall be provided on the motor for the purpose of lifting.

3.3.1.5.2 Shaft Extension

All motors shall have a single shaft extension unless otherwise specified.

3.3.1.5.3 Bearings

All bearings shall have an L10 life of at least 40000 h according to IS 3824:2002 'Rolling bearings – Dynamic load ratings & rating life.' The bearings shall be selected so as to take care of the thrust to which the motors are likely to be subjected. The actual thrust value shall be indicated by the user.

3.3.1.5.4 Lubrication of Bearings

Re-greasing facility through a grease nipple conforming to IS 4009 (Parts 1 & 2):1981 Specification for grease nipples (*first revision*), along with facility for excess grease removal shall be provided for motors of frame sizes 200 and larger.

3.3.1.5.5 EARTHING

Two separate earthing terminals of proper size suitable to receive galvanized iron conductor shall be provided on the bottom half of the motor body. In addition to the two outside earthing terminals, provision for one more earthing terminal inside the terminal box is to be kept. Size of

earthing terminal shall conform to clause 12.2.2.2 of IS 3043: 1987 `Code of practice for earthing (first revision)'. Cable gland earth tag/ring should be used for motor cable gland earthing.

3.3.1.5.6 LIMITS OF VIBRATION

Limits of vibration intensity shall be in accordance with normal class of Table 1 of IS 12075:2008 Mechanical vibration of rotating electrical machines with shaft heights 56 mm and higher – measurement, evaluation and limits of vibration severity. ‘The manufacturer shall indicate in the test certificate that rotor has been dynamically balanced with half key.

3.3.1.5.7 LIMITS OF NOISE LEVEL

The noise level shall not exceed the limits specified in IS 12065:1987 `Permissible limits of noise level for rotating electrical machines’

3.3.1.6 NAME PLATE

Name plate made of stainless steel stating the following particulars shall be fixed on the body of the motor:

- a. Rated output in kW,
- b. Name of the manufacturer and trade mark,
- c. Manufacturer’s serial number and frame reference,
- d. Rated voltage and winding connection of the motor,
- e. Rated current in Amps. at rated voltage,
- f. Speed in rev/min at rated output,
- g. Rated frequency,
- h. Class of insulation,
- i. Type of duty,
- j. Bearing designation,
- k. Type of enclosure,
- l. Mass of motor in kg,
- m. Year of manufacture.
- n. Motor suitable for VFD
- o. Power factor details
- p. Efficiency of motor.
- q. EFF classification.

NOTE:

- i. An additional name plate may be used to indicate the designation of bearings, Lubrication details (type, quantity and frequency).
- ii. Permanently attached winding connection diagram shall be mounted inside the terminal box cover

3.3.1.7 TESTS

The tests applicable to the motors covered by this standard shall be in accordance with the table given below. A certificate indicating the routine tests conducted on each motor including thermal withstand capability shall be supplied with the motors. A Performa to be used to indicate the results of type tests specified in below table shall be provided for the approval. The manufacturer shall carry out the type test and provide certificate at the time of delivery. All motors with rating of 75kW and above shall be tested for type test as per the table given here at manufacturer's works.

3.3.1.7.1 TESTS ON AC MOTORS FOR VFD APPLICATION

Table 21: TESTS ON AC MOTORS FOR VFD APPLICATION

Sr.No.	Name of Test	Remarks
1	ROUTINE TESTS	
a	IR test of winding before and after HV test	On all motors
b	HV test	
c	Winding resistance measurement	
d	IR, HV, IR on space heaters and winding RTDs	
e	Phase sequence and direction of rotation	
f	Locked rotor test	
g	Reduced voltage running test on no load	
h	No load test and bearing temperature	
i	Noise level on no load	
j	Vibration on no load	
k	Functional checks on all accessories and auxiliaries	
l	Terminal marking and rating plates details	
m	Overspeed test at 120% of rated speed for 2 minutes	
2	TYPE TEST	
a	Current balance test at no load	One motor of same type and same rating
b	Polarization index test	
c	Temperature rise test at full load at 90% rated voltage and rated frequency	
d	Load test and derivation of performance data corresponding to 25%, 50%, 75% and 100% load at rated voltage	
e	Test for degree of protection by enclosure of motor and terminal boxes	
f	Momentary overload test	
g	Operation of motor at full load at 80% of rated voltage for 10 minutes and at 70% of rated voltage for 10 secs	

3.3.1.8 PROTECTION DURING SHIPPING AND STORAGE

1. All motors shall be neatly finished in workmanship like manner. All exposed metal surfaces shall be smooth and free from burrs. Finished surface shall be protected against corrosion and mechanical damage.
2. All steel and cast-iron surfaces shall be thoroughly cleaned to remove mill scale rust etc. Exterior surfaces shall be given one coat of red or Zinc Chromate primer and minimum two coats of final enamel paint the color of which shall be approved before hand by purchaser.
3. All parts shall be properly boxed and protected to prevent all possible damage during transportation.
4. The Equipment shall be delivered in clean, grease, oil or dirt-free condition. All shipments shall be tropically packed, suitably boxed and protected from damage in transit. These shall then be delivered safely to the IPR Site Facility, Bhat Ahmedabad.

3.3.1.9 ERECTION AND INSTALLATION

The contractor shall ensure that the motors shall be erected at site as per the manufacturer's guidelines. Special care should be taken during unloading at site, transfer from storage area to plant room with special handling arrangement shall be carried out by the contractor. Contractor shall ensure that no damage during transit. If there is any damage happen during transit, immediately the same should bring notice to the purchase. He should provide detailed installation drawings and follow the plant layout drawing attached herewith the tender.

3.3.1.10 INSPECTION, TESTING AND COMMISSIONING

The methodology of testing and commissioning shall be intimated with full procedures, checklists, sequence and any temporary arrangements, needed, list of related agencies involved, and to be intimated, etc. to the purchaser sufficiently in advance (minimum two weeks) for his approval. All measurements, observations shall be taken in the presence of purchaser's representative and shall be certified by the purchaser after his full satisfaction for meeting deigned conditions.

3.3.2 VARIABLE FREQUENCY DRIVES

3.3.2.1 SCOPE

The Variable Frequency Drives (VFD) shall be compatible with AC motor of pump set as per the system requirement of ICECRH, DNBHP, DNBLP, DNBCH and IPRCH cooling loops. The (VFDs) shall be a Clean Power voltage source, advanced Pulse-Width Modulated, space vector technology motor controller which utilizes the latest IGBT technology and surface mount construction to afford efficient use of available space, prudent energy consumption and reliability. The VFDs shall not induce excessive power losses in the motor. Input (AC) Line Reactor shall be factory mounted and wired within the VFD enclosure.

The VFDs shall operate satisfactorily when connected to a bus supplying other solid-state power conversion equipment which may be causing up to 10% total harmonic voltage distortion and commutation notches up to 36,500 volt/microseconds, or when other VFD's are operated from the same bus.

The Total harmonic Distortion (THD) of the voltage and current at the inverter output shall be as per IEC-61800. The harmonic at the supply side of the drive system at PCC (Point of Common System) shall be restricted within the maximum allowable levels of current and voltage distortions as per latest edition of IEEE-519. The VFD shall maintain input as well as displaced power factor of 0.95 or better, at all speeds without external correction capacitors, and shall have a continuous output current rating of 110% of nameplate current.

Suitable VFDs shall utilize advanced Pulse Width Modulation (PWM) strategy which can be of the space vector type, implemented within a microprocessor, which generates a sine-coded output voltage.

All VFDs shall be supplied by one manufacturer and all Microprocessor systems must be products of the same manufacturer as the Variable Frequency Drive (to assure single source responsibility, availability of service and access to spare parts).

3.3.2.1.1 BASIC DESCRIPTION

Variable Frequency Drive(s) (VFD's) shall be a Clean Power voltage source, advanced Pulse-Width Modulated (PWM), space vector technology, utilizing the latest IGBT technology, 18-pulse minimum full-wave diode bridge converter to convert 415 Volt, three-phase, 50 Hertz utility/generator power to a fixed DC voltage with IP-55 protection.

The advanced Pulse-Width Modulation strategy shall be of the space vector type that is implemented within a microprocessor which generates a sine-coded output voltage, which results in lower harmonics and extremely quiet motor operation.

Phase shift transformers required to produce the phase shifted input to the multi-pulse rectifier shall be factory wired and mounted within the Variable Frequency Drive (VFD) enclosure, as an integral part of the VFD assembly.

External transformers shall not be required nor used.

The inverter output shall be generated by power transistors which shall be controlled by six (6) identical base driver circuits, which shall yield an adjustable voltage (0 – 415 Volt) and frequency (0 - 50 Hertz) three-phase, Alternating Current (AC) power for step less motor speed control from 20 percent to 100 percent of base speed, with a minimum capability of 10:1 speed range.

This motor controller shall produce an adjustable Alternating Current voltage/frequency output. It shall have an output voltage regulator to maintain correct output Volt/Hertz ratio despite incoming voltage variations.

3.3.2.1.2 BASIC FEATURES

All Variable Frequency Drives (VFD's) shall have the following basic features:

1. The keypad of each VFD shall include a "POWER ON" light, VFD fault light, VFD run light, manual stop push-button, manual start push-button, a fault reset push-button, An "AUTOMATIC" push-button and increase/decrease pushbuttons.
2. The VFD's shall be software programmable to provide automatic restart after any individual trip and/or condition resulting from either over current, over voltage, under voltage, or over temperature. For safety, the variable frequency drive shall shut down and require manual reset and restart if the automatic reset/restart function is not successful within a maximum of three attempts within a short time period.
3. A speed droop feature shall be included which reduces the speed of the VFD on transient overloads. The drive is to return to set speed after transient is removed. If the acceleration or deceleration rates are too rapid for the moment of inertia of the load, the drive is to automatically compensate to prevent VFD trip.
4. Automatic restart after drive trip and/or utility failure. Automatic or Manual restart after VFD trip and/or utility failure shall be Software selectable.
5. Speed profile: Individual adjustable settings for start, stop entry, slope, and minimum and maximum speed points.
6. Process Signal Inverter: Software selectable to allow speed of VFD to vary inversely with input signal.
7. A critical speed avoidance circuit: will be included for selection of two critical speeds with a rejection band centered on that speed. The VFD will ignore any speed signals requiring drive operation within the rejection band.
8. Proportional and Integral set point process controller with menu driven selection and programming via door-mounted keypad.
9. The VFD shall be able to determine the motor speed and resume control of a motor which is spinning in either direction without tripping. The VFD shall be able to successfully Pick Up a spinning load.
10. A door-mounted membrane keypad with integral 2-line, 24-character LCD display shall be furnished, which is capable of controlling the VFD and setting drive parameters, and shall include at a minimum the following features:

11. The digital display must present all diagnostic message and parameter values in engineering units when accessed, without the use of codes. The keypad module shall contain a “self-test” software program which can be activated to verify proper keypad operations. The digital keypad shall allow the operator to enter exact numerical settings in engineering units. A user menu shall be provided in software as a guide to parameter setting, (rather than codes). Drive parameters shall be factory set in EEPROM and resettable in the field through the keypad.
12. Six (6) levels of password security shall be available to protect drive parameters from unauthorized personnel. The EEPROM stored drive variables must be able to be transferred to new boards to reprogram spare boards. Normally the digital display shall simultaneously display:
 - a. Speed demand in percent
 - b. Output current in amperes
 - c. Frequency in Hertz or RPM
 - d. Control Mode: Manual/Automatic
 - e. Total three-phase kW or output volts

3.3.2.2 SERVICE CONDITIONS

The controller shall be designed and constructed to operate within the following service conditions:

1. **Ambient Temperature** – 50°C.
2. **Relative Humidity** –100%
3. **Ambient Air** – Ambient air may contain fair amount of conductive dust.

However, maximum ambient temperature and 100% relative humidity may not occur simultaneously.

3.3.2.3 ENCLOSURE

1. The manufacturer’s illustrated operating instructions and parts list shall be mounted within the Variable Frequency Drive enclosure door.
2. Provide an Input circuit breaker, interlocked with the enclosure door, with through-the-door handle to provide positive disconnect of incoming AC power.
3. The bypass cabinet shall include a door-interlocked input circuit breaker, a VFD output contactor, and a full-voltage starting contactor (both contactors electrically interlocked), a thermal overload relay to provide motor protection, and a control power transformer to afford continued operation of the motor, in the event the Variable Frequency Drive malfunctions.
4. A door-mounted RS232C/RS422 port for connection of the printer, for each VFD, is to be provided for units of 75kW and larger capacity. Units with 1 to 22 kW must be supplied with a printer and a RS232C/RS422 port available on the microprocessor board. The bypass selector switch, motor fault light, power “ON” light, motor “ON” VFD light and motor “ON LINE” light shall be mounted on the cabinet door.

Door-mounted meters shall be provided on all units 100 Horsepower and larger:

- a. Digital ammeter (0 - 110%)
- b. Digital speed/frequency meter (0-110% speed as well as Hertz)
- c. Digital voltmeter (0-600 VAC)
- d. Digital kW meter (0-110%)

All Variable Frequency Drive's components shall be factory mounted and wired on a dead front, grounded, NEMA-1 enclosure suitable for bottom or top conduit entry.

3.3.2.4 PROTECTIVE FEATURES AND CIRCUITS

All Variable Frequency Drive(s) shall include the following protective features:

1. Single phase fault or 3-phase short circuit on VFD output terminals without damage to any power component.
2. Static instantaneous over current and over voltage trip with inverse over current protection.
3. Static over speed (over frequency) protection.
4. Line or fuse loss and under voltage protection.
5. VFD over temperature protection.
6. Electronic motor protection having following preventive functions:
 - a. Short circuit
 - b. Unbalanced current
 - c. under current
 - d. overload current
 - e. Earth fault
 - f. Stalled rotor
 - g. Phase failure and phase reversal
7. Responsive action to motor winding temperature detectors or thermostatic switches.
8. LED monitor lamps for each inverter stage.
9. LED status indicators on regulator, and printed circuit board face plates.
10. Isolated operator controls.
11. Input line fuses.
12. Be insensitive to incoming power phase sequence.
13. Have desaturation circuit to drive inverter section transistor base current to zero in event of controller fault.
14. Have DC bus discharge circuit for protection of operator and service personnel with an indicator lamp.
15. Input line noise suppression with line reactor.
16. Individual transistor over current protection.

3.3.2.5 PARAMETER SETTINGS

The following system configuring settings shall be provided, without exception, field adjustable through the keypad/display unit or via the serial communication port only.

- 1. Motor Nameplate Data**
 - a. Motor frequency
 - b. Number of poles

- c. Full load speed
- d. Motor volts
- e. Motor full load amps
- f. Motor kW
- g. Current min
- h. Current Max

2. VFD Limits

- a. Independent accel/decel rates
- b. No load boost
- c. V min, Vmax, V/Hz
- d. Full load boost
- e. Overload trip curve select (Inverse or Constant)
- f. Min/Max speed (frequency)
- g. Auto reset for load or voltage trip select
- h. Slip compensation
- i. Catch-a spinning-load select
- j. Overload trip time set

3. VFD Parameters

- a. Voltage loop gain
- b. Voltage loop stability
- c. Current loop stability

4. Controller Adjustments

- a. PID control enable/disable
- b. Set point select
- c. Proportional band select
- d. Reset time select
- e. Rate time select
- f. Input signal scaling
- g. Input signal select (4-20mA/0-5 Volts)
- h. Auto start functions: On/Off, Delay On/Off, Level Select
- i. On/Off
- j. Speed profile: Entry, Exit, Point Select
- k. Min, Max speed select
- l. Inverse profile select (allows VFD speed to vary directly or inversely with input signal)

3.3.2.6 DIAGNOSTIC FEATURES AND FAULT HANDLING

1. The VFD shall include a comprehensive microprocessor based digital diagnostic system which monitors its own control functions and displays faults and operating conditions. Microprocessor systems must be products of the same manufacturer as the VFD (to assure single source responsibility, availability of service and access to spare parts).
2. A "FAULT LOG" shall record, store, display and print upon demand, the following for the 50 most recent events:

- a. VFD mode (Auto/Manual)
 - b. Elapsed time (since previous fault)
 - c. Type of fault
 - d. Reset mode (Auto/Manual)
3. A “HISTORIC LOG” shall record, store, display and print upon demand, the following control variables at not 2.7 M/Sec. intervals for the 50 intervals immediately preceding a fault trip:
- a. VFD mode (manual/auto/inhibited/tripped/etc.)
 - b. Speed demand
 - c. VFD output frequency
 - d. VFD inhibit (On/Off)
 - e. Feedback (motor) Amps
 - f. VFD output volts

Type of fault:

- a. Inverter O/Temp. (H-M) Out of Sat 1-6
 - b. Over Voltage (N) Software Fault
 - c. Detection Error (O) Waveform Gen.
 - d. Earth Leakage (P) Remote Watchdog
 - e. Watchdog (Q) Thermistor
 - f. PSU Power Fail @@ Sustained O/L
 - g. Manual Test (S) Bypass SCR Trip
4. The fault log record shall be accessible via a RS232/RS422 serial link as well as line by line on the keypad LCD display.

3.3.2.7 DRIVE OPTIONS/MODIFICATIONS

Provide the following applicable options/modifications to the VFD. All special features shall be factory mounted and wired within the VFD enclosure unless otherwise specified.

1. Input circuit breaker, interlocked with the enclosure door, with through-the-door handle to provide positive disconnect of incoming AC power. The circuit breaker shall be rated for minimum 200,000 AIC.
2. Door-mounted meters to be provided on all units 100 Horsepower and larger as follows:
 - a. Analog ammeter (0 - 110%)
 - b. Analog speed/frequency meter (0-110% speed as well as Hertz)
 - c. Analog voltmeter (0-600 VAC)
 - d. Analog kW meter (0-110%)
 - e. 5-digit elapsed time meter

3. Constant speed bypass shall be provided to allow the motor to run across the line in the event of VFD shutdown. Transfer from the VFD to the line shall be accomplished manually by means of a selector switch.
4. All bypass circuitry shall be enclosed within a NEMA-1 compartment or cabinet isolated from the VFD. The bypass cabinet shall include a door-interlocked input circuit breaker, a VFD output contactor, and a full-voltage starting contactor (both contactors electrically interlocked), a thermal overload relay to provide motor protection, and a control power transformer. The bypass selector switch, motor fault light, power "ON" light, motor "ON" VFD light and motor "ON LINE" light shall be mounted on the cabinet.

3.3.2.8 SYSTEM OPERATION

With the manual start push-button selected, the VFD shall be controlled by the front panel increase/decrease pushbuttons on the VFD keypad. With the automatic push-button selected, the VFD shall start when a remote signal is received and its speed shall be controlled by a 4-20mA, internally isolated (or 0-10VDC non-isolated) signal from a remote source.

3.3.2.9 QUALITY ASSURANCE AND FACTORY TESTS

The Variable Frequency Drive(s) shall be subject to, but not necessarily limited to, the following quality assurance controls, procedures and tests:

- a. Power transistors, SCR's and diodes shall be tested to ensure correct function and highest reliability.
- b. Every Variable Frequency Drive will be functionally tested with a motor to ensure that if the VFD is started up according to the Instruction & Operations Manual provided, the unit will function properly as intended.
- c. The VFD systems shall be fabricated by the same VFD manufacturer, to assure a properly coordinated system. VFD systems must not be fabricated in whole or in part by parties other than the VFD manufacturer. Third party distributor or package modifications to a standard product will not be allowed.
- d. VFD shall utilize a field proven design. The VFD manufacturer shall demonstrate at least 5 years of continuous field operating experience with equipment of similar size and design.
- e. Following tests shall be offered by the manufacturer at factory:
 - i. General inspection
 - ii. Insulation Resistance Test (before and after HV test)
 - iii. Checking of the auxiliary devices and their functioning (as per internal test procedure of contractor)
 - iv. Checking of the setting of the protection devices and their functioning (as per internal test procedure of contractor)
 - v. Speed variation test (within operating range)
 - vi. V/F Test
 - vii. Output Current and voltage waveform
 - viii. Checking of the control and wiring diagram
 - ix. High voltage test
 - x. General operational test

- xi. Checking interface of control circuits & signals
- xii. Power factor measurement
- xiii. Audible noise

3.3.2.10 PROTECTION DURING SHIPPING AND STORAGE

1. All parts shall be properly boxed and protected to prevent all possible damage during transportation.
2. The Equipment shall be delivered in clean, grease, oil or dirt-free condition. All shipments shall be tropically packed, suitably boxed and protected from damage in transit. These shall then be delivered safely to the IPR Site Facility, Bhat Ahmedabad.

3.3.2.11 ERECTION AND INSTALLATION

The contractor shall ensure that the VFDs shall be erected at site as per the manufacturer's guidelines. Special care should be taken during unloading at site, transfer from storage area to plant room with special handling arrangement shall be carried out by the contractor. Contractor shall ensure that no damage during transit. If there is any damage happen during transit, immediately the same should bring notice to the purchase. He should provide detailed installation drawings and follow the plant layout drawing attached herewith the tender.

3.3.2.12 INSPECTION, TESTING AND COMMISSIONING

The methodology of testing and commissioning shall be intimated with full procedures, checklists, sequence and any temporary arrangements, needed, list of related agencies involved, and to be intimated, etc. to the purchaser sufficiently in advance (minimum two weeks) for his approval. All measurements, observations shall be taken in the presence of purchaser's representative and shall be certified by the purchaser after his full satisfaction for meeting deigned conditions.

3.3.3 ELECTRICAL PANELS, CABLING AND EARTHING

3.3.3.1.1 Scope

The scope of this section is to define the specifications for the fabrication, supply, erection testing and commissioning of electric panels, control panels, cabling, wiring and earthing of all equipment, components and accessories that is in the scope of the tender of CWS. SLD provided by IPR shall be indicative and contractor shall develop and finalized SLD as per the requirement of system during final design phase. The following shall be taken as “minimum” requirements.

3.3.3.2 General

The scope of work shall be carried out in accordance with the Specifications, Local Rules, Indian Electricity Act 2003 as amended up to date, and rules issued thereunder, Regulations of the Fire Insurance Company and relevant BIS Codes of Practice. The control panels shall be BIS approved and manufactured by a reputed manufacturer. The ingress protection class shall not be less IP 54.

The design, materials, construction, manufacture, inspection, testing and performance of Panel shall comply with all currently applicable statutory regulation and safety codes in the locality where the equipment will be installed. The equipment shall also confirm to the latest applicable standards and codes of practice.

All materials shall be of the best quality complying with the BIS (Bureau of Indian Standards) Specifications. Materials used shall be subject to the approval of the Engineer-in-charge and samples of the same shall be furnished where required.

3.3.3.3 TECHNICAL SPECIFICATIONS

3.3.3.3.1 Construction Features:

- a. The Motor control center shall be sheet steel cabinet for indoor installation, floor mounted/ wall mounted type. The control panel shall be suitable for the climatic conditions/ outdoor installation type as specified during the detailed design.
- b. The control panel shall be totally enclosed, dead front, completely dust and vermin proof and shall be with hinged doors, Neoprene gasket and padlocking arrangement shall be provided.
- c. The basic enclosure shall be fabricated from Cold rolled sheet steel material, of thickness not less than 2 mm in all sides. For all the load bearing application sheet steel thickness shall not be less than 2 mm. Doors and covers shall be made of cold rolled sheet steel of thickness not less than 1.6mm. Stiffeners shall be provided wherever required. The panel frames shall be fabricated using cold rolled sheet steel of thickness not less than 2.5 mm.

- d. Joints of any kind in sheet metal shall be seam welded, all welding slag shall be grounded off and welding pits wiped smooth with plumber metal.
- e. All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts.
- f. Self-threading screws shall not be used in the construction of Control panels.
- g. A base channel of 75 mm x 75 mm x 5mm thick or ISMC 100 or suitable (in accordance with the size of panel board) shall be provided at the bottom for floor mounted panels and shall be painted black.
- h. The finish shade shall be conforming to shade 631 as per IS.
- i. 1100V-grade rubber mat shall be provided in front of the panel board.
- j. Minimum clearance of 200 mm shall be provided between the floor of Control panel and the lowest unit. The control panel shall be of adequate size with a provision of 25% spare space to accommodate possible future switch or as specified in SOQ.
- k. Switches shall be arranged in multi-tier. Knockout holes of appropriate size and number shall be provided in the Control Panel in conformity with the location of cable/conduit connections.
- l. Removable sheet steel plates shall be provided at the top to drill holes for cable entry at site if required.
- m. Every cabinet shall be provided with Trafolyte or engraved metal name plates.
- n. All panels shall be provided with circuit diagram engraved on PVC sheet.
- o. All live accessible connections shall be shrouded and minimum clearance between phase and earth shall be 20 mm and phase to phase shall be 25mm.
- p. All equipment such as meters and indicating lamps etc. Shall be located adjacent to the unit with which it is associated and care shall be taken to achieve a neat and symmetrical arrangement.
- q. Facility shall be provided for termination of cables from both above and below the control panel.
- r. Where cables enter from below, cable boxes shall be fitted at the rear and arranged in tiers to facilitate making connections to the upper and lower units.
- s. Clamps shall be provided to support the weight of the cables.
- t. All power wiring inside the control panel shall be colour coded and control wiring ferruled for easy identification.
- u. Internal wiring of panel shall be done with minimum 2.5 sq.mm tinned copper wires. All incoming and outgoing feeders shall be brought out to a terminal block of adequate size at suitable location inside the control panel. All wiring inside the control panel shall be colour coded and labeled with approved plastic beads for identification. Circuit diagrams showing the arrangement of circuit shall be pasted on the inside of panel door and covered with transparent plastic sheet and all labeling shall be provided on the front face of the panel board.
- v. Painting: Seven-tank process treatment shall be followed for treatment of the fabrication parts of the panel. Two coats of epoxy-based primer shall be applied before applying two final coats of epoxy paint which shall have good weather resistance and heat transfer properties. Electrostatic epoxy powder coating shall be applied after pre-treatment.

3.3.3.3.2 Wiring System:

All wiring inside MCC shall be of 1100 volts grade PVC insulated Copper wire.

3.3.3.3.3 Circuit Compartment

Each circuit breaker, contactor and relay shall be housed in a separate compartment and shall have steel sheets on top and bottom of compartment. Sheet steel hinged lockable door shall be duly interlocked with the breaker in the “ON” position. Safety interlocks shall be provided to prevent the breaker from being drawn out when the breaker is in ‘ON’ position. The door shall not form an integral part of the draw out portion of the panel. Sheet steel barriers shall be provided between the tiers in a vertical section.

3.3.3.3.4 Instrument Accommodation:

Adequate space shall be provided for accommodating instruments, indicating lamps, control contactors and control fuses etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker and bus bar. ‘ON’ lamps shall be provided on all outgoing feeders.

- a. Control wiring shall be done using 1100 V grade PVC stranded wire 1.5 sq. mm for control and 2.5 sq. mm for CT circuit.
- b. As a standard practice, all control cables shall be neatly bunched together with ferrules at either end of each wire. As per application colour ferrules shall be provided.
- c. For safety and reliability, cable bunch shall be routed through flexible metallic conduit wherever it passes through HV compartments like breaker, PT chamber etc.

3.3.3.3.5 Bus Bars and Bus Bar Connections:

- a. The bus bar and interconnections shall be of Copper and of rectangular cross section suitable for full load rated current for phases and 50% for neutral and shall be extendable on either side.
- b. The temperature rise shall be within permissible limits as per applicable standards without causing injurious heating to the elements in the panel.
- c. The bus bars and interconnections shall be insulated with heat shrinkable sleeve and shall be colour coded.
- d. All bus bars shall be provided in a separate chamber and shall be shrouded throughout, bolting shall be done for all connections and additional cross section area to be provided to compensate for the holes drilled in the bus bars.
- e. The bus bars shall be supported on glass fiber reinforced thermosetting plastic insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system.
- f. Bus bars shall be of Electrolytic Copper material and shall comply the requirements of IS: 8130. The bus bars should have rectangular section. The current density while calculating the size of the bus bars should be as per 1.6 A/sq.mm.

- g. The bus bars shall be supported non-hygroscopic, anti-tracking high impact epoxy cast resin insulator. The support shall be rigid and suitable for all thermal and electrodynamic stresses arising out of short circuit current for 3 sec.
- h. All connections between bus bars and breakers shall be through solid strips of proper size to carry full rated current and insulated with insulating tapes.
- i. Bus bars in the switchgear may be provided with insulating sleeves OR insulating coatings. The sleeves or coating material shall comply with the following requirements:
 - 1. The insulating material shall safely withstand the hot-spot temperatures of the bus bars.
 - 2. The material shall be flame retardant in accordance with ANSI-C37.20.
 - 3. Minimum phase to phase and phase to earth clearance shall be 25 mm.

3.3.3.3.6 Cable compartments, Terminals, wire ways:

Cable compartment of adequate size shall be provided in the control panels for all incoming and outgoing cables entering from bottom or top. Adequate and proper supports shall be provided in cable compartments to support cables. The outgoing terminals and neutral links shall be brought out to a terminal block suitably located in the control panel. The current transformer for instruments, metering and for protection shall be mounted on the terminal blocks. Separate cable compartments shall be provided for incoming and outgoing cable. Minimum 20% spare terminals shall be provided in each terminal block. A horizontal wire way with screwed covers shall be provided at the top to interconnecting control wiring between different vertical sections.

3.3.3.3.7 Labels:

Aluminum Anodized labels shall be provided on all incoming and outgoing feeder switches. Circuit diagram showing the arrangements of the circuit inside the Control Panel shall be pasted on inside of the panel door and covered with transparent plastic sheet. Cable alley and bus chamber shall be identified on all panels by proper labels.

3.3.3.3.8 Rubber mat:

Rubber mat shall be provided to cover the full length of front of all panels and rear of panels where back space shall be available for working from the rear.

3.3.3.3.9 Air Circuit Breakers:

The Air Circuit Breakers shall be sheet metal enclosed flush front, draw out type, and shall be provided with a trip free manual operating mechanism with mechanical “ON” - “OFF” indications. The circuit breaker shall be suitable for continuous rating and of capacity as called for. It shall be possible to switch “ON” and “OFF” the Circuit Breaker without opening the circuit breaker compartment door. The operating handle and the mechanical trip push button shall be at the front of the breaker and integral with the breaker.

- a. Air Circuit Breakers shall fully conform to IS: 13947 part I & III.
- b. ACBs shall be designed for circuit protection of 415 V, three phase four wire AC distribution system. They shall be designed for use in panel boards as main breakers and for protection of feeder circuits and connecting equipment.
- c. The ACB's shall be suitable for installation on multi-tier panel box.
- d. The terminals of the ACBs shall be designed to maintain adequate clearances and to accept Aluminium / Cu cables and bus bars.
- e. ACBs shall be of draw-out type, electrically/motor operated. The fully draw out type compartments shall be provided.
- f. All ACBs shall be provided with integrated Microprocessor based trip releases for overload, short circuit, instantaneous and earth fault with multiple characteristic curves and adjustable setting for each characteristic to ensure proper co-ordination with upstream and downstream breakers.
- g. For all air circuit breakers, monitoring of close and trip circuit voltages, trip coil shall be provided.
- h. Each circuit breaker shall be provided with distinct SERVICE/TEST/ISOLATED positions.
- i. Potential free auxiliary contacts shall be provided for ACB's status indication (ON, OFF & TRIP).
- j. Motor for ACBs shall be rated at 230VAC.

1. **Protective Devices:** C.T. Operated Electronic Relays for short circuit, over current and earth fault operation with adjustable settings shall be provided for all air circuit breakers. Suitable under voltage tripping mechanism for voltage less than + 10% of full rate voltage shall be provided.

The release shall incorporate an 8-bit micro-computer to offer accurate and versatile protection with complete flexibility and shall offer complete overcurrent protection to the electrical system in the following four zones:

- a. Overload or long-time protection
- b. Short circuit or short time protection with intentional delay
- c. Instantaneous protection with no intentional delay
- d. Ground fault protection
- e. True RMS sensing

The release shall sample the current at the rate of 16 times per cycle to monitor the actual load current waveform flowing in the system and shall monitor the true RMS value of the load current. It shall take into the effect of harmonics also.

2. **Selector Switch** Where called for, selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

- k. All ACBs shall have inbuilt thermal memory which shall ensure reduced tripping time in case of subsequent overloads, realistic Hot/Cold curves shall take in to account the integrated heating effects to offer closer protection to the system
- l. All ACBs shall have predefined time-current characteristics and electromechanical fault indications shall be provided to display the type of fault that caused trip, without any auxiliary supply or battery, resulting in faster fault diagnosis and reduced system down time.
- m. All ACBs shall have test facility for testing operation of the release in different protection zones by simulation CT inputs eternally through a testing kit. The release shall draw its power from the main breaker's CTs and shall require no external power supply for its operation.
- n. The release shall trip the breaker through a flux shift device which shall directly act on the breaker tripping rod.

3.3.3.3.10 Moulded Case Circuit Breakers:

Moulded Case Circuit Breaker (MCCB) shall be of motor duty and shall be suitable for continuous load, manufactured in accordance with relevant BIS Codes, well-coordinated with the upstream circuit. MCCBs shall fully conform to IS: 13947 part II.

- a. MCCB's shall be designed for circuit protection of 415 V, three phase four wire AC distribution system. They shall be designed for use in panel boards as breakers and for protection of feeder circuits and connecting equipment.
- b. All MCCBs shall comprise of Quick Make-Break switching mechanism, preferably Double Break contact system, arc extinguishing device. All MCCBs rated 200 Amps and above shall have adjustable magnetic short circuit pick up.
- c. The terminals of the MCCB's shall be designed to maintain adequate clearances and to accept Aluminium / Cu cables.
- d. The insulating case and cover shall be made of high strength, heat resistant, flame retardant thermosetting material, providing a very high dielectric strength, high withstand capability against thermal and mechanical stresses, protection against secondary fire hazards and enhanced safety of operating personnel.
- e. All MCCB's shall be provided with integrated static trip releases for overload, short circuit and earth fault with multiple characteristic curves and adjustable setting for each characteristic to ensure proper co-ordination with overload, short circuit and earth fault protection.
- f. The trip command shall override all other commands. The breaking capacity specified will be $ICU=ICS$ i.e. type-2.
- g. The MCCBs shall be provided with rotary handle operating mechanism. The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped'. In case of 4 pole MCCB, the neutral shall be defined and capable of offering protection.

3.3.3.3.11 Miniature Circuit Breaker (MCB):

Miniature Circuit Breaker shall comply with relevant BIS Codes and shall be quick make and break type for 230/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection.

- a. The breaking capacity shall not be less than 10KA at 415 VAC. MCBs shall be Current limiting type (Class-3) and shall be classified as Type D as per their tripping characteristics curves defined by the manufacturer.
- b. The housing shall be high heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 degree of protection. All DP, TP and TPN- MCBs shall have a common trip bar independent to the external operating handle.

3.3.3.3.12 Starters:

Each motor (except the motors run on VFD) shall be provided with a starter of suitable rating. Starters shall be in accordance with relevant BIS Codes. All Star Delta and ATS Starters shall be fully automatic. Starter's contactors shall have 3 main and 2 Nos. NO / NC auxiliary contacts and shall be air break type suitable for making and breaking contact at minimum power factor of 0.35. For design consideration of contactors, the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on- line starters and 3 times the full load current of the motor in case of Star Delta / Reduced Voltage Starters. The insulation for contactor coils shall be of Class "E".

Operating coils of contactors shall be suitable for 220 / 415 \pm 10% volts AC, 50 cycles supply system. The contactors shall drop out when voltage drops to 90% of the rated voltage. The housing of the contactors shall be heat resistant and having high impact strength. Each starter shall have thermal overload protection on all three phases. Unless otherwise specified, Direct on-line starters shall be provided for motors up to 7.5 HP. Star Delta Type starters shall be provided for motors 10 HP and above rating.

3.3.3.3.13 Motor Protection relays:

All motors shall be provided with Motor Protection Relay (MPR) which shall cover minimum following preventive functions:

- i. Short circuit
- ii. Unbalanced current
- iii. under current
- iv. overload current
- v. Earth fault
- vi. Stalled rotor
- vii. Phase failure and phase reversal

The MPR shall conform to relevant IS/IEC standard with latest edition and shall suitably selected according to the process requirement

3.3.3.3.14 Current Transformers:

Current transformers shall be provided for Control Panels carrying current in excess of 60 Amps. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondaries for operation for associated metering.

Current transformers shall comply with IS: 2705. Construction of CT's shall be bar type, separately mounted type. These shall be resin casted. Secondary terminals of the CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5P8 and measurement CTs shall be accuracy class I.

3.3.3.3.15 Meters:

- a. All Voltmeter and indicating lamps shall be through MCBs
- b. Meters and indicating instruments shall be plug type
- c. All CTs connection for meter shall be through Test terminal block
- d. CT ratio and burdens shall be as specified during detailed design

3.3.3.3.16 Single Phase Preventers:

Single phase preventers shall be current sensing. Single Phase preventers shall be in conformity with relevant BIS standards. Single phase preventers shall act when the supply voltage drops down to 90% of the rated voltage or on failure of one or more phases.

3.3.3.3.17 Indicating Lamp and Metering:

All meters and indicating lamps shall be in accordance with IEC regulations. The indicating lamps shall be LED type and of low burden.

Each MCC and control panel shall be provided with digital voltmeter 0-500 volts with three way and off selector switch CT operated ammeter of suitable range with three nos. CTs of suitable ratio with three way and off selector switch, phase indication lamps and other indicating lamps as called for.

Each phase indicating lamp shall be backed up with 5 amps fuse and toggle switch. Other indicating lamps shall be backed up with fuses as called for.

3.3.3.3.18 Toggle Switch:

Toggle switches, where called for, shall be in conformity with relevant BIS Codes and shall be of 5 amps rating.

3.3.3.3.19 Push Button Stations:

Push button stations shall be provided for manual starting and stopping of motors / equipment as called for. Green and Red colour push buttons shall be provided for 'Starting' and 'Stopping' operations. 'Start' or 'Stop' indicating flaps shall be provided for push buttons. Push Buttons shall be suitable for panel mounting and accessible from front without opening door, Lock lever shall be provided for 'Stop' push buttons. One set of normally open and one set of normally closed contacts shall be provided in push button stations. The push button contacts shall be suitable for 15 amps current capacity. Outdoor push button stations shall be IP55 protection.

3.3.3.3.20 Cables:

All power Cables shall be XLPE type copper conductor Armoured cables conforming to BIS Codes. All Cables shall be suitable for laying in trenches, duct, and on cable trays as required. All Cables shall be termite resistant. Cable jointing shall not be allowed. Control cables shall be of 1100 Volts grade, annealed solid copper conductor, PVC insulated, extruded FRLS PVC inner sheathed, single galvanized steel armored, overall FRLS PVC sheathed conforming to relevant IS

3.3.3.4 Cable Laying

- a. Cables shall be laid generally in accordance with Bureau of Indian Standard Code of Practice. Cables shall be laid on perforated GI/MS cable trays and cable drops/risers shall be fixed to ladder type cable trays fabricated out of steel angles as indicated on the Drawings/BOQ or as approved by the Engineer. Easy access to all cables shall be provided to allow cable withdrawal/replacement in future. Where more than one cable is running, one dia. Proper spacing shall be provided to minimize the loss in current carrying capacity.
- b. Cables laid on trays and risers shall be neatly dressed and clamped at an appropriate interval for horizontal and vertical cable runs.
- c. When buried, they shall be laid in 350 mm wide and 750 mm deep trench and shall be covered with 250 mm thick layers of soft sifted sand and protected with cement concrete tiles. Special care shall be taken to ensure that cables are not damaged at bends.
- d. Where cables are run on walls, proper saddling and dressing shall be done. The runs from wall to equipment shall be through suitably sized GI pipes, preferably below the floor surface.
- e. Each cable run shall be tagged with number that appears in the cable schedule. Cables shall be tagged at their entrance, every 30 Mt 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.

- f. The termination and connection of cables shall be done strictly in accordance with drawing and/or directed by the Engineer. 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.
- g. The vendor shall supply the required cable glands of suitable type and size. Cable glands shall be of heavy duty, tinned brass, 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.

3.3.3.5 Wires / Power Cables Sizes:

For all single phase/ 3 phase power cabling, 1100 volts grade XLPE copper conductor FRLS armoured cable shall be used. All the wires inside the control panel shall be neatly dressed and plastic beads shall be provided at both the ends for easy identification in control wiring.

Minimum power wiring and earthing sizes for different motor ratings shall be as per following table. However, if cable derating is necessitated in any particular situation, suitable higher size cable shall be used.

Note:

In addition, the client will decide the cable runs per phase and size based on the voltage drop calculation and SLDs provided by the contractor.

3.3.3.5.1 Power wiring, cabling shall be of the following sizes:

Sr. No.	Motors Rating	Power Wiring / Cables Sizes
1.	Up to 5 HP motors/ 5 kW heaters	3C x 4 sq.mm copper conductor wires / armoured cables
2.	From 6 HP to 7.5 HP motors / 6 kW to 7.5 kW heaters	3C x 6 sq.mm copper conductor wires / armoured cables
3.	10 HP to 15 HP motors	3C x 6 sq.mm copper conductor armoured cables
4.	20 HP to 25 HP motors	3C x 10 sq.mm copper conductor armoured cables
5.	30 HP to 35 HP motors	3C x 16 sq.mm copper conductor armoured cables/
6.	40 HP motors	3.5C x 25 sq.mm aluminum conductor armoured cables
7.	50 HP motors	3.5C x 35 sq. mm. aluminium conductor armoured cables
8.	60 HP to 75 HP motors	3.5C x 70 sq.mm aluminum conductor armoured cables
9.	100 HP motors	3.5C x 150 sq.mm aluminum conductor armoured cables

10.	150 HP to 225 HP motor	3.5C x 240 sq.mm aluminum conductor armoured cables
11.	250 HP to 300 HP motor	3.5C x 400 sq.mm aluminum conductor armoured cables

3.3.3.6 Earthing:

- a. Earthing shall be provided as per IS: 3043-1987 and shall be copper strips /wires. The main panel shall be connected to main earthing system of the power supply. All single-phase metal clad switches and control panels be earthen with minimum 3 mm diameter copper conductor wire.
- b. The earth bus shall be robust and capable of carrying full short circuit current for 1 sec.
- c. Doors, covers and all non-current carrying metallic parts shall be earthed through flexible copper wires. This should also include instrument's casing and cable armour, which should also be connected to the earth bus.
- d. The earthing connections shall be tapped off from the main earthing of electrical installation. The overloading in earthing strips at joints where required shall be minimum 75 mm. These straight joints shall be riveted with brass rivets & brazed in approved manner. Sweated lugs of adequate capacity and size shall be used for all termination of wires. Lugs shall be bolted to the equipment body to be earthen after the metal body is cleaned of paint and other oily substance and properly tinned.

The earth bus shall have provisions for terminals at each end for connecting to grid earthing and earthing shall be of copper strips / wires. The main panel shall be connected to main earthing system of the power supply. All single-phase metal clad switches and control panels are earthen with minimum 3 mm diameter copper conductor wire. All 3 phase motors and equipment shall be earthen with 2 numbers distinct and independent copper wires / tapes as follows:

Motors up to and including 10 HP rating	2 Nos. 3 mm dia copper wires
Motors 12.5 HP to 40 HP. Capacity	2 Nos. 4 mm dia copper wires
Motors 50 to 75 HP capacity	2 Nos. 6 mm dia copper wires
Motors above 75 HP capacity	2 Nos. 25 mm X 3 mm copper tapes

All 3 phase switches and control panels shall be earthed with two numbers distinct and independent copper wire's tapes as follows:

- a. up to 60 amps rating : 2 nos. 3 mm dia copper wires
- b. all 63 amps to 100 amps rating: 2 Nos. 4 mm dia copper wires
- c. all 125 amps to 200 amps rating : 2 Nos. 6 mm dia copper wires
- d. Switches, Panels and bus ducts above 200 amps rating: 2 Nos. 3 mm X 25 mm copper tapes

The earthing connections shall be tapped off from the main earthing of electrical installation. Sweated lugs of adequate capacity and size shall be used for all termination of wires. Lugs shall be bolted to the equipment body to be earthen after the metal body is cleaned of paint and other oily substance and properly tinned.

3.3.3.7 INSTRUCTION FOR INTERNAL WIRING:

All wiring shall be carried out with 1100-volt grade single core multi strand flexible copper conductor wires with P.V.C insulation and shall be vermin and rodent proof. The current carrying capacity of wire shall be adequate for the duty assigned to it and shall have sufficient flexibility to facilitate proper termination at any location.

Panel wiring shall be securely supported, neatly installed by lacing and typing, readily accessible and connected to equipment terminals and terminal blocks.

Wire terminations shall be made with solder less crimping type of tinned copper lugs, which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Ferrules shall fit tightly on the wires and shall not fall off when the wire is disconnected.

The vendor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment. The vendor shall make every effort to minimize wastage during erection work.

3.3.3.8 Testing:

The MCC shall be tested at factory with minimum following tests to be officered by the manufacturer:

- a. General inspection and dimensions check
- b. IR test before and after HV test
- c. HV test
- d. Overall functional test

3.3.3.9 Painting:

All sheets steel work shall undergo a process of degreasing, derusting, rinsing, passivation, drying, thorough cleaning, primer application, and painting with a high corrosion-resistant/epoxy primer. All panels shall be baked in an oven. The finishing treatment shall be by application of synthetic Powder coated/ enamel/epoxy paint of approved shade.

Part C: Instrumentation and Control System

3.4 INSTRUMENTATION AND CONTROL

3.4.1 SCOPE

- a. This specification covers the minimum technical requirement of design, manufacture, inspection, testing, and guarantee of the instruments complete with accessories and auxiliaries as specified herein.
- b. The scope of this section comprises the supply, erection, testing and commissioning of automatic controls and instruments conforming to these Specifications and in accordance with the Schedule of Quantities.
- c. The vendor/contractor shall supply the instruments in accordance with this specification.
- d. Compliance to this specification shall not relieve the vendor of the responsibility of supplying the instrument and auxiliaries of proper design, material and workmanship to meet the operating requirements specified herein and the Technical datasheet. In case any accessories that is necessary to make a complete, and enable to operate independent as well as controlled manner but not specifically identified herein shall also be in the vendor's scope of supply.
- e. The vendor shall be responsible for the complete design, engineering, coordination, testing, packing, delivery and proper functioning of the instrument, notwithstanding any omissions in this specification.
- f. Materials, processes and standard parts which are not specifically designated herein and which are necessary for fulfillment of the intent of this specification shall be of good quality and in accordance with good practice pertinent to the manufacture of precision industrial instrument and shall be subject to the approval of PURCHASER.
- g. As the space available in the plant is limited, a design which reduces the overall size of the instrument is preferred. The weight of the instrument shall be as low as possible.
- h. All necessary mounting hardware such as clamps, screws, brackets etc. depending on the mounting style shall be considered as a part of instrument and shall be supplied by the vendor.
- i. IS system of units shall be used for all measurement, dial markings and in design drawings.

3.4.2 TYPE

All automatic controls shall be electro-mechanical controls as described in the various sections of these Specifications.

The individual safety controls and selected automatic controls may be installed within the machines by the manufactures before shipment. However, the following automatic controls, if not already installed on the machines, may be installed at site by the contractor as indicated in the Schedule of Quantities:

3.4.2.1 Flow Switches:

Flow switches shall be provided in condensing water outlet and chilled water outlet at the water chilling machines. Flow switch shall prevent the compressor from starting unless the cooling water

flow is sufficient in the condensing water lines and chilled water flow is established in chilled water lines.

3.4.2.2 Thermostat:

Thermostat shall be electric, filed differential type as specific herein with sensing element located in the water pipe. All thermostats shall be supplied with the standard mounting boxes, as recommended by the manufacturer. The profiles, mounting arrangement and exact location of the thermostats shall be as per approved drawing or to suit to the process requirement. Requirement of thermostats shall be finalized during detailed design.

3.4.3 TECHNICAL DATA SHEET FOR INSTRUMENTS

This specification covers the minimum technical requirement of design, manufacture, inspection, testing, and guarantee of the instruments complete with accessories and auxiliary as specified herein. It is not the intent to completely specify all details of design and construction of Pressure Gauge, temperature gauges, pressure transmitter, temperature transmitter, pH meter, DO meter, conductivity meter, level meter, Flow meters etc.; nevertheless, the instrument shall conform to high standards of engineering, design and workmanship in all respects.

Instruments required for different types of machines have been described in the various sections of these Specifications. All automatic controls and instruments shall be factory calibrated and provided with necessary instructions for site testing.

Following instruments shall be provided as per the requirements indicated in the Schedule of Quantities.

A. Pressure Gauge

Table 22: PRESSURE GAUGE

Type	Direct sensing
Pressure element	Bourdon
Pressure element material	SS316 or SS304
Unit of measurement	Kg/cm ²
Accuracy	±1 % of span
Pressure range	0-25 kg/cm ² (as per process requirement)
Repeatability	< ± 0.5 % of span
Range	Various range as per process requirement
Dial size	150
Scale length	270-degree arc
Dial color	White

Dial letter marking	Black
Pointer	Pointer stop on both side of the scale and should be of standard material
Pointer adjustment	Yes
Over range protection	Yes, 130% of full range pressure
Movement material	SS304
Socket and tip material	SS316
Case material	SS304
Enclosure class	IP65
Liquid fillings	As per requirements
Glass	Shatter proof borosilicate glass
Gasket material	EPDM
Process fluids	SOFT/DM water
Ambient Temperature range	10° C to +45° C
Case	Material Case finish
Pointer	Pointer stop on both side of the scale and should be of standard material
External zero span adjustment	Yes
Over range protection	Yes, 130% of full range pressure
Enclosure class	IP65
Liquid fillings	As per requirements
Glass	Shatter proof borosilicate glass
Ambient relative humidity	5% to 95%
Process fluid temperature	0° C to +100° C
Max. operating pressure	< 15 Kg/cm ² ; < 30 Kg/cm ² for DNBHP
Fluid velocity	< 4 m/s
Process connection	½” NPT(M)
Siphon (if required)	SS316
3-way isolating needle valve	SS316

B. Temperature Gauge

Table 23: TEMPERATURE GAUGE

Type	Bimetal
Mounting	Rigid stem
Sensing Element	Bimetallic helical/spiral coil
Unit of Measurement	°C

Calibrated Range		0 °C – 100 °C
Case Material		SS 304
Enclosure Class		IP 65
Dial Size		150
Color	Dial	White
	Letters & Markings	Black
Scale Length		270-degree arc
Pointer		Aluminum / Plastic, Anti-Parallax Pointer stop on both side of the scale
Pointer Assembly		With Micrometer Adjustment
Zero Adjustment in Pointer		Micro Zero Adjustment
Over Range Protection		130% of Full scale
Blow out Disk		Required
Glass window		Borosilicate shatter proof glass
Stem	Material	SS 316
	Length	As per requirement
Gasket/ Packing Material		EPDM
Ambient Temperature compensation		Required
Thermowell	Material	SS 304 or SS 316
	Dimension	To be submitted by the VENDOR
	Insertion opening for Gauge	½” NPT (F)
	Bore Concentricity	< 5% of wall thickness
Accuracy		±1.0% Full Scale, as per ASME B40.3 Grade A or

C. Pressure Transmitter

Table 24: PRESSURE TRANSMITTER

Type	Electronic SMART	
Pressure element	Capacitance type or single crystal silicone resonance sensor or similar	
Sensing element material	SS316	
Unit of measurement	Kg/cm ²	
Wetted parts material	SS316	
Pressure range	0-25 kg/cm ² (as per process requirement)	
Accuracy	±0.25 % of calibrated span or better	
Repeatability	< ± 0.5 % of calibrated span or better	
Hysteresis	< 0.05% of calibrated span or better	
Dead band	< 0.1 % of calibrated span or better	
Rangeability	10:1	
Response time	< 1 sec.	
Power supply	24 VDC, Loop powered	
Signal connection	2-wire	
Output signal	4-20 mA (HART) at 600 Ω load	
Insulation resistance between signal terminal and casing	100 MΩ at 100 VDC	
Local display	LCD	
Vent and drain	Required	
Case	Material	Die Cast low copper Aluminum
	Case finish	Polyurethane, Epoxy finish painted
Pointer	Pointer stop on both side of the scale and should be of standard material	
External zero span adjustment	Yes	
Over range protection	Yes, 130% of full range pressure	
Enclosure class	IP65	
Liquid fillings	As per requirements	
Glass	Shatter proof borosilicate glass	
Gasket material	Glass filled PTFE/ PEEK/ EPDM	
Process fluids	SOFT/DM water	
Ambient Temperature range	10° C to +45° C	
Ambient relative humidity	5% to 95%	
Process fluid temperature	0° C to +100° C	

Max. operating pressure	< 15 Kg/cm ² ; < 30 Kg/cm ² for DNBHP
Fluid velocity	< 4 m/s
Process connection	½” NPT(M)
Cable gland connection	2 x ½” NPT (F), One of which shall be plugged
Cable length	Approx... 5 meter (atleast)

D. Temperature Transmitter

Table 25: TEMPERATURE SENSOR CUM TRANSMITTER

Type	RTD- Pt100	
Ro	100 Ω	
Sensing element	High purity Platinum wire	
RTD insert sheath material	SS 304 or SS 316	
Unit of measurement	°C	
Temperature range	0-100 (as per process requirement)	
Electrical connection	4-wire	
Element dimension	To be submitted by vendor	
RTD assembly	To be submitted by vendor	
RTD Head assembly	Case and cover material	Die cast Aluminium
	Cover chain	SS304
	Cable entry	½” NPT (F)
Thermowell	Material	SS 304 or SS316
	Dimension	To be submitted by vendor
	Opening for RTD	½” NPT (F)
	Bore connectivity	< 5% of wall thickness
Accuracy	Class A	
Repeatability	< 0.5 % of Calibrated range	
Local display	LCD display in ° C	
Power supply	24 VDC	
Input	From RTD	
Signal output	4-20 mA DC	
Enclosure class	IP65	
Response time	RTD element	< 10 sec (without thermowell)
	RTD assembly	< 30 sec (with thermowell)
Gasket material	EPDM	
Process fluids	SOFT/DM water	
Ambient Temperature range	10° C to +45° C	
Ambient relative humidity	5% to 95%	
Process fluid temperature	0° C to +100° C	
Max. operating pressure	< 15 Kg/cm ² ; < 30 Kg/cm ² for DNBHP (few)	

Fluid velocity		< 4 m/s
Process connection	Upto 150 mm	½” NPT(M)
	>150 mm	1” NPT(M)
Siphon (if required)		SS316
3-way isolating needle valve		SS316
Immersion length of RYD assembly for lines	Upto 150	75 mm
	200 mm-350 mm	150 mm
	400 mm- 500mm	250 mm
	Vessel	250 mm

E. Conductivity Meter and Transmitter

Table 26: CONDUCTIVITY METER AND TRANSMITTER

Type	Two electrode resistance measurement, continuous, electronic analyzer	
Cell constant	Vendor to specify	
Unit of measurement	µS/cm	
Measuring range	0 – 2 µS/cm, 0 – 10 µS/cm,	
Resolution	0.01 µS/cm	
Accuracy (Including conductivity cell)	± 1% of Calibrated Span or better	
Repeatability	± 1% of Calibrated Span or better	
Response time (Including conductivity cell)	< 10 Second	
Separate provision for zero and span adjustment	Required	
Transmitter housing	Type	Die Cast Aluminum
	Enclosure class	IP 65 according to IEC 60529
Local display	4 ½ digit LED / LCD display in µS/cm	
Power supply	24 VDC	
Input	From conductivity cell	
Signal output	4-20 mA DC	
Relay output	2 No. of SPDT Potential free contact for High/Low Alarms, Contact Rating of 1 AMP at 24 VDC, Adjustable throughout the range.	
Input /output isolation	Required	
Data logger facility	Yes	
Temperature Compensation	Integral Temperature Sensor	
Cell electrode material	SS 316	

Cell body material	SS 316
Sensor Insertion length	Vendor to specify
Cable entry	½” NPT (F)
Power supply	24 VDC, Loop powered
Signal connection	2-wire
Output signal	4-20 mA (HART) at 600 Ω load
Insulation resistance between signal terminal and casing	100 MΩ at 100 VDC
Local display	LCD
Enclosure class/cell housing	IP65
Gasket material	PTFE/ PEEK/ EPDM
Process fluids	DM water
Ambient Temperature range	10° C to +45° C
Ambient relative humidity	5% to 95%
Process fluid temperature	0° C to +100° C
Max. operating pressure	< 15 Kg/cm ² ; < 30 Kg/cm ² for DNBHP
Fluid velocity	< 4 m/s
Process connection	½” NPT (M) or better. Vendor to specify
Cable gland packing material	Graphoil
Diagnostic	Indication of Temperature Sensor Failure, Power Supply Failure, Sensor failure.

F. PH Meter and Analyzer

Table 27: PH METER AND ANALYZER

Type	Electronic analyzer
Sensor type	Retractable glass electrode
Measurement type	Continuous
Unit of measurement	pH
Measuring range	0-14 pH
Resolution	0.01 pH
Accuracy	± 1% of Calibrated Span or better
Repeatability	± 1% of Calibrated Span or better
Response time	< 10 sec.
Sensor material	Glass Membrane, Glass Sensor Encapsulated In The Synthetic Material for Protection
Isolation valve type and material	Ball/gate valve of SS316
Isolation valve Packing material	Graphoil
Separate provision for zero and span adjustment	Required

Transmitter housing	Type	Die Cast Aluminum
	Enclosure class	IP 65 according to IEC 60529
Local display		LCD display in $\mu\text{S}/\text{cm}$
Power supply		24 VDC
Input		From conductivity cell
Signal output		4-20 mA DC
Relay output		2 No. of SPDT Potential free contact for High/Low Alarms, Contact Rating of 1 AMP at 24 VDC, Adjustable throughout the range.
Input /output isolation		Required
Data logger facility		Yes
Temperature Compensation		Integral Temperature Sensor
Cell electrode material		SS 316
Cell body material		SS 316
Sensor Insertion length		Vendor to specify
Cable entry		$\frac{1}{2}$ " NPT (F)
Power supply		24 VDC, Loop powered
Signal connection		2-wire
Output signal		4-20 mA (HART) at 600 Ω load
Insulation resistance between signal terminal and casing		100 M Ω at 100 VDC
Local display		4 $\frac{1}{2}$ Digit LED/LCD display in pH
Enclosure class/cell housing		IP65
Gasket material		PTFE/ PEEK/ EPDM
Process fluids		DM water
Ambient Temperature range		10° C to +45° C
Ambient relative humidity		5% to 95%
Process fluid temperature		0° C to +100° C
Max. operating pressure		< 15 Kg/cm ² ; < 30 Kg/cm ² for DNBHP
Fluid velocity		< 4 m/s
Process connection		$\frac{1}{2}$ " NPT (M) or better. Vendor to specify
Cable gland packing material		Graphoil
Diagnostic		Indication of Temperature Sensor Failure, Power Supply Failure, Sensor failure.

G. DO Meter and Analyzer

Table 28: DO METER AND ANALYZER

Type	Electronic analyzer	
Sensor type	Optical	
Measurement type	Continuous	
Unit of measurement	ppm	
Measuring range	Suitable to measure the range of 5 to 1000 ppb	
Resolution	0.01 ppm	
Accuracy	± 1% of Calibrated Span or better	
Repeatability	± 1 ppb or better	
Response time	< 60 sec.	
Sensor material	Glass Membrane, Glass Sensor Encapsulated In The Synthetic Material for Protection	
Isolation valve type and material	Ball/gate valve of SS316	
Isolation valve Packing material	Graphoil	
Separate provision for zero and span adjustment	Required	
Transmitter housing	Type	Die Cast Aluminum
	Enclosure class	IP 65 according to IEC 60529
Local display	LCD display	
Power supply	24 VDC	
Input	From conductivity cell	
Signal output	4-20 mA DC	
Relay output	2 No. of SPDT Potential free contact for High/Low Alarms, Contact Rating of 1 AMP at 24 VDC, Adjustable throughout the range.	
Input /output isolation	Required	
Data logger facility	Yes	
Temperature Compensation	Integral Temperature Sensor	
Cell electrode material	SS 316	
Cell body material	SS 316	
Sensor Insertion length	Vendor to specify	
Cable entry	½" NPT (F)	
Power supply	24 VDC, Loop powered	
Signal connection	2-wire	
Output signal	4-20 mA (HART) at 600 Ω load	

Insulation resistance between signal terminal and casing	100 MΩ at 100 VDC
Local display	LCD
Enclosure class/cell housing	IP65
Gasket material	PTFE/ PEEK/ EPDM
Process fluids	SOFT/DM water
Ambient Temperature range	10° C to +45° C
Ambient relative humidity	5% to 95%
Process fluid temperature	0° C to +100° C
Max. operating pressure	< 15 Kg/cm ² ; < 30 Kg/cm ² for DNBHP
Fluid velocity	< 4 m/s
Process connection	½” NPT (M) or better. Vendor to specify
Cable gland packing material	Graphoil
Diagnostic	Indication of Temperature Sensor Failure, Power Supply Failure, Sensor failure.

H. Level gauge: As per Industrial practice which is suitable for our requirement

I. Level Transmitter

Table 29: LEVEL TRANSMITTER

Type	Electronic SMART
Transmitter principle	Differential pressure or Ultrasonic
Pressure element	Capacitance type or single crystal silicone resonance sensor or similar
Sensing element material	SS316
Unit of measurement	mm
Wetted parts material	SS316
Accuracy	±0.25 % of calibrated span or better
Repeatability	< ± 0.5 % of calibrated span or better
Hysteresis	< 0.05% of calibrated span or better
Response time	< 1 sec.
Power supply	24 VDC, Loop powered
Signal connection	2-wire
Output signal	4-20 mA (HART) at 600 Ω load
Insulation resistance between signal terminal and casing	100 MΩ at 100 VDC
Local display	LCD
Vent and drain	Required
Enclosure class	IP65

Gasket material	Glass filled PTFE/ PEEK/ EPDM
Process fluids	DM water, Chiller water
Ambient Temperature range	10° C to +45° C
Ambient relative humidity	5% to 95%
Process fluid temperature	0° C to +100° C
Max. operating pressure	< 15 Kg/cm ² ; < 30 Kg/cm ² for DNBHP
Fluid velocity	< 4 m/s
Process connection	½” NPT(M)
Cable gland connection	2 x ½” NPT (F), One of which shall be plugged
Accessories	Direct Mounting five valve manifold for isolation pressure equalization & drain

J. Flow Transmitter

Table 30: FLOW TRANSMITTER

Type	Electronic smart vortex type
Sensing element material	SS316
Unit of measurement	Kg/s
Wetted parts material	SS316
Flange connection	Flanged as per ASME B16.5
Accuracy	±0.25 % of calibrated span or better
Repeatability	< ± 0.05 % of calibrated span or better
Hysteresis	< 0.05% of calibrated span or better
Dead band	< 0.1 % of Calibrated Span
Response time	< 1 sec.
Rangeability	10:1
Power supply	24 VDC, Loop powered
Signal connection	2-wire
Output signal	4-20 mA (HART) at 600 Ω load
Insulation resistance between signal terminal and casing	100 MΩ at 100 VDC
Local display	LCD
Vent and drain	Required
External zero span adjustment	Yes
Over range protection	Yes, 130% of full range pressure
Enclosure class	IP65
Gasket material	Glass filled PTFE/ PEEK/ EPDM
Process fluids	DM water, Chiller water
Ambient Temperature range	10° C to +45° C
Ambient relative humidity	5% to 95%

Process fluid temperature	0° C to +100° C
Max. operating pressure	< 15 Kg/cm ² ; < 30 Kg/cm ² for DNBHP
Fluid velocity	< 4 m/s
Process connection	½” NPT(M)
Cable gland connection	2 x ½” NPT (F), One of which shall be plugged
Accessories	Direct Mounting five valve manifold for isolation pressure equalization & drain
Pressure drop	≤ 0.3 Bar at 100% flow range

3.5 DATA ACQUISITION AND CONTROL SYSTEM

3.5.1 SCOPE:

The control and monitoring system for the CWS comprises of following basic flow loops:

1. ICECRH Loop
2. DNBHP Loop
3. DNBLP Loop
4. DNBCH Loop
5. IPRCH Loop
6. CHILLER Loop as secondary Loop
7. HRS Loop
8. WPU Loop

3.5.1.1 Control system specifications:

Broadly, the system is required to operate with a view to ensure the following minimum functional aspects but not restricted to those mentioned below:

1. Maintain Temperature, Flow and Pressure of the entering water in primary loops:
(Loop – 1 to 5)
35°C ± 0.15°C tolerance band for Loop 1.
38°C ± 0.15°C tolerance band for Loop 2 to 5.
Temperature, Flow rate and Inlet pressure as per P&IDs
2. Maintain the Temperature, Flow and Pressure of the entering water in secondary loops:
(Loop –6)
14°C ± 0.15°C tolerance band for Loop 6.
Temperature, Flow rate and Inlet pressure as per P&IDs
3. Maintain the Temperature, Flow and Pressure of the entering water in HRS loops:
(Loop –7)
32°C ± 0.15°C tolerance band for Loop 7.
Temperature, Flow rate and Inlet pressure as per P&IDs
4. Maintain the Conductivity and dissolved Oxygen level of D&D as under:
(Loop- 1 to 5)
< 1µ S (or Max. 1.0 µ S)
O₂ level: 0.1 ± 0.05 ppm. (Or Max. 0.2 ppm)
Temperature, Flow rate and Inlet pressure as per P&IDs

5. Monitor Conductivity and dissolved Oxygen of ultra-pure water of WPU Loop (Loop- 8)
Note: - WPU Unit (Loop-8) is not in the scope of this contract (the same shall be integrated with SCADA of CWS in near future)

For Other Level, Pressure and Flow control shall be as per the requirement of the water-cooling system.

Although the conditions are to be maintained within the tolerance specified, but the system configuration should be such that even within the control band, the signal outputs from the system shall maintain the control variable nearest to the set point (causing minimum of the fluctuations in the parameters) withstanding maximum changes specifically for the temperature control. However, the water quality level may be allowed below the set points.

3.5.1.2 Monitoring aspects:

A central monitoring operating Interface is envisaged for the system. The parameters monitored under this system include:

1. Pressure monitoring at: For Indication and ON / OFF - Annunciation
 - a. Heat Exchanger inlet/outlet
 - b. Sub-system inlet/outlet
 - c. Storage tank outlet line.
 - d. Differential of PUMP inlet/outlet for status.
2. Temperature monitoring at:
 - a. System Load common inlet
 - b. Storage Tank / pump suction
 - c. Heat Exchanger inlet and outlet primary side DM water -for Heat transfer control
 - d. Heat Exchanger inlet and outlet secondary side cooling water- do-
3. Level monitoring of
 - a. DM Make Up for level control
4. Conductivity / Oxygen level monitoring of
 - a. DM water entering sub-systems
5. Flow monitoring of System load inlet DM water for pump - VFD / Actuator control.
6. Status monitoring of Pumps sets and valve at in the process as per PID
7. Status monitoring of incoming AC breakers

Provision for Auto- manual mode switch over shall be made for the operator to operate the system in either mode through the control monitor mouse, like pump-set ON/OFF and valve opening/closing etc.

It is desired to network all the individual controllers, to a seamless communication BUS, with a view to monitor and centrally control the entire system. Further, through this system it shall also be possible to log all the data pertaining to all monitoring parameters on real time basis.

3.5.1.3 Controller Specifications

Table 31: SPECIFICATIONS FOR MAIN CONTROLLER

Sr. No.	Specification	Description
	Type of controller	PLC based
1	Digital display	On the Controller Fascia for the analog and digital parameters
2	Set point	Can be changed from the controller function keys
3	I/O density	Minimum parameter density as per specs
4	Supply voltage	240V AC \pm 15%;
5	Internal battery specification	Internal batteries shall be lithium with minimum 10 years of disconnected self-life and minimum 5 years of working life.
6	Serial Interfaces	Two optically isolated RS-485 interfaces on the CPU; 9600 Baud
7	Analog Inputs	Shall be 13-bit resolution; Input selectable via jumper for 0-10 V as well as 4-20 mA or RTD's 3-wire / 4-wire
8	Real Time Clock	Time in Hr. and Min; Date in Yr., Min, day. Auto calendar for day of week.
9	Scheduling modules	Optimal start stops modules
10	Exception days	Exception day (holiday) periods defined by begin and end date
11	Programmable Function Modules	PID Controller, ON/OFF controller, Heating/Cooling PID Controller, Heating cooling ON/OFF controller, Avg. Calculation, Min/Max selection, calorific or Psychrometric calculation, Line Segment Function, Input selector, Calculator(liner/polynomial), 8 channel timer function, Totalization for 8 channels (of event, integration, run-time), Comparator for 8 channels, Sequencer (up to 8 output stages), Simple calculator (8 channels)
12	Programmed Logic Control	PLC module executing Boolean Functions: AND, AND NOT, OR, OR NOT, AND-Block, OR-Block, OUT/OUT NOT, Change of State, SET/RESET.
13	Sequencing	Always Operates a set of Chillers in their optimum kW/Ton ranges with respect to instantaneous Cooling load distribution.

	(Necessary for plant room)	
--	-------------------------------	--

3.5.1.4 Control and monitoring system

The Central Control System for CWS at IPR should basically carry out the following functions:

1. Functionality required from Central Control System as operational requirements
 - a. Online Data Base Generation of all parameters logged to the system.
 - b. Commands to start, stop, override, set point changes, logic implementation, monitor/control, energy consumption.
 - c. Monitor facility for alarms, I/O summaries and status for operator.
 - d. Maintains Schedules of events and holidays.
 - e. Power-Fail Restart to command Break Off points to scheduled states.
 - f. 4 level Password Protection - monitor only, command, operate system level.
 - g. Optimal Start stop operations to Economize “Morning Warm-up/Cool-down” and “Evening Shutdown” Sequences while furnishing occupant comfort.
 - h. Optimal Start/Stop Adaptive Modeling for seasonal variations to continually optimize start/stop sequences.
 - i. Load Rolling to Turn OFF the drives for fixed duration on selective basis but without discomfort to occupants.
 - j. Demand Limiting to prevent demand from exceeding the operator defined demand limit.
 - k. Alarm Processing.
 - l. Auto shut down on nuisance alarm reporting.
 - m. Dial In out communications to connect to remote terminal for monitoring, control, and alarm messages.
 - n. Printer Functions for maintaining hard copy records.
 - o. Easy Data Base Generation and Configuration including trend history for energy analysis.
 - p. Energy Profiles and Trending.
 - q. Totalization Features
 - r. Global Data Sharing
 - s. Signal Select for averaging, HI/LO indications.
 - t. Mimic generation package with color graphics.
 - u. Data base transfer to allow operator to restore data to system or back up data to disk.
 - v. Built –In RS Communications.
 - w. Memory back up to Save and restore database.
 - x. Self-diagnostics to warn operator of the error with full description

2. Design criteria

The Centralized Control System offered shall have the following features:

- a. State-of-the-art technology and use of open system computing and networking architecture.
- b. High level of reliability and availability for continuous satisfactory operation.
- c. Modularity.
- d. Expandability.
- e. Support to EMS software.
- f. Multi-platform support.
- g. Multi-user support.
- h. High speed data transfers.
- i. Multi-vendor Networking.
- j. On-line bi-directional Relational Database support.
- k. Scalable Application.
- l. Open access for Users and other programs.
- m. Flexible system integration.
- n. Client/ Server architecture support.
- o. LAN support.
- p. AM/FM support

3. Operating system

The offered system shall be based on the state of the art 64-bit Windows 10 operating system with following features:

- a. Multi-Tasking.
- b. Multi User.
- c. C2-level security.
- d. Networking protocols support.
- e. Graphical Users Interface (GUI).
- f. DOS & WINDOWS emulation.
- g. UPS support: There should be support for UPS. The offered UPS shall keep operating system running in the event of a mains power cut and lets your shutdown operating system correctly, thus avoiding any potential data loss. Operating System shall warn you when the main power fails and shall automatically shut down safely before the UPS itself runs down its batteries.
- h. Various Password support.
- i. Development tools & Administration tools to be provided as part of the Operating System.
- j. Support for object linking like Dynamic Data Exchange, Object Linking Embedding etc.

4. Software: SCADA

A software package shall be provided by the contractor for the development of Operator Interface, Alarm configuration and data archiving configuration etc. A PLC based plant control system and a

modular fast data acquisition system with data logging time is required for this facility. This modular data acquisition system shall be integrated with SCADA Software and shall be integrated seamlessly.

All the application software shall be designed to be data- centric and not code- centric as far as practical. The settings which are expected to be changed, however rarely, in course of the plant system life time, should be made configurable without additional program recompilation and, preferably, without program restart.

Remote control functions for plant controller like reboot, configure, start, stop, switch to local shall be accessible from main control room.

An industry standard windows graphical configuration package shall be provided to configure the processor. It should be integrated, configured and set the I/O Parameters and control them in a real time when PLC is connected to the process.

SCADA software i.e. “Supervisory Control and Data Acquisition System software should allow an operator to make set point changes on distant process controllers, usually to control, monitor alarms, to analyses or report industrial automation applications. With SCADA, user should be able to collect data from experimental facility's sensors and devices and transform them into dynamic text, alarm or graphic scheme. The SCADA should have functionality viz. Data Acquisition, Data Processing, Alarms, Data Archiving, Visualization, Controlling, Trending, and Reporting. The SCADA software should be able to connect with PLC as well as controllers.

3.5.1.4.1 General requirement

1. SERVER Configuration & Software System

i7, 3 GHz processor, Quad core CPU with 12 MB L3 cache.

16GB of RAM or higher VGA graphics card capable of 1280 x 1024-pixel resolution (or better) and

32-bit colors, non- interlaced (70 Hz or better vertical refresh rate) or higher with 21” LCD Color Display, 12 functions-key keyboards (English) with Mouse pointing device. 2X western Digital Raptor SATA Hard Disk Drive of 8 TB after RAID 5 configuration or higher complete with DVD +/- RW Drive Disk Drive.

A Network Interface Card (NIC) for Ethernet Networking compatible with TCP/IP network protocols (UTP & Fibre), with Antivirus, MS Windows Server Software and operating license and MS SQL Server License.

Vendor shall provide equivalent or with higher specs for server for operating the system. It shall be vendor’s responsibility to provided efficient server as per site requirement to run the system without any lag/or delay.

2. Desktop Computer Software System

A new graphics-based software system and Desktop Computer shall be provided by the controls specialist. It shall consist at a minimum of:

i7 Quad Core 3.2 GHz processor, 12 GB of RAM,

21" LCD Color Display (1280 x 1024) , 12 function- key keyboards (English) Mouse pointing device;

500GB X @ Mirrored HDD for OS & BMS Software

DVD Combo Drive

Graphics Card – one NVS 395 or higher version, 1024MB or better;

NIC (network interface card) for Ethernet Networking compatible with TCP/IP network protocols (UTP/fibre);

Complete with Antivirus, MS Windows Client Software and operating license; MS SQL CAL.

- The System shall support multiple Operators' Work Stations.
- The Workstation shall not function as a dedicated control device to the network. It shall be connected to the Plant network via standard network connection devices.
- No. of SCDA workstations to be provided by the contractor: 3 nos.

3. Data processing

The offered system shall be capable of the following data processing functions:

- a. It shall be possible to perform mathematical calculations.
- b. It shall be possible to perform logical operations.
- c. It shall be possible to program control logic. This is an important requirement of the system. The programming software offered shall allow development of complex control logic using flow chart programming. Flow chart programming is gaining in popularity due to its intuitive nature ease of programming and IPR desires to use the same for programming of control logic. The flowchart programming tool offered shall have facility for validating the logic developed, carrying out simulation runs, to control the process and to provide an operator interface.
- d. The software shall be capable to add pseudo measurements.

4. Spare capacity:

The Contractor shall provide 10% spare control points of each type in the form of universal input/output contacts and supporting software capacity at each outstation. Each Floor network shall have the capacity of a 25% increase in the number of nodes on that floor without introduction of further networks. The Contractor shall also provide 2(two) spare Ports at each TCP/IP Hub or Switch if applicable to allow future BMS network expansion.

5. Mimic generation:

The Application software shall consist of a built-in module for mimic generation. This function can be used for creating complex process diagrams using basic drawing entities and a library of pre-defined symbols. It shall be possible to represent a measurement as a digital readout, dial, horizontal bar, and vertical bar. It shall be possible to customize alarm messages window anywhere on the screen.

It shall be possible to create a detailed customized data acquisition / control screens by simply click and drag icons.

It shall be possible to create backgrounds using scanned photographs, maps, one-line diagrams, engineering drawings etc. using popular graphics or engineering applications which can save images in bitmap formats.

i. Mimic Display

It should be possible to create new process diagrams that represent various sections of the electrical network at different levels of details using the mimic generator package.

ii. A Uniform Mimic Colour Scheme shall be followed

Readability of mimics shall be possible to be improved by use of appropriate colour scheme. It should be possible to colour code the entire electrical network based on the voltage level. The suitable default colour scheme should be implemented based on the standard electrical distribution network norms and practice. However, operator shall be free to select his own colour combination if he desires.

iii. Performing Switching Operations from Within Mimic

It shall be also possible to perform switching operations from within mimic displays by just taking his cursor to the equipment that he wants to switch and double click. This shall display switching dialog box on the screen that displays the current status of the equipment. Operator shall be able to toggle this status and upon confirmation the actual switching operation shall be performed.

iv. Switching Between Mimics

A list of all available mimics shall be displayed in a menu that can be invoked by selecting the mimic menu option. User can then select the mimic of his choice and on confirmation the selected mimic should be displayed.

Alternatively, a list of 6 mimics shall be always displayed on the bottommost line of the mimic. User can view its description in the right bottom portion of the screen by just taking his cursor over the mimic name. To select any mimic, one has to just click at the mimic name.

6. Database functions that can be changed online

A highly flexible database editor shall be provided for configuring analog channels that allow as many as approximately 28 fields to be changed/specified on-line.

Editable Analog Database Fields

1. Tag Name
2. Tag Description
3. Channel Number
4. Units
5. Sensor Type
6. Scan Frequency: The following options shall be available:
 - a. No Scanning
 - b. 1 Second Scan-class
 - c. 5 Second Scan-class
 - d. 15 Second Scan-class
 - e. 30 Second Scan-class
 - f. 60 Second Scan-class
7. Scan Skip Flag: The options available shall be:
 - a. Square Root Extraction
 - b. Reasonability Limits
 - c. Group/Section Assignment
 - d. Trend Page Assignment
 - e. Trip Group Assignment
8. Historical Group Assignment shall be selectable from:
 - a. No Logging
 - b. 01 Second
 - c. 30 Seconds
 - d. 60 Seconds
 - e. 2 Minutes
 - f. 5 Minutes
9. H-L Alarm Limits:
 - a. HH-LL Alarm Limits
 - b. EH-EI Alarm Limits
 - c. Rate of Change Alarm Limits
 - d. Significant Change Limit
10. Alarm Priority
 - a. Critical

- b. Normal Priority and
- c. Low Priority.
- d. Alarm Dead Band
- e. Zero Dead Band
- f. Annunciator Output
- g. Alarm Inhibit

11. Equation

12. Device Tagging

13. Data Quality Code shall be:

- a. Editable Digital Database Field
- b. Tag Name
- c. Tag Description
- d. Channel Number

14. Alarm Code: The following codes shall be available:

- a. Alarm code 1. TRIP/NORMAL
- b. Alarm code 2. RUN/STOP
- c. Alarm code 3. OPEN/CLOSE
- d. Alarm code 5. UP/DOWN
- e. Alarm code 6. FULLOPEN/INTRANSIT
- f. Alarm code 7. FULLCLOSE/INTRANSIT
- g. Alarm code 8. CLKWS/ACLKWS
- h. Alarm code 9. OFF/ON
- i. Alarm code 10. FAST/SLOW
- j. Alarm code 11. TOP/BOTTOM
- k. Alarm code 12. NORMAL/FIRE
- l. Alarm code 13. NORMAL/ABNORMAL

15. Group Assignment

16. Trip Group Assignment

17. Device Tagging

18. Alarm Priority

19. Annunciator

20. Normal Status

21. Skip Flag

22. Historical Group Assignment

23. Alarm Inhibit

24. Auto/Manual Override

25. Status

26. Calculated

27. Quality Codes

7. Graphical Historical trending Functions

This option shall allow trending of historical data. The various data types that should be possible to trend shall include:

a. Historical data types:

This data type refers to the data that shall be logged using standard logging frequency and duration as specified by the system manager. The default logging frequencies required are 15 seconds, 30 seconds, 60 seconds, 5 minutes and 15 minutes or as desired and user shall be free to select any one of them. Moreover, to avoid disk full condition due to huge amount of data, these files should be deleted by the system after specified number of days. This data shall be therefore available only for a limited duration.

b. Hourly Data

Analog Data

Spot
Minimum
Maximum
Average

Digital Data

ON/OFF Data
ON Time

This data type refers to standard logging frequency of one hour and all database channels are logged.

c. User Defined Data

Analog X Minute Data

Spot
Minimum
Maximum
Average

Digital X Minute Data

ON/OFF Data
ON Time

This option shall be similar to hourly data option, the only difference being the logging frequency, which is specified by the user during initial system configuration.

d. Special Data Type

For specified or any particular logging frequency and logging duration, it shall be possible to retrieve that data using this option.

iv. Historical Trend Display Options

The following options shall be provided to facilitate historical trend display.

- a. Hide Trend Channel
- b. Unhide Trend Channel
- c. H-L Limit
- d. HH-LL Limit
- e. EH-EL Limit
- f. With $\pm 10\%$.

v. Tabular historical data display functions

An option for tabular display of the historical data shall also be provided as well as spread sheet options.

The following options shall be provided under this option:

- a. Change Date of Data Being Displayed
- b. Change Time of Data Being Displayed
- c. Edit Historical Data
- d. Save Historical Data

8. Report generation

The report generation module shall have facility to customize it as per IPR/IPR's requirement. The customization shall be user friendly with application of GUI tools. The report generation module shall consist of the following:

- a. Generation of customized report using any field of the database, historical database, real-time data or combination of the above using advanced mathematical calculations.
- b. The report shall be possible to be triggered based on time, event or user defined demand.
- c. It shall be able to generate shift reports, daily reports, monthly reports, yearly reports from the historical database.
- d. Reports formats shall also include:
- e. Communications summary report
- f. Active alarm summary report
- g. Historical alarm/ event summary report
- h. Selective alarm/ event report
- i. Information and control tags reports
- j. Reports shall be created in report generation and shall be exported to relational database.
- k. It shall be possible to print reports on demand, scheduled or automatically triggered by an event or time of day.
- l. Facility should be provided for scheduling of reports automatically at the end of hour, shift or day. It should be possible to schedule reports multiple times within a day based on the user-defined times.
- m. Based on the data already collected the system should be able to carry out the following:
 - i. Hourly/daily/weekly/monthly/yearly peak values of important parameter
 - ii. Peaks reached for individual Loops
 - iii. It should also be possible to graph out the above information on screen as well as on the printer in different colors to allow proper differentiability.

A number of standard reports shall be provided to enable use of the system from day one.

The sample standard reports to be provided like: -

1. Demand Log Report: This report prints the current status of all parameters at the time of request.
2. Alarm Summary Reports: This report gives a list of all the channels that are in alarm or have returned back to normal but are not yet acknowledged with date and time. Moreover, for normal channels the time when that channel returned to normal shall be also shown.
3. Spot Group Logs: This report is quite similar to the demand log, the only difference being that parameters belonging to a specified group or groups shall only printed.

4. Historical Group Log: This report is similar to the spot group log report except that user can generate report based on the historical data that is logged.
5. Hourly Log Reports: These are logs that are printed at specific time intervals. However, in case printer is not on-line at that time, a facility shall be provided to print these reports on demand.

The following types of logs shall be provided:

- a. Hourly log: This log shall be initiated every hour and shall print out the hourly maximum/minimum and average values for the previous hour.
- b. Shift log: Every 8 hours or at manager defined interval, shift log shall be printed out. This report shall consist of average, minimum and maximum values for each analog channel for the previous eight hours.
- c. Daily log: This log provides information about average, minimum and maximum values of the entire day for each channel.

9. Daily Deviation Log

For each process variable, a report of its maximum value along with its time of occurrence, minimum value along with its time of occurrence and running average value of the parameter shall be printed.

i. Event List

This report prints a list of events that match the following inputs.

- a. Start Date: This defines the start date from which events should be searched.
- b. Start Time: This defines the start time from which events should be searched.
- c. End Date : This defines the date till which events have to be searched.
- d. End Time: This defines the time till which events have to be searched.
- e. Parameters (Analog) : User shall have the flexibility in defining the parameters that he wants to get reported.
- f. Parameters (Digital): This option allows for selection of digital channels and shall be similar to the one above.
- g. Alarm Types: User shall also be able to select the alarm types that he wants to view.

ii. Custom Reports

A very powerful and flexible report generator package shall be provided that allows its user to configure reports as per his specific requirements. This should be flexible and allow for selection of the following:

- a. Any field of the database
- b. Current or historical data

- c. Min/Max/Avg. function over time
- d. Total of a row or column
- e. Text fields
- f. Print historical values from a given time until another time

The date and time of data should be relative or fixed to the user-defined time of reporting. Details of the report generator shall be finalized during final design.

iii. Custom Graphs

Similar to user defined report generation facility, a facility shall be also provided to generate graphical reports of historical data. Details of the software package offered shall be mentioned in the bid.

iv. Alarm / Event Display

The alarm generation module shall consist of following:

- a. The module shall provide monitoring the data acquired from field, internally calculated points, on event bases and shall provide real time alarms.
- b. There shall be a facility for acknowledgement of each and every alarm generated using various options.
- c. The system alarms shall also be generated for following:
 - i. Failure of communication link
 - ii. Main computer failure
 - iii. Controller failure, power supply/ UPS failure
 - iv. Hard disk full/ hard disk crashed
 - v. Printer off-line
- d. Manual overwrites: User may force a state, condition or value or overwrite erroneously reported data (real time I/O shall be inhibited until manual overwrites is removed).
- e. Local station should also be able to report violations of alarm limits. At least last 1000 alarms should be stored in memory, and displayed on request. The alarm display should also show along with TAG name and TAG description, the type of alarm along with the signal value at each scan interval.
- f. There should be a provision for individual acknowledgement of alarms and alarm display should provide information on whether a particular alarm has been acknowledged.
- g. There shall be a separate window display for alarm. It shall be possible to customize alarm messages window anywhere on the screen. The window shall flash when there is alarm condition and computer shall beep or play pre-recorded sound to alert the user.
- h. There shall be a provision to assign different user defined priority levels.
- i. The system should support six or more levels of alarms. Each alarm type should be displayed in different user configurable colour to allow easy differentiability.
- j. The Loop name and name of the channel in alarm should also be indicated. It should be possible to retrieve alarms on the basis of the following conditions.

- i. Start date and Time
- ii. End date and Time
- iii. Controller source
- iv. Type of alarms
- v. Alarm Priority

The most recent alarm should be displayed at the bottom of the screen.

v. Customization

It is mandatory for the vendor to customize the offered system as per IPR's requirement. During the period of System Definition, the Vendor shall define formats of reports, mimic diagrams, tag names, channel nos., tag description, terminal nos., limits etc. for analog and digital parameters in consultation with IPR. The vendor shall prepare customization specification along with IPR. During the period of System engineering, design and customization, the vendor shall carry out above-mentioned activities.

3.5.1.5 ONLINE UPS

The Vendor shall supply, install and commission On-line UPS for the offered OWS of the DACS system. The UPS shall be of suitable rating with back up time of 20 minutes at full load. The harmonic distortion shall be less than 3 %. The output shall be Single phase, 230 Volts AC, Sine wave, and 50 Hz. The noise level shall be less than 45 dB.

The offered On-line UPS shall be supplied with UPS power management and diagnostic software on offered operating system of SCADA with features like Automatic shutdown, UPS Self-test, Battery replacement warning, real-time graphical display of UPS status, Battery run time etc. UPS parameters shall be software configurable. The UPS shall be delivered with necessary interfacing cables and connectors.

3.5.1.6 CONTROL AND LOW VOLTAGE POWER CABLING

Table 32: CONTROL CABLING

Sr. No.	Equipment	Cable Size
1	Transmitters like pH, DO meter, Conductivity, Flow transmitters	
	a. For 2 wire type	1.0 sq. mm X 1pair twisted Cu
	b. Other than 2 wire type	1.0 sq. mm X 2 pair twisted Cu
2	Temperature sensors (RTD Ni-1000)	1.0 sq. mm X 1pair twisted Cu

3	DP Switches, Solenoid Valves and for ON/OFF status signals from Panel and Controller	1.0 sq. mm X 2 pair twisted Cu
4	Communication Cable connecting the entire DCS network	CAT-5 or better Ethernet standard cable
5	Network Cable between each Operating Work stations	CAT-5 or better Ethernet standard cable

3.5.1.6.1 General Requirements:

Shielded twisted pair Control cable shall be used from Field sensor/transmitter to respective Junction Box. Multicore shielded twisted cable shall be used to connect number of Junction Boxes to Marshalling Cabinet. Ethernet/profinet cable shall be used to connect Marshalling cabinet to DCS cabinet. Control room shall be having the DCS cabinet and marshalling cabinets/junction boxes. The location shall be finalized during detailed design. The manufacturing/construction requirement of DCS/Marshalling cabinet/ Junction boxes shall be detailed out during design phase.

3.5.1.6.1.1 Control wiring:

- a. Provide interlock wiring between supply, electrical wiring for relays (including power feed) for temperature and pressure indication.
- b. Provide power wiring, conduit and connections for thermostats, alarms, flow switches, actuating devices for temperature, humidity, pressure and flow indication, point resets controlled by this CWS plant.
- c. Provide all other wiring required for the complete operation of the specified systems.
- d. Install all wiring raceway systems complying with the requirements of the National Electrical Code. All installations shall be installed in Electrical Metallic Tubing (EMT).
- e. Network communication requirement:
 1. In all communication conduits, provide one spare twisted pair to be installed, tagged and labelled at each end.
 2. Communication conduits shall not be installed closer to high power transformers or should not run parallel to electrical high-power cables. Care shall be taken to route the cable as far from interference generating devices as possible.
 3. Unshielded cables shall be used for communication.
 4. There shall be no power wiring, in excess of 30 VAC rms, run in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, all communication wiring and signal wiring shall be run using separate twisted shielded pairs (24awg) with the shields grounded in accordance with the manufacturer's wiring practices.

- f. Splices: Splices in shielded cables shall consist of terminations and the use of shielded cable couplers, which maintain the integrity of the shielding. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties as specified herein.
- g. Conduit and Fittings:
 - 1. Conduit for Control Wiring, Control Cable and Transmission Cable: Electrical metallic tubing (EMT) with compression fittings, cold rolled steel, zinc coated or zinc-coated rigid steel with threaded connections.
 - 2. Outlet Boxes (Dry Location): Sherardized or galvanized drawn steel suited to each application, in general, four inches square or octagon with suitable raised cover.
 - 3. Outlet Boxes (Exposed to Weather): Threaded hub cast aluminium or iron boxes with gasket device plate.
 - 4. Pull and Junction Boxes: Size according to number, size, and position of entering raceway as required by National Electrical Codes. Enclosure type shall be suited to location.
- h. Relays: Relays other than those associated with digital output cards shall be general purpose, enclosed plug-in type with 8-pin octal plug and protected by a heat and shock resistant duct cover. Number of contacts and operational function shall be as required.
- i. Solid State Relays (SSR): Input/output isolation shall be greater than $10E9$ ohms with a breakdown voltage of 1500V root mean square or greater. The contact life shall be $10 \times 10 E6$ operations or greater. The ambient temperature range of SSRs shall be -20 to +140F. Input impedance shall not be less than 500 ohms. Relays shall be rated for the application. Operating and release time shall be for 100 milliseconds or less. Transient suppression shall be provided as an integral part of the relay.
- j. Contactors: Contactors shall be of the single coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches, or semi-permanent magnets. Contractor shall be double-break-silver-to-silver type protected by arcing contacts. The number of contacts and rating shall be selected for the application. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices.

3.5.1.7 FACTORY INSPECTION AND TESTING

Bidder shall provide the inspection plan for FAT during detailed design and necessary tests shall be offered before dispatch from the factory.

3.5.1.8 ERECTION AND INSTALLATION AT SITE

- A. Do not install electronic hardware in the project until non-condensing environmental conditions have been established. Products installed in violation of this request maybe requested to be replaced at no additional cost to the project.

- B. Coordinate storage requirements for factory mounted terminal control units on air terminal devices, air handling units or other packaged control equipment. Do not store control units on site in non-conditioned areas for more than two weeks.
- C. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.
- d. Install all control components in accordance with manufacturer's instructions and recommendations.
- e. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide nameplates for instruments and controls inside cabinet and nameplates on cabinet face.
- f. After completion of installation, test and adjust control equipment, submit data showing setpoints and final adjustments of controls.
- g. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

3.5.1.9 TESTING AND COMMISSIONING AT SITE

1. Upon completion of the installation, Contractor shall start-up the system and perform all necessary calibration and testing to ensure proper operation of the project control systems.
2. Schedule a hardware demonstration and system acceptance test in the presence of the Contracting Officer and/or the Engineer. The acceptance testing is defined as demonstrating the sequence of operation as indicated in the drawings (drawing shall be prepared by the contractor during detailed design stage). The Contractor shall perform all tests prior to scheduling the acceptance test and hardware demonstration to insure the overall system is ready for inspection and observations.
3. When the system performance is deemed satisfactory in whole or in part by IPR representatives, the system parts will be accepted for beneficial use and be deemed substantially complete as defined in scope of work and SOQ.
4. The contractor shall be responsible for the full commissioning of his system and any other controls equipment supplied by him.
5. All safety interlocks, overrides and fail-safe conditions are to be operational prior to starting the plant. Demonstrate as agreed with the engineer prior to starting plant in SCADA auto mode.
6. Fault conditions for all critical alarms, safety devices and control interlocks shall be simulated and proved effective as soon as practical once SCADA control mode is selected.

7. Sensors shall be checked to ascertain accuracy within limits, pressure switches checked for switch points and hysteresis.
8. All the necessary test equipment and materials used in commissioning shall be supplied by the contractor. All test equipment shall have valid test certificates.
9. Graphs shall be provided to demonstrate the stable control of the plant. Simulated inputs shall be employed to check stability over the designed environmental range.
10. Commissioning documentation and schedules shall be submitted for approval during the design phase showing each plant, point, interlock and control algorithms, and the stages of checks and commissioning required. Each cleared item shall have date and engineer reference.
11. After plant is commissioned and put in operation on Centralised control system, necessary documents on overrides, control and software configuration shall be made available in the control room.

3.5.1.10 ACCEPTANCE DEMONSTRATIONS

The contractor shall give advance notice to the engineer of his intention to provide the acceptance demonstrations once the commissioning is complete. The operation of all safety interlocks shall be tested. The contractor shall supply sufficient man-power/test equipment, consumable items to conduct the demonstration efficiently. Testing shall also incorporate an audit of the wiring and hardware installation, demonstration of safety interlocks, start of system from power-down and review of time schedules and alarm levels, grouping and selected control parameters.

**4. SECTION- IV INSPECTION, TESTING AND
MEASUREMENT**

4.1 INSPECTION, TESTING & ACCEPTANCE

Pre-dispatch inspection shall be carried out for certain items. All the system equipment, parts shall be checked for physical damage, before commencing the installation work. Complete fabrication, installation and commissioning work shall be jointly supervised and shall be carried out as per the specifications and instructions of IPR/IPR Engineer In-charge. All the rotating equipment shall be checked for static and dynamic balancing, minimum operating vibration and noise.

All the system / equipment shall be checked before / after satisfactory commissioning, at site as per the approved technical specifications, performance data provided by contractor / manufacturer. Actual capacity of equipment shall be calculated based on the test readings, recorded jointly, for design conditions / operating conditions. Performance acceptance is subject to comparison of test results with contractor / 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 / performance. In case of system modification / rectification complete performance tests are to be repeated. Site test readings shall be jointly recorded.

In general, following Inspection / tests are involved. Type of test, duration of test, testing procedure / parameters, will be as per the applicable BIS codes. However, the detail Inspection and test procedure shall be worked out jointly by the purchaser and the contractor along with the approval of detailed design/drawings.

- a. Pre-dispatch Inspection
- b. Pre-dispatch testing at manufacturers shop / factory (material, performance, joints, pressure etc.)
- c. Physical Inspection – pre-installation at site.
- d. Welding joint inspection and testing at site.
- e. Pressure testing at site.
- f. Performance testing at site. (Capacity, power consumption, pressure drop, vibration, etc.)
- g. Calibration at site

Table 33: INSPECTION, TESTING & ACCEPTANCE

Sr. No.	Items/Equipment	Inspection/test involved
1.	Water chiller machines	a, b, c, e, f.
2.	Cooling tower	a, b, c, f.
3.	Plate type heat exchangers	a, b, c, e, f.
4.	Pumps	a, b, c, e, f.
5.	Pressurizer and pressure vessels	a, b, c, e.
6.	Thermal Insulations	a, c.
7.	MS structural works	c, d.
8.	Piping – CS & SS	a, b, c, d, e.

9.	Pipe fittings- CS & SS	a, b, c, e.
10.	Valves	a, b, c, e, f.
11.	Strainers	a, b, c, e, f.
12.	Electricals control panel Boards	a, b, c, f.
13.	VFD, Motor, Soft Starter	a, b, c, f.
14.	Instruments, control and Data Acquisition System	a, b, c, e, f, g.

- All the arrangement for the said inspection and testing must be made available at manufacturer's works/ site by the contractor at no extra cost. 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 site.

4.2 TEST CERTIFICATES

Contractor shall furnish following Test certificates:

- Material testing of various components of the Equipments/ system parts.
- Fabrication inspection / test certificates– Radiography and others
- Welder's qualification certificate.
- Performance test certificates carried out by manufacturer before Pre- dispatch inspection & testing.
- Performance test certificates carried out by manufacturer.
- Performance guarantee certificate. / Calibration certificate/ balancing certificate.
- Performance curves of all equipment, along with operation and maintenance manual.

4.3 SITE INSPECTION AND TESTING

All the tests shall be carried out in the presence of the representative of IPR. All manpower, instruments, services, required for the tests shall be provided by the contractor. All the system components (Including the parts cleared after pre-dispatch inspection and testing) will be physically inspected and tested before and after installation according to approved specifications and drawings.

Capacity ratings and power consumption with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of the installation. Manufacturer's tests certificates shall be furnished for all equipment / materials.

The contractor shall demonstrate the capacity and the power consumed by the equipment.

The contractor shall also demonstrate the proper operation of all controls, Instruments and other equipment.

Hydrostatic test for all pressure piping shall be carried out.

Alignment of drives, checking of vibration isolation, running tests for pumps, chillers, cooling towers etc. shall be carried out.

Water piping 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 Kg/cm², for a period of not less than 4 hours. Any leaks, defects shall be rectified and re-tested in same manner. After completion of the installation, all water system equipment such as pumps, chillers (including existing working chiller), Cooling towers, valves, instruments etc. Shall be adjusted and balanced to deliver the water as specified. (All piping shall be measured in units of length along the centerline including of all joints, bends, fittings, flanges and other accessories).

4.3.1 EQUIPMENTS/COMPONENTS/ITEMS TESTING

Following equipment shall be tested for performance at site:

Cooling Tower, Chillers, Pumps, PHEs, Pressurizers, valves, actuators, motors, VFDs, MCCs, Control Panels, DACs, entire piping network, power and control cabling networks, earthing network, instruments and controls etc. All individual equipment/components/items shall be tested according to the relevant test standards, approved procedures, criteria and test conditions covered in respective equipment/components/items Quality, Inspections, testing and acceptance chapters/paragraphs.

4.3.2 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 in all respect. 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 Engineer In-charge. The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Engineer In charge.

The following aspects shall be considered for performance testing:

- a. Prevailing conditions shall be as close as to design conditions.
- b. Type, quantity, location, frequency, duration of test parameters shall be decided and recorded accordingly during the test.
- c. Rated capacity, power consumption, and other operating parameters shall be checked.

- d. Functional test for all Instruments, controls (safety and capacity) and DACS shall be carried out to check for the expected operation / action / accuracy / response time / repeatability parameters.

4.4 MEASUREMENT OF WORK

In general, the linear measurements shall be carried out in meters, corrected to the nearest centimeter, the measurements of weights will be in kilograms

4.4.1 MEASUREMENT OF 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 center line of installed pipes including all pipe fittings, flanges (with gaskets, nuts, and bolts for jointing), unions, bends, elbows, tees, reducers, inspection pieces, weldolets, nozzles, caps, coupling etc. which are part of PMS (Piping material specifications). No extra charges shall be applicable for supply, installation, testing and commissioning of such fittings as well as other items which are mentioned in the PMS and provided to complete piping network functional.

The above accessories shall be measured as part of piping length along the center line of installed pipes, and no special multiples of pipe lengths for accessories shall be permitted. The quoted rates for center line linear measurements of piping shall include all wastage allowances, wooden haunches, nuts and bolts, check nuts, piping supports, 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. Piping supports shall be measured in terms of weight with unit kgs. Piping measurements shall be taken before application of the insulation. Piping rate shall include cost of testing/radiography as specified. No extra charge will be paid for portion of piping which is extra/additional for testing/radiography.

However, all valves (gate / globe / check / balancing / purge / butterfly / drain etc.), strainers, and instruments such as thermometers, pressure gauges, transmitters, flow meters etc. shall be separately counted and paid as per their individual unit rates, which shall also include their installation as per specifications.

4.4.2 MEASUREMENT OF STRUCTURAL STEEL WORK

The weight of structure can be assessed from the approved / fabrication / execution drawing, approved Bill of material, calculation on the basis of IS Hand book/ Manufacturer's data book / Formula. Actual weighing of the fabricated items may be done if required. This excludes all welds and fasteners used. No payment shall be made for temporary structure created by contractor for execution purpose.

Piping supports like MS angle, Channel etc. and piping section support shall be paid on weight basis.

4.4.3 MEASUREMENT OF INSULATION

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

1. Pipe Insulation

Piping insulation shall be measured in units of length along the center line of the installed pipe, strictly on the same basis as the piping measurements described earlier. The linear measurements shall be taken for 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, valves, orifice plates and strainers shall be considered strictly by linear measurements along the center line of pipes and no Special rate shall be applicable for insulation of any accessories, fixtures or fittings whatsoever.

2. Equipment Insulation

All equipment such as pumps, heat exchangers, valves, chilled water storage tank, pressurizer which are required to be insulated, the cost of supply, fixing of insulation on same shall be included in the cost of respective equipment/tank, hence shall not be paid separately.

4.4.4 MEASUREMENT OF ELECTRICAL PANEL, WIRING AND CABLING

Panels shall be counted as number of units. Quoted rates shall include as lump-sum (NOT measurable lengths) for all internal wiring, cabling, Bus bars, Connectors etc. The quoted rate of panel shall also include all accessories, switch-gear, fuses, contactors, indicating meters and lights as per the specifications. Control wiring for interlocking, automatic and safety controls, and control wiring for remote start/stop as well as indication as per the Specifications, done inside the panel shall be included as 'LOT' and be included in the MCC cost.

Power wiring and earthing connections from the control panel to the starter and to the motor, shall be measured in RMT (running meter length). The payment for additional quantity (In excess of quantity or limit as specified in SOQ, if any) of cabling shall be made as per unit rate provided with the BOQ. No wastage measurement shall be allowed.

5. SECTION-V: PAINTING COLOUR CODE

5.1 PAINTING COLOUR CODE

All Equipment 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 coat of synthetic enamel paint. Pump base-plate / piping supports subject to water exposure to be painted with rubber paint using zinc base primer.

The Colour code for identification of piping shall be as per IS: 2379.

All Pipes and structure steel work shall undergo a process of degreasing, thorough cleaning, and painting with a high corrosion resistant primer. All panels shall be baked in an oven. The finishing treatment shall be by application of synthetic enamel paint of approved shade.

Standard Colour Code:

The tentative colour code given below shall be followed. However, changes if any will be indicated well in advance. All painting colour code shall be approved before execution.

Table 34: STANDARD COLOUR CODE

Item	Colour
<ul style="list-style-type: none"> ▪ Electrical panel ▪ Chilled water Line – In let / Return / & storage tank Out let / Supply ▪ All supports / Stands / drain ▪ Condenser water piping In let / Return / & storage tank Out let / Supply ▪ Fresh / Raw / Make-up / waste Water 	<ul style="list-style-type: none"> ▪ RAL 7035 ▪ Light Blue ▪ Dark Blue ▪ Black ▪ Light Green ▪ Dark Green ▪ Approved Shade

All “Approved shade” shall be duly approved by IPR Engineer In-charge.

6. SECTION-VI: LIST OF MAKES

6.1 MECHANICAL ITEMS

Sr. No.	DESCRIPTION	MANUFACTURERS NAME
1	Screw Chillers	Carrier, Climaveneta, Daikin -McQuay, Trane, York, Kirloskar, Blue star, Voltas
2	Cooling Tower	Paharpur, Bell, Mihir, Advance 20-20, United cooling system, Marley
3	Centrifugal pump	KBL, Beacon, CG, Johnson, Grundfoss, C.R.I., KSB, Mather & Platt, ITT, Wilo, Armstrong
4	Plate type Heat Exchanger	Alfa Laval, GEA, Tranter, IDMC
5	Pressurizers	BEVPL, DCMS, L&T Limited, Hindustan Dorr Oliver, ISGEC, Lloyd steel
6	Stainless steel pipes	Ratnamani Metals & Tubes, NFC Sandvik, Apex Tubes, Prakash Steelage, ITC, Jindal, Surya, Tata, Mukund, Indus
7	PVC pipes	Astral, Finolex, Supreme
8	Structural steel	SAIL, TATA Steel, Jindal steel
9	Fittings (all types)	Tube line fab, Stewarts & Lloyd, Arvind pipes and fittings, steel smart, super tech, GIPL, MS Fittings, EBY Engineer
10	Flanges	Paramount forge, Arvind pipes & fittings, Punjab steel works, metal forge, Sanghvi forging, techno forge, tube products
11	Valves	
a)	Gate, globe, swing check, lift check	Audco, BDK, NSSL, KBL, L&T Limited, Intervolve, R&D Multiples, Flowserve, Oswal
b)	Balancing Valves	L&T, Forbes Marshall, Advance, Danfoss, Honeywell, CRI, Saunders, Weir, BDK, Trishul ,ITT, Crescent, Unimac, Flowserve, Oswal
c)	Safety relief valve	Tyco Sunmar, Tiruchy, Forbes Marshal, Fainger Leser, Sempell, Flowserve, Oswal
d)	Pressure reducing valve	Dewarane, Mencil, Placka, Nirmal Industries, J. N. Marshall, Mazda, Flowserve, Oswal
e)	Control valve	Fouress, Avcon Valves, R K Control Instrumentation Ltd, oswal
f)	Butterfly valve	Audco, Advance, Intervolve, C.R.I., L&T, Weir, BDK, CRI, Virgo, Fisher control, AMRI, Technova, Saunders, Crescent, Deltech, kitz, Flowserve, Oswal
g)	Ball Valves	L&T, Forbes Marshall, Virgo, Velan, Saunders, Accuflow, Weir-BDK, Trishul, Indian, Crescent, Unimac, CRI, Audco, Aptek, Lodha, Ped-Lock, Oswal
12	Gasket	Starflex, IGP, Flexitellic
13	Y & T-type strainer	Trishul, Triveni, Unimac, Rex, Emerald, Sant, Leader, Advance, Flowtech, Crescent valves, Flairs Gujarat Otofilt, Filtration, Multitex engineers

14	Nonmetallic bellows	Cori, Flexatherm, D.Wren, Macoga
15	Insulation (NBR, PUF, Expanded Polystyrene)	Lloyds Insulation / Beardsell./ Cooline / Owens/Armacell/ K-flex / Armaflex/Superlon / Aeroflex/ Arcoflex/ Navair/ Pyroguard/Supreme, Twiga, Fibregalass
16	Paint/Primer	Asian Paints, Nerolac, Berger

6.2 INSTRUMENTS AND CONTROLS

Sr. No.	DESCRIPTION	MANUFACTURERS NAME
1	Dial type temperature and pressure gauges	Pricol / Fiebig / Forbes Marshall / Emerald / Star / WIKA/Baumer /Waree
2	Magnetic Flow meter	Honey well / Forbes marshall/ Siemens / Johnsons Controls / Krohne marshall/ Yokogawa / Rosemount / E+H / Emerson rosemount
3	Pressure transmitter	Siemens, Emersion, ABB, Yokogawa, Honeywell, Smar
4	Level transmitter	Siemens, Emersion, ABB, Yokogawa, Honeywell, Smar
5	RTD	GI, Pyroelectric, Forbes Marshall, Emersion
6	Temperature gauge	GI, Pyroelectric, Forbes Marshall, Emersion, Waaree
7	Flow transmitter	Forbes Marshall, Emersion, Siemen, ABB, Honeywell, Rockwin,Sandvik
8	Orifice flow meter	Forbes Marshall, Emersion, Siemen, ABB, Honeywell, GI
9	pH meter	Emersion, E&H, Forbes Marshall,
10	Conductivity meter	Emersion, E&H, Forbes Marshall,
11	Level gauge/switch	Chemtrols, Pune techtrol, SBEM, Forbes Marshall
12	DO meter	Emersion, E&H, Forbes Marshall, Mettler toledo
13	PLC	Siemens, Schneider, ABB
14	I/P Converter	Fisher, Metso, Samson, Siemen

6.3 ELECTRICALS

Sr. No.	DESCRIPTION	MANUFACTURERS NAME
1	Induction Motors	Siemens, NGEF, ABB, CGL, Havells, Marathon, Bharat Bijlee
2	Starters, Contactors, Push Button,	Schneider,Siemens,ABB, L & T
3	ACB	Schneider,Siemens,ABB, L & T
4	MCCB, MCB	Schneider,Siemens,ABB, L & T,Legrand

5	SPP, OLR	Minilec, Telemecanique, Siemens, Schneider, ABB, L & T
6	Current Transformers	Automatic Electric, Kappa, G&M
7	Timer	Siemens, L&T, BCH, Schneider, ABB
8	Rotary switches, toggle switches, selector switches	Kaycee, Sulzer, Siemens, English Electric, ABB, Siemens, Schneider, ABB, L & T
9		
10	Digital Multifunction meter, Digital Ammeter	Schneider, Siemens, ABB, Automatic Electric, Meco, Rishabh, Selec, Conserve
11	LED type Indicating Lamps	Siemens, Teknic, Kaycee, Concorde, Essen
12	Power, control and PVC insulated Cable, copper conductor wires	Finolex, Gloster, Universal, Polycab, Incab, RR cable, Havells, Avocab, KEI, Delton cables, Uniflex, Nicco, Lapp
13	Time Delay Relay	Siemens, Minilec, Telemecanique, Siemens, Schneider, ABB, L & T
14	VFDS	Siemens, Danfoss, ABB, Schneider electric, L&T, Robicon
15	UPS	Emerson, APC, Hirel, Su-Kam, luminous, Microtek

7. SECTION-VII: SCHEDULE OF QUANTITY

7.1 NOTES TO BIDDER:

- 7.1.1 The bidder is required to quote only in INR (Indian Rupees)
- 7.1.2 The bidder should have quoted for the overall scope of the tender, failure of which shall lead to rejection of the bid.
- 7.1.3 In case the bidder has not quoted unit price for some of the items in their detailed price schedule, these items will be treated as zero value and the same shall be supplied by the bidder at zero cost.
- 7.1.4 All the items are broadly specified in SOQ, however for detail specifications refer to technical specification of relevant items in the tender document.
- 7.1.5 This schedule shall be fully priced and the extension and totals duly checked.
- 7.1.6 All the system parts, equipment shall be offered as per the list of make. Bidders may suggest other makes if equipment/items are not available with any of listed makes.
- 7.1.7 Prices for each item listed in this schedule must be clearly and completely filled in.
- 7.1.8 In the event of error occurring in the amount column of the schedule, as a result or wrong extension of the unit rate and quantity, the unit rate quoted by the Bidder shall be regarded as firm and the extensions shall be amended on the basis of the same rates.
- 7.1.9 The rate of each item of work included in the Schedule of quantities shall, unless expressly stated otherwise, includes cost of:
 - 7.1.9.1 All materials, fixing materials, accessories, operation, appliances, tools, plant, equipment, transport, labour and incidentals required in preparation for and in the full and entire execution, testing balancing, commissioning and completion of the work called for in the item and as per specifications and drawings.
 - 7.1.9.2 Wastage on materials and labour shall not be accounted in the final measurement.
 - 7.1.9.3 Loading, transporting, unloading, handling/double handling, hoisting to all levels, setting, fitting and fixing in position, protecting, disposal of debris and all other labour, necessary for the full and entire execution and to fully complete the job in accordance with contract documents, good practice and recognized principles.
 - 7.1.9.4 Liabilities, obligations and risks arising out of conditions of contract.
- 7.1.10 The specifications and drawings wherever available, are to be read as complimentary to and part of the Schedule of quantities and any work called for in shall be taken as required.

- 7.1.11 In the event of conflict between Schedule of quantities and other documents/drawings/diagrams including the specifications, the most stringent shall apply and the interpretation of the Engineer In-charge shall be final and binding.
- 7.1.12 All equipment, quantities and technical data indicated in this Schedule (SOQ) are based on the engineering by IPR and shall be indicative and for the Contractor's guidance. Contractor shall have to submit DETAILED drawings, specifications with the actual system requirement. Contractor shall be paid for the actual quantity of work executed by him in accordance with the approved shop Drawings at the SOQ rates.
- 7.1.13 If any of the items in addition to the schedule of supply of materials is required during execution of the Contract due to change in specifications, drawings, designs etc., which in the opinion of the Purchaser, if not procured promptly may delay the completion of the supplies, the Contractor shall procure the required material as per the specifications to the extent required to keep the progress of work unhindered. The Contractor shall be paid for such additional procurement in the following manner:
- 7.1.14 In the event of increase or decrease in Contract quantity as mutually agreed between the Purchaser and the Contractor, Contract price shall be increased or reduced for the increment or reduction in quantity at the unit rates given in the Contract.
- 7.1.14.1 For items and materials of the rating/capacity, for which unit rates are not available in the Contract, the Purchaser and the Contractor shall arrive at the price based on "unit rate proportionate price" which shall be utilized for pricing "increase" or "decrease" in rating/capacity. The units for such price calculation are listed in Table-6. Where there are more than one equipment/item are available in the Contract with different capacities of the same equipment (for e.g, horizontal pumps of different kW ratings), the lowest unit rate shall be utilized for price calculation.

Table 35: UNITS FOR PRICING THE CHANGE PROPOSAL

Sr. No.	Equipment	Unit
1	Cooling tower	MW
2	Water cooled Chiller	MW
3	Plate type Heat Exchanger	MW
4	Pump	Kg/sec X Kg/Cm ²
5	Motor for Pump	kW
6	Pressurizer/tank	kg
7	Variable Frequency Drive	MW
8	Pipe/valve/support	Kg

If the required item is not available in the Contract, the Purchaser shall reimburse the actual cost of procurement of such item (invoice value + 15% overhead charges), for which the Contractor shall submit quotations from three manufacturers among those from the List of suggested manufacturers in Part-B and the procurement should have been made from lowest among these three.

- 7.1.15 In case, the total price arrived on the basis of the unit prices furnished by the bidder in detailed price schedules is found to be higher than the total price indicated, then the unit prices quoted in the detailed price schedules shall prevail and total price indicated shall be corrected accordingly before issue of LOI.
- 7.1.16 In case the total price indicated is higher than the total prices arrived at by adding the prices quoted in the detailed price schedule, the total price shall prevail and the unit prices of the items contained in the detailed price schedule shall be corrected accordingly before issue of LOI.
- 7.1.17 This work is to be executed with a single point responsibility on the part of the successful bidder. No splitting of the contract will be made. This clause will supersede any other clause in this regard stated anywhere in this tender document.
- 7.1.18 The bidder should have been techno-commercially qualified. The bids which are technically qualified shall ONLY be considered for price bid opening.
- 7.1.19 The bidder whose total bid price (total of item1 to 34) excluding GST, is LOWEST among all technically qualified bids, shall be chosen to be awarded the contract

Place:

Signature of Vendor

Date:

(Office Seal)

7.2 SCHEDULE OF QUANTITY
(To be filled in by bidder and returned to IPR)

Sr No.	Description	Unit	Qty (Tentative)
1.0	<p>COOLING TOWER Supply, installation, testing and commissioning of FRP Induced draft, counter-flow, multicell type cooling tower complete with FRP basin, supports, propeller fans, fills, eliminators, HDPE / suitable sump distribution system, induction motor, drain, make up, float valve, quick fill, equalizer connection and vibration isolation etc. as per detailed technical specification forming part of tender.</p> <p>Tower selection: On following design conditions:</p> <ul style="list-style-type: none"> • WBT: 28.7 °C. • Water temperature range of 12 (44 – 32) °C. • Water flow rate: ~305kg/s 	No.	1
2.0	<p>SCREW CHILLERS (WATER COOLED) Supply, Factory testing, installation, testing and commissioning of Screw chiller unit of 300 TR actual Refrigeration capacity. Each machine complete with Semi – hermetic type Screw compressor, Factory fitted unit mounted motor with VFD Starters microprocessor based control panel along with required hardware & software for integration with a 3rd party BMS (Open protocol), water cooled condenser, insulated evaporator, integral refrigerant piping, first charge of refrigerant, incomer switchgear with terminations box suitable for terminations of bus duct/Cable , earth terminations etc. all mounted on a steel frame, wiring with all accessories with necessary instruments and controls, including vibration isolation, differential pressure switches, etc. suitable for following design conditions:</p> <ol style="list-style-type: none"> 1. IPLV (IKw/TR) value: ≤ 0.56 2. COP: ≥ 5.5 3. Refrigerant: Non-CFC, R-134a 4. Evaporator / Chiller. <ol style="list-style-type: none"> a) Chilled water entering Temp.: ≥ 19 °C b) Chilled water leaving Temp.: ≤ 14 °C 5. Condenser: <ol style="list-style-type: none"> a) Condenser water entering Temp.: ≥ 32 °C b) Condenser water leaving Temp.: ≤ 39 °C 	No.	2

3.0	<p>CENTRIFUGAL PUMPS FOR WATER CIRCULATION Supply, installation, testing and commissioning of centrifugal pump with mechanical seal, impeller, motor, Variable Frequency Drive (applicable only to primary cooling loop pump-motors) base frame for pump & motor, coupling, coupling guard, vibration isolators and TEFC induction motor for water circulation in the cooling loop as per detailed technical specification forming part of the tender. The various cooling loops pumps are listed as under:</p> <p>NOTE: - All pumps of Primary cooling loops namely, ICECRH, DNBHP, DNBLP, DNBCH, IPRCH shall be equipped with Variable Frequency Drive (VFD) suitable to respective pump set.</p>		
3.1	<p>CHILLER WATER PUMP SETS For circulation of chilled water for screw chillers as per detailed technical specification forming part of tender.</p> <p>a. Differential Head:40 MWC b. Water flow rate:52kg/sec c. Pump type: Back Pull Out (BPO) d. Motor kW (Minimum): 45 Pump set as described above: (1W+1S)</p>	Nos.	2
3.2	<p>CONDENSER WATER PUMP SETS For circulation of condenser water for screw chillers as per detailed technical specification forming part of tender.</p> <p>a. Differential Head: 40 MWC b. Water flow rate:56kg/sec c. Pump type: Back Pull Out (BPO) d. Motor kW (Minimum): 45 Pump set as described above: (1W+1S)</p>	Nos.	2
3.3	<p>COOLING TOWER PUMP SETS For circulation of Cooling Tower water to secondary side of client's PHE, as per detailed technical specification forming part of tender.</p> <p>a. Differential Head: 40 MWC b. Water flow rate:94kg/sec c. Pump type: Back Pull Out (BPO) d. Motor kW (Minimum):75 Pump set as described above: (3W+1S)</p>	Nos.	4

3.4	<p>ICECRH-PRIMARY COOLING PUMP SETS For circulation of cooling water on primary side of PHE, as per detailed technical specification forming part of tender.</p> <ul style="list-style-type: none"> a. Differential Head: 90 MWC b. Water flow rate:120kg/sec c. Pump type: Back Pull Out (BPO) d. Motor kW (Minimum): 150 e. With suitable Variable Frequency Drive (VFD) <p>Pump set as described above: (1W+1S)</p>	Nos	2
3.5	<p>DNBHP- PRIMARY COOLING PUMP SETS For circulation of cooling water on primary side of PHE, as per detailed technical specification forming part of tender.</p> <ul style="list-style-type: none"> a. Differential Head: 240 MWC b. Water flow rate:31 kg/sec c. Pump type: HSC/Vertical in Line d. Motor kW (Minimum): 125 e. With suitable Variable Frequency Drive (VFD) <p>Pump set as described above: (1W+1S)</p>	Nos	2
3.6	<p>DNBLP- PRIMARY COOLING PUMP SETS For circulation of cooling water on primary side of PHE, as per detailed technical specification forming part of tender.</p> <ul style="list-style-type: none"> a. Differential Head: 150 MWC b. Water flow rate:66 kg/sec c. Pump type: HSC/Vertical in Line d. Motor kW (Minimum): 200 e. With suitable Variable Frequency Drive (VFD) <p>Pump set as described above: (1W+1S)</p>	Nos	2
3.7	<p>DNBCH- PRIMARY COOLING PUMP SETS For circulation of cooling water on primary side of PHE, as per detailed technical specification forming part of tender.</p> <ul style="list-style-type: none"> a. Differential Head: 70 MWC b. Water flow rate:10kg/sec c. Pump type: Back Pull Out (BPO) d. Motor kW (Minimum): 22 e. With suitable Variable Frequency Drive (VFD) <p>Pump set as described above: (1W+1S)</p>	Nos	2

3.8	<p>IPRCH- PRIMARY COOLING PUMP SETS For circulation of cooling water on primary side of PHE, as per detailed technical specification forming part of tender.</p> <ul style="list-style-type: none"> a. Differential Head: 70 MWC b. Water flow rate:25kg/sec c. Pump type: Back Pull Out (BPO) d. Motor kW (Minimum): 30 e. With suitable Variable Frequency Drive (VFD) <p>Pump set as described above: (1W+1S)</p>	Nos	2
3.9	<p>DRAIN PUMPSET Supply, installation, testing and commissioning of self-priming, non-clogging Monobloc / submersible type Drain /Sump pump with foot valve suitable for 1ϕ, 230\pm10%V, 50Hz, AC supply, factory mounted on MS base plate, suction & discharge valve, NRV, level switch / level sensor with cable (for pump auto start) and other accessories as per detailed technical specification forming part of tender</p> <ul style="list-style-type: none"> a. Differential Head: 15 MWC b. Water flow rate:2kg/sec c. Motor kW (Minimum):1.5 <p>Pump set as described above: (1W+1S)</p>	Nos.	2

4.0	PLATE TYPE HEAT EXCHNAGER Supply, installation, testing and commissioning of Plate type heat exchanger as per detailed technical specification forming part of tender for following primary cooling loops:		
4.1	ICECRH-Loop, 9.0 MW Capacity	Nos	1
4.2	DNBHP- Loop, 2.0 MW Capacity	Nos	1
4.3	DNBLP-Loop, 2.0 MW Capacity	Nos	1
4.4	DNBCH-Loop, 1.0 MW Capacity	Nos	1
4.5	IPRCH-Loop, 1.0 MW Capacity	Nos	1
5.0	STAINLESS STEEL PIPING WORK Supply, fabrication, installation, testing and commissioning SS PIPING complete with fittings such as tee, reducers, elbows, weldolets, threadolete, couplings, flanges, endcaps, gasket, nuts&bolts, etc. as per detailed technical specification forming part of tender for following sizes:		
5.1	DN25	RMT	100
5.2	DN40	RMT	50
5.3	DN50	RMT	100
5.4	DN80	RMT	180
5.5	DN100	RMT	150
5.6	DN150	RMT	550
5.7	DN200	RMT	400
5.8	DN250	RMT	700
5.9	DN300	RMT	20
5.10	DN400	RMT	25
6.0	CARBON STEEL PIPING WORK Supply, fabrication, installation, testing and commissioning CS PIPING complete with fittings such as tee, reducers, elbows, weldolets, threadolete, couplings, flanges, endcaps, gasket, nuts & bolts, etc. as per detailed technical specification forming part of tender for following sizes:		
6.1	DN25	RMT	75
6.2	DN40	RMT	50
6.3	DN50	RMT	75
6.4	DN80	RMT	50
6.5	DN100	RMT	75
6.6	DN150	RMT	50
6.7	DN200	RMT	200
6.8	DN250	RMT	150
6.9	DN300	RMT	50
6.10	DN400	RMT	120
6.11	DN450	RMT	120
6.12	DN500	RMT	80

6.13	DN600	RMT	20
7.0	VALVES Supply, installation, testing and commissioning of following type of valves complete with mating flanges, gasket, nuts& bolts, as per detailed technical specification forming part of tender.		
7.1	MANUAL BUTTERFLY VALVE (SS) construction with Class-150 of following sizes:		
7.1.1	DN50	Nos	14
7.1.2	DN80	Nos	16
7.1.3	DN100	Nos	4
7.1.4	DN150	Nos	9
7.1.5	DN200	Nos	2
7.1.6	DN250	Nos	7
7.1.7	DN300	Nos	2
7.2	MANUAL BUTTERFLY VALVE (SS) construction with Class-300 of following sizes:		
7.2.1	DN40	Nos	1
7.2.2	DN50	Nos	2
7.2.3	DN80	Nos	10
7.2.4	DN100	Nos	3
7.2.5	DN150	Nos	8
7.2.6	DN200	Nos	7
7.3	MANUAL GATE VALVE (SS) construction with Class-150 of following sizes:		
7.3.1	DN50	Nos	5
7.3.2	DN80	Nos	2
7.3.3	DN100	Nos	1
7.3.4	DN150	Nos	1
7.4	MANUAL GATE VALVE(SS) construction with Class-300 of following sizes:		
7.4.1	DN50	Nos	2
7.4.2	DN80	Nos	2
7.4.3	DN100	Nos	2
7.5	MANUAL GLOBE VALVE(SS) construction with Class-150 of following sizes:		
7.5.1	DN50	Nos	8
7.5.2	DN80	Nos	4
7.5.3	DN100	Nos	2
7.5.4	DN150	Nos	2
7.6	MANUAL GLOBE VALVE(SS) construction with Class-300 of following sizes:		

7.6.1	DN40	Nos	1
7.6.2	DN50	Nos	1
7.6.3	DN80	Nos	2
7.6.4	DN100	Nos	1
7.6.5	DN150	Nos	2
7.6.6	DN200	Nos	1
7.7	GLOBE VALVE(SS) construction with ELECTRIC ACTUATOR , Class-150 of following sizes:		
7.7.1	DN25	Nos	4
7.7.2	DN40	Nos	1
7.7.3	DN50	Nos	4
7.7.4	DN80	Nos	3
7.7.5	DN100	Nos	1
7.7.6	DN150	Nos	1
7.8	GLOBE VALVE(SS) construction with ELECTRIC ACTUATOR , Class-300 of following sizes:		
7.8.1	DN25	Nos	2
7.8.2	DN40	Nos	1
7.8.3	DN50	Nos	3
7.8.4	DN80	Nos	2
7.8.5	DN100	Nos	1
7.8.6	DN150	Nos	1
7.9	PRSSURE REDUCING VALVE (SS) construction with Class-150 of following sizes:		
7.9.1	DN25	Nos	4
7.9.2	DN40	Nos	4
7.9.3	DN50	Nos	4
7.9.4	DN80	Nos	4
7.9.5	DN100	Nos	4
7.9.6	DN150	Nos	4
7.10	PRSSURE REDUCING VALVE (SS) construction with Class-300 of following sizes:		
7.10.1	DN25	Nos	2
7.10.2	DN40	Nos	4
7.10.3	DN50	Nos	2
7.10.4	DN80	Nos	4
7.10.5	DN100	Nos	4
7.10.6	DN150	Nos	4
7.11	MANUAL BALL VALVE (SS) construction with Class-150 of following sizes:		
7.11.1	DN15	Nos	24

7.11.2	DN25	Nos	27
7.11.3	DN40	Nos	5
7.12	MANUAL BALL VALVE (SS) construction with Class-300 of following sizes:		
7.12.1	DN15	Nos	16
7.12.2	DN25	Nos	18
7.12.3	DN40	Nos	2
7.13	CHECK VALVE (SS) construction with Class-150 of following sizes:		
7.13.1	DN25	Nos	3
7.13.2	DN50	Nos	3
7.13.3	DN80	Nos	2
7.13.4	DN100	Nos	2
7.13.5	DN150	Nos	2
7.13.6	DN200	Nos	1
7.13.7	DN250	Nos	2
7.14	CHECK VALVE construction with Class-300 of following sizes:		
7.14.1	DN25	Nos	2
7.14.2	DN50	Nos	2
7.14.3	DN150	Nos	1
7.14.4	DN200	Nos	2
7.15	SAFETY RELIEF VALVE MOC: Body -ASTM 479 316L, Wetted part - SS316L , End connection: Screwed end NPT(F), Set Pressure -adjustable range 5-16 bar		
7.15.1	DN25	Nos	6
7.16	MANUAL BUTTERFLY VALVE (CS) construction with Class-150 of following sizes:		
7.16.1	DN50	Nos.	1
7.16.2	DN80	Nos.	7
7.16.3	DN100	Nos.	15
7.16.4	DN150	Nos.	3
7.16.5	DN200	Nos.	8
7.16.6	DN250	Nos	22
7.16.7	DN300	Nos	14
7.16.8	DN400	Nos	1
7.16.9	DN450	Nos	1
7.16.10	DN500	Nos	4
7.17	BUTTERFLY VALVE (CS) construction with ELECTRIC ACTUATOR , Class-150 of following sizes:		
7.17.1	DN200	Nos.	4
7.17.2	DN250	Nos.	4

7.18	MANUAL GLOBE VALVE (CS) construction with Class-150 of following sizes:		
7.18.1	DN80	Nos	1
7.18.2	DN100	Nos	1
7.18.3	DN150	Nos	2
7.18.4	DN200	Nos	1
7.18.5	DN250	Nos	1
7.18.6	DN300	Nos	1
7.19	GLOBE VALVE(CS) construction with ELECTRIC ACTUATOR , class-150 of following sizes:		
7.19.1	DN25	Nos	1
7.19.2	DN40	Nos	1
7.19.3	DN50	Nos	1
7.19.4	DN80	Nos	1
7.19.5	DN100	Nos	2
7.19.6	DN150	Nos	1
7.19.7	DN200	Nos	1
7.20	MANUAL GATE VALVE (CS) construction with Class-150 of following sizes:		
7.20.1	DN50	Nos.	1
7.20.2	DN80	Nos	1
7.21	PRSSURE REDUCING VALVE (CS) construction with Class-150 of following sizes:		
7.21.1	DN25	Nos	2
7.21.2	DN40	Nos	2
7.21.3	DN50	Nos	4
7.21.4	DN80	Nos	4
7.21.5	DN100	Nos	4
7.21.6	DN150	Nos	4
7.22	MANUAL BALL VALVE (CS) construction with Class-150 of following sizes:		
7.22.1	DN15	Nos	27
7.22.2	DN25	Nos	29
7.22.3	DN40	Nos	2
7.22.4	DN50	Nos	5
7.22.5	DN80	Nos	2
7.23	MANUAL BALANCING VALVE (CS) construction with Class-150 of following sizes:		
7.23.1	DN200	Nos	2
7.23.2	DN250	Nos	2
7.24	CHECK VALVE (CS) construction with Class-150 of following sizes:		

7.24.1	DN25	Nos	1
7.24.2	DN50	Nos	1
7.24.3	DN150	Nos	3
7.24.4	DN200	Nos	2
7.24.5	DN250	Nos	4
7.25.0	Supply and fixing of portable differential pressure mercury manometer complete with flexible pipe, matching connection for balancing valves and charts for all valve's sizes, metallic carrying case, calibrated scale and manometer valves etc.	Sets	4
8.0	STRAINER (Y-Type) Supply, installation, testing and commissioning of "Y" Type Strainer having ASTM A240 TP316 body, Strainer & wetted parts SS316, Seat- EPDM or better. CLASS 150. Mesh Size & Material: 100, SS316, Design pressure: 10 bar, of following sizes:		
8.1	DN80		2
8.2	DN150		4
8.3	DN200		2
8.4	DN250		2
9.0	STRAINER (Basket type) Supply, installation, testing and commissioning of Basket Type Strainer having body A106, Seat- EPDM or better. CLASS 150. Mesh Size & Material: 100, SS304, Design pressure: 10bar, of following sizes:		
9.1	DN500	Nos.	2
10.0	NON-METALLIC BELLOW Supply and fixing in position nonmetallic type bellows (Flexible connection) including matching flanges and fasteners, as per detailed technical specification forming part of tender for following sizes:	Nos.	
10.1	DN-80	Nos.	4
10.2	DN-100	Nos.	4
10.3	DN-150	Nos.	6
10.4	DN-200	Nos.	10
10.5	DN-250	Nos.	14
10.6	DN-300	Nos.	8
11.0	PRESSURIZER (SS) Supply, fabrication, installation, testing and commissioning of Pressurizer having MOC as SA 240 GR. 304L of 1M ³ volume water holding capacity with necessary safety valve, drain, makeup water inlet & outlet, nitrogen inlet etc. to be provided along with mating flange, hardware & gaskets, foundation bolts for ICECRH, DNBHP, DNBLP, DNBCH, IPRCH cooling Loops as per detailed technical specification forming part of tender	Nos.	5
12.0	PRESSURIZER (CS)	No.	1

	Supply, fabrication, installation, testing and commissioning of Pressurizer having MOC as SA 515 GR. 70 of 1M ³ volume water holding capacity with necessary safety valve, drain, makeup water inlet & outlet, nitrogen inlet etc. complete with insulation to be provided along with mating flange, hardware & gaskets, foundation bolts for Chiller cooling Loops as per detailed technical specification forming part of tender		
13.0	STORAGE TANK (CS) Supply, fabrication, installation, testing and commissioning of Chilled water storage tank having MOC as SA 515 GR. 70 of 50M ³ volume water holding capacity with necessary safety valve, drain, makeup water inlet & outlet, complete with insulation to be provided along with mating flange, hardware & gaskets, foundation bolts for chilled water-cooling Loops as per detailed technical specification forming part of tender	No.	1
14.0	INSULATION FOR CHILLED WATER PIPING Supply and fixing of insulation with NBR/PUF and aluminium cladding over piping as per detailed technical specification forming part of tender for following sizes:		
14.1	DN 250 piping	RMT	200
14.2	DN 200 piping	RMT	250
14.3	DN 150 piping	RMT	150
14.4	DN 100 piping	RMT	90
14.5	DN 80 piping	RMT	75
14.6	DN 50 piping	RMT	75
14.7	DN 25 piping	RMT	75
15.0	MS STRUCTURE WORK Design, supply, fabrication, installation of MS structure work for supporting equipment, tanks, piping network, cable tray, instruments etc. at the site to suit the system requirements, including operating platform/maintenance floors (If at all needed) within the building etc., to be fabricated from standard plates, channels, I-section beams, angles, pipes etc. with clamps etc. including grouting/anchoring and finished with anti-corrosion painting.	Kgs	8000
16.0	MOTOR CONTROL CENTER PANEL Design, manufacture, supply, installation, testing and commissioning of the following integrated cubicle type dead front extensible sheet steel indoor type, floor mounted MCC panels. The panel shall be suitable for 415V, 4 wire 50 Hz AC supply. The MCC shall be provided as described below including incoming, outgoing feeders, earthing etc. as per detailed technical specification forming part of tender and SLD. The scope includes necessary cable alleys, space for spare switches, cable glands, terminations, trays, support structure, clamping, internal copper wiring with all	No.	1

	<p>accessories, internal power / control wiring / copper earthing between panels for all equipment including all necessary cables and other material. 1100V-grade rubber mat shall be provided in front of the panel board.</p> <p>a. All the feeders shall be provided with a Suitable interface scheme for remote monitoring (ON/OFF/TRIP) at SCADA. All Suitable interfaces shall be carried out up to marshalling chamber.</p> <p>b. Feeders <u>F1-F2</u> shall be provided with a Suitable interface scheme for 4-20 mA current transducers for remote metering at SCADA for chillers units. All connection shall be carried out up to marshalling chamber.</p> <p>c. Quoted price shall include all internal wiring, cabling (power/control) and copper earthing inside the power panel etc. as LOT</p>		
16.1	<p>INCOMING</p> <p>i. One no. 3200 Amps electrically operated drawn-out type incoming TPN ACB (4 pole) with Electronic S/C, O/C & E/F release with breaking capacity of 50kA (ICu) at 440V AC/50Hz.</p> <p>ii. Digital Multi function meter (Amp, Volt, Kwh, f, PF etc.).</p> <p>iii. Under, Over Voltage Relay and SPP/RPP,</p> <p>iv. a set of indicating lamps,</p> <p>v. 4-20 mA voltage and current transducer for remote metering,</p> <p>vi. Suitable interface scheme for remote monitoring (ON/OFF/TRIP) at SCADA, and</p> <p>vii. Suitable interface scheme for local operation (ON/OFF/TRIP) with Phase indicating lamps shall be provided.</p>		
16.2	<p>OUT GOING FEEDERS</p> <p>i. (F1-2) 02 nos. 400 amps. TP+N MCCB, MPR with O/L, SPP, E/F relay and outgoing feeders to Screw chiller Compressor motor starters. This compartment shall contain Digital multifunction meter with selector switch and indicating lamps with fuse for ON/OFF and TRIP status of Comp. Motor.</p> <p>ii. (F3-4) 02 nos. 100 amps. TP MCCB, Star / Delta starters, MPR with O/L, SPP, E/F relay and outgoing feeders to Chilled water pump motors having rating 45kW minimum.</p> <p>iii. (F5-8) 04 nos. 160 amps. TP MCCB, Star / Delta starters, MPR with O/L, SPP, E/F relay and outgoing feeders to HRS/CT Pump motors rating 75 kW minimum.</p>		

<p>iv.(F9-16) 08 nos. 32 amps. TP MCCB, DOL starters, MPR with O/L, SPP, E/F relay and outgoing feeders to CT fan motors.</p> <p>v.(F17-18) 02 nos. TP 300 amps MCCB, MPR with O/L, SPP, E/F relay and outgoing feeders to ICECRH pump motors having rating 150kW minimum with VFD</p> <p>vi.(F19-20) 02 nos. TP 250 amps MCCB, MPR with O/L, SPP, E/F relay and outgoing feeders to DNBHP pump motors having rating 125kW minimum with VFD</p> <p>vii.(F21-22) 02 nos. TP 400 amps MCCB, MPR with O/L, SPP, E/F relay and outgoing feeders to DNBLP pump motors having rating 200kW minimum with VFD</p> <p>viii.(F23-24) 02 nos. 50 amps. TP MCCB, MPR with O/L, SPP, E/F relay and outgoing feeders to DNBCH pump motors having rating 22kW minimum with VFD</p> <p>ix.(F25-26) 02 nos. TP 63 amps MCCB, MPR with O/L, SPP, E/F relay and outgoing feeders to IPRCH pump motors having rating 30kW minimum with VFD</p> <p>x.(F27-28) 02 nos. TP 63 amps MCCB, 45 kW rating motor Star-Delta starters, MPR with O/L, SPP, E/F relay and outgoing feeders to Condenser cooling pump motors.</p> <p>xi.(F29-30) 02 nos. TP 63 amps MCCB, Star-Delta starters, MPR with O/L, SPP, E/F relay and outgoing feeders to WPU pump motors.</p> <p>xii.(F31-32) 02 no. Spare 100 amps TP MCCB feeders & E/F Relay with switchgears for future.</p> <p>xiii.(F-33-34) 02 no. Spare 63 amps TP MCCB feeder & E/F Relay with switchgear for future.</p> <p>xiv.(F35-36) 02 nos. Spare 32 amps TP+N MCCB feeder with switchgear for future.</p> <p>xv.(F37-38) 02 no. feeder for marshalling chamber.</p> <ul style="list-style-type: none"> All Feeder compartment shall contain Digital ammeter with selector switch, PB switches for ON/OFF and indicating lamps with fuse for ON/OFF and TRIP status of motor. 		
--	--	--

16.3	EARTHING Providing a Copper bus earth of size not less than 35 X 6 Sq.mm continuously runs at the top / bottom of the panel.		
17.0	ELECTRICAL POWER CABLE Supply, Laying, termination, testing and commissioning of XLPE,1100 volts grade FRLS cables of following sizes with suitable lugs, cable glands, as per the system requirements and detailed technical specification forming part of the tender.		
17.1	3C x 4 mm ² Copper unarmored Power Cables	RMT	60
17.2	3C x 6 mm ² Copper unarmored Power Cables	RMT	300
17.3	3C x 4 mm ² Copper Armoured Power Cables	RMT	60
17.4	3C x 6 mm ² Copper Armoured Power Cables	RMT	300
17.5	3C x 10 mm ² Copper conductor Armoured Power Cables	RMT	50
17.6	3C x 16 mm ² Copper conductor Armoured Power Cables	RMT	100
17.7	3.5C x 25 sq.mm aluminum conductor Armoured cables	RMT	110
17.8	3.5C x 35 sq. mm. aluminum conductor Armoured cables	RMT	50
17.9	3.5C x 70 sq.mm aluminum conductor Armoured cables	RMT	110
17.10	3.5C x 95 sq.mm aluminum conductor Armoured cables	RMT	110
17.11	3.5C x 150 sq.mm aluminum conductor Armoured cables	RMT	200
17.12	3.5C x 185 sq.mm aluminum conductor Armoured cables	RMT	200
17.13	3.5C x 240 sq.mm aluminum conductor Armoured cables	RMT	200
17.14	3.5C x 400 sq.mm aluminum conductor Armoured cables	RMT	200
18.0	EARTHING Supply, Laying, termination, testing and commissioning of following earthing, as per the system requirements:		
18.1	3 mm dia. Copper wires	RMT	700
18.2	4 mm dia. Copper wires	RMT	200
18.3	6 mm dia. Copper wires	RMT	400
18.4	25 mm x 3 mm Copper strips	RMT	1200
19.0	PERFORATED CABLE TRAYS Supply and Installations of 'C type' perforated cable trays made from 2.0 mm thick hot galvanized GI / MS powder coated perforated sheets, with clamping etc., suitable for power cables laying, of the following sizes:		
19.1	150 mm both side riser x450 mm width	RMT	100
19.2	75 mm both side riser x450 mm width	RMT	50
19.3	50 mm both side riser x 300 mm width	RMT	50
19.4	50 mm both side riser x 150 mm width	RMT	50
19.5	50 mm both side riser x 100 mm width	RMT	100
20.0	LOCAL PUSH BUTTON PANELS FOR COOLING TOWERS	Nos.	8

	Supply, fabrication, installation, testing and commissioning of Weather proof local ON-OFF/Emergency Stop push button panel with all controls, earthing, power and control wiring for equipment located away from the panel boards (e.g. cooling tower' fan motor, pumps)		
21.0	FLOW TRANSMITTER Supply, Installation, testing and commissioning of vortex type, flanged end flow meter for ultra-pure water and chilled water header as per detailed technical specification forming part of the tender for following sizes:		
21.1	DN50	No	1
21.2	DN80	No	1
21.3	DN100	No	1
21.4	DN150	No	2
21.5	DN200	No	3
21.6	DN250	No	1
22.0	PRESSURE GAUGE Supply and fixing Bourdon tube type pressure gauges having dial size 150 mm, glycerin filled with Stainless steel casing of suitable range, along with syphon & 3-way valve as per detailed specification	Nos.	125
23.0	TEMPERATURE GAUGE Supply and fixing Temperature gauges of dial size 150mm, casing stainless steel, with suitable range and length with thermowell and relevant accessories as per detailed technical specification	Nos.	70
24.0	PRESSURE TRANSMITTER Supply and installation of pressure indicator cum transmitter with controller, LCD display and all relevant accessories as per detailed technical specification	Nos.	20
25.0	TEMPERATURE SENSOR AND TRANSMITTER Supply and installation of temperature sensor and transmitter with controller, LCD display and all relevant accessories as per detailed technical specification	Nos.	30
26.0	LEVEL GAUGE Supply and fixing of magnetic liquid level gauge of suitable range having SS construction with indication, compatible for process temp and press with all relevant accessories	Nos.	6
27.0	LEVEL TRANSMITTER Supply and installation of level transmitter with controller, LCD display and all relevant accessories as per detailed technical specification	Nos.	7
28.0	DO METER AND ANALYSER Supply and fixing DO (Dissolved Oxygen) measuring online meter as per detailed technical specification	Nos.	5
29.0	pH METER AND ANALYSER Supply and fixing pH meter for online measurement as per detailed technical specification	Nos.	6
30.0	CONDUCTIVITY METER AND ANALYSER	Nos.	6

	Supply and fixing conductivity meter for online measurement as per detailed technical specification		
31.0	<p>DATA ACQUISITION & CONTROL SYSTEM</p> <p>Design, supply, installation, testing and commissioning Data Acquisition and Control system comprising of followings:</p> <p>1- HARDWARE</p> <p>a. A Standalone, expandable, programmable centralized plant controller with necessary Input/outputs density as per design requirement and as per tender specifications. The controller shall be housed in a Heavy gauge sheet steel panel duly powder coated and including Power supply unit, Switch fuse unit for 230 V supply, status indication for Controller ON/OFF, acrylic window on front door for viewing display parameters, necessary Terminal strip, internally wired and tested.</p> <p>i. One Central controller which covers cooling loops namely, ICECRH, DNBHP, DNBLP, DNBCH, IPRCH, Chilled water secondary, Water polishing system and HRS (tertiary) cooling loops</p> <p>ii. Handle all I/Os of Electrical system</p> <p>b. Centralized control system's hardware including One no. Industrial monitor with necessary CPU, Operating drives, software, printer set, including communication processor / RS converter, open communication port (RS 232 / 485) for integration to main control room system Including UPS for the system as per the tender specification.</p> <p>2- SOFTWARE-SCADA</p> <p>Supply, developing, installing and testing of DACS Software as specified in the tender for operating work stations located within a control room with 8 license copies.</p> <p>Further, the data shall also be viewed on the OWS meant for other process utilities in control room and user building.</p> <p>Each copy of software shall be with run time and development versions. The package shall be customized to IPR's requirement.</p> <p>Software features required are as per tender specifications. Including mimic display with status of required process parameters, programming and logging of control parameters, history recording, on line print out (printer), annunciation, pass word protection for system, reset and reprogramming etc., including the open communication port (RS 232 / 485) for integration to main IICWS control room system.</p>	1	LOT

	• Total SCADA workstation. -2 nos.		
32.0	INSTRUMENTATION AND CONTROL WIRING Supply and installation of EPR insulated no Halogen, Low Smoke, Sheathed, Unarmored Instrumentation Cable of following size with necessary glanding, lugging and dressings for instruments and other hardware		
32.1	1.0 sq. mm X 1 pair twisted Cu cable	RMT	500
32.2	1.0 sq. mm X 2 pair twisted Cu cable	RMT	500
32.3	2 Core x 18 AWG twisted pair shielded cable	RMT	500
32.4	Cat-5 ethernet standard cable	RMT	500
33.0	SS TUBING FOR INSTRUMENTATION Supply and installation of following size instrument air tubing with all necessary fittings, supports and hardware		
33.1	1/4" SS-316 instrument air tubing	RMT	100
33.2	1/3" SS-316 instrument air tubing	RMT	50
34.0	PAINTING & TAGS Painting of the new piping, supports, MS structure etc.; equipment identification tags (stickers/Paints/Al tags) for Chiller, Pumps, valves, heat exchangers, electricals and instrumentation Equipment, strainers, cooling tower supports, directional arrows for pipes, Al tags (for cable, one at equipment side and other is panel side) etc. All pipes, its supports and MS structure shall be thoroughly cleaned and given one (Or two, if required) coat of, red oxide paint before painting.	Lot	1
35.0	MINOR / MAJOR CIVIL WORKS For all equipment covered under Schedule of quantity of this tender, following civil works shall be included. a. RCC foundations/beams and columns structure to support FRP basin of Cooling tower and main members of Cooling tower cells. b. RCC Floating / Fixed foundation blocks lined with MS angle on edges, pedestals for all Equipment like Chillers, Pumps, Heat exchanger, instrumentation and Electrical panel etc. of adequate size at site as per the recommendation of equipment manufacturer. c. Other Civil and associated Works require to be carried-out for the Erections / Installations of all the Equipment, pipe racks crossing roads etc. The above includes making, cutting and finishing of holes in roof / floor/ wall, opening for cables, pipe crossings etc. and making good of them. Including digging and refilling work/s and minor civil work required for laying / removal of piping or any other equipment. This also includes	Lot	1

	providing finished plastered floor below Cooling Tower basin area with sufficient drain arrangement connecting to nearest main drainage. Grouting of supports and finishing good of them. All civil repairing work with final finish coat of painting shall be done		
--	---	--	--

7.3 IMPORTANT NOTES:

- IPR reserves the right to add / delete any or all of the items mentioned in SOQ.
- Understand all the specifications, terms and conditions of this tender thoroughly, visit the site and contact the Engineer in charge for any clarification if necessary.
- Deviations if any shall be clearly specified on separate sheet with all details.
- The bidder should sign all pages in token of acceptance of the terms and condition and return the same to us.

Place:

Date:

Signature of Vendor

(Office Seal)

8 SECTION–VIII: SITE VISIT

For site visit, the bidder shall contact the following persons. It may please be noted that any clarifications required in this tender either technical or otherwise shall be carried out before submission of bids. Bidder shall not have any right to revise the price bid once submitted.

Contact Persons at IPR to co-ordinate site visits:

1. Mr. Dinesh Gupta

Tel: 079 – 2396 4350, 23269561

Email: dkg@ipr.res.in, dinesh.gupta@iter-india.org

2. Mr. Mehul Chodavadiya

Tel: 079 – 23964350

Email: mehul.chodavadiya@iter-india.org

9 SECTION-IX: REGISTRATION FORM FOR ATTENDING PRE-BID MEETING

(This form should be duly filled- in, signed, stamped and sent to the following address by email so as to reach the Purchase officer, IPR latest by 26th June, 2020).

From:

Name and address of Applicant Bidder
Name of Contact Person
Contact Number (Tel. no., mobile no., Fax no., E-mail)

Date:

To:

The Purchase Officer-II
Institute for Plasma Research
Near Indira Bridge, Bhat, Gandhianagar-382 428,
Gujarat, INDIA Tel: + 91-79-23962020, 23962021
Email: ramesh@ipr.res.in, vijayan@ipr.res.in

Subject: Registration for pre-bid meeting

Dear Sir/Madam,

This is in reference to your tender No. IPR/TN/PUR/TPT/ET/20-21/1 dated 1-6-2020. We understood the requirements of the referred tender and intend to participate in the pre-bid meeting. The following is the list of participants representing our organization.

1 -----	e-mail:	mobile:
2 -----	e-mail:	mobile:

- We shall upload the pre bid queries on the e-tender portal on or before the stipulated time mentioned in the tender notice.

Signature

Bidder's stamp

Name:

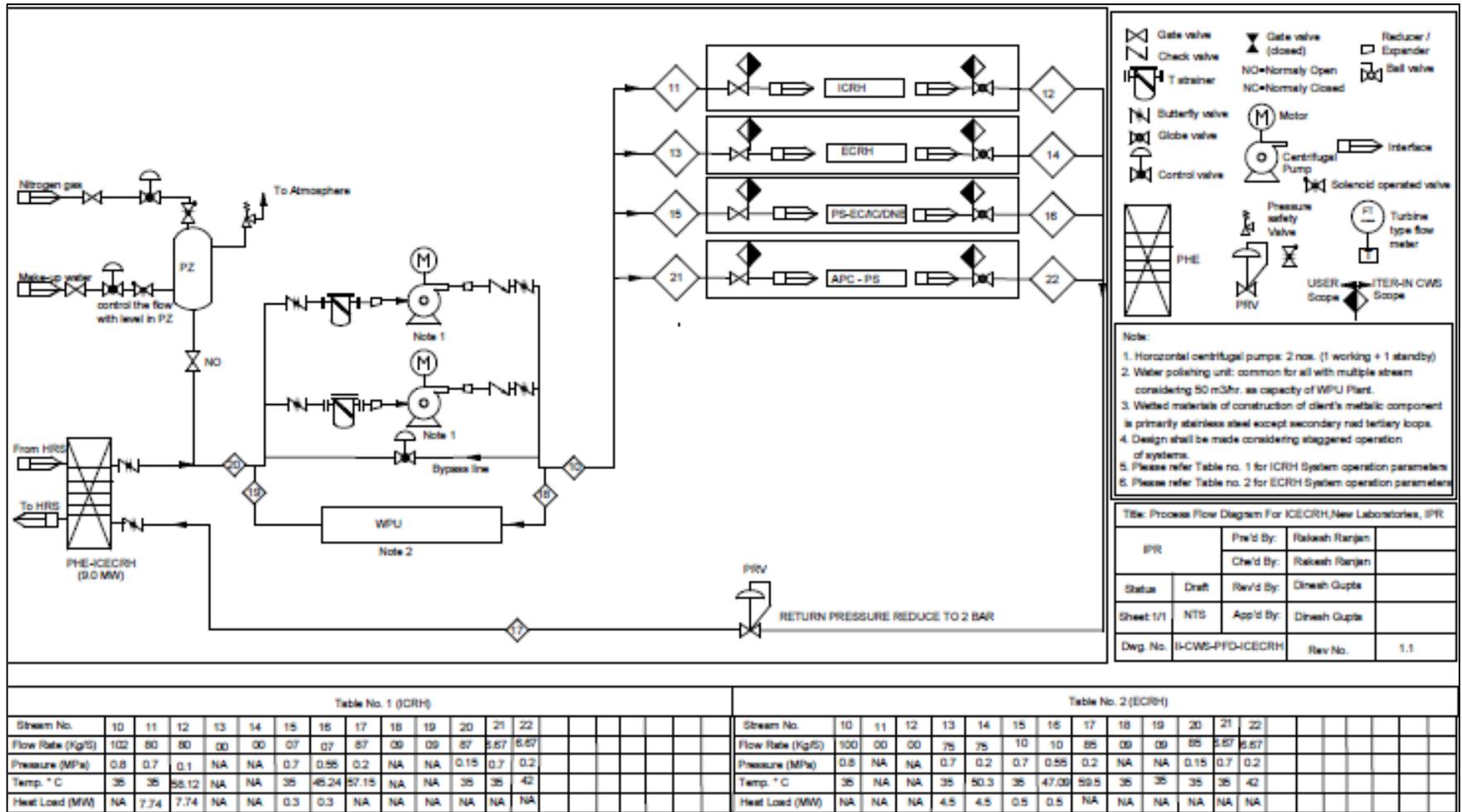
Position:

Address:

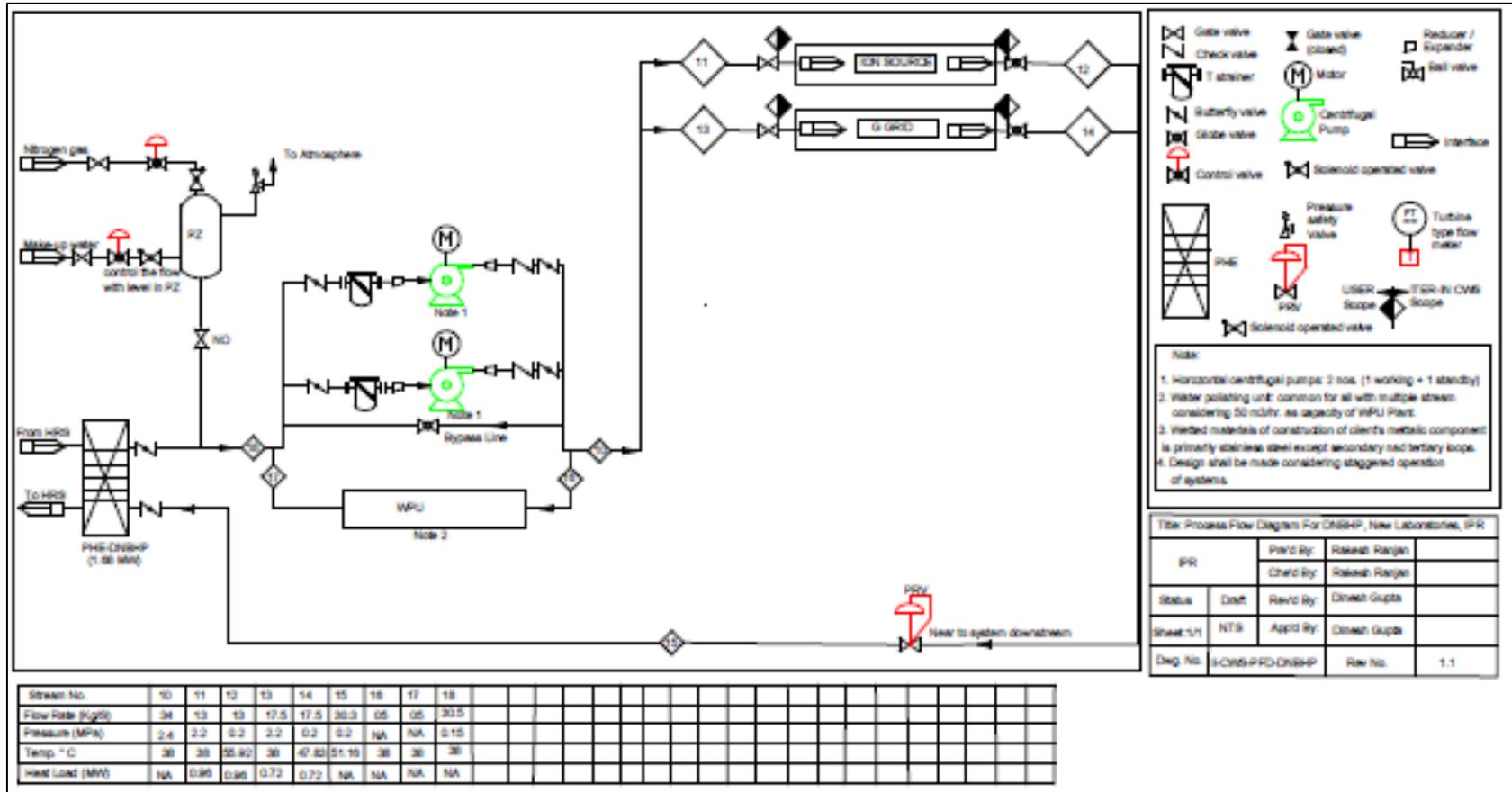
Tel:

e-mail:

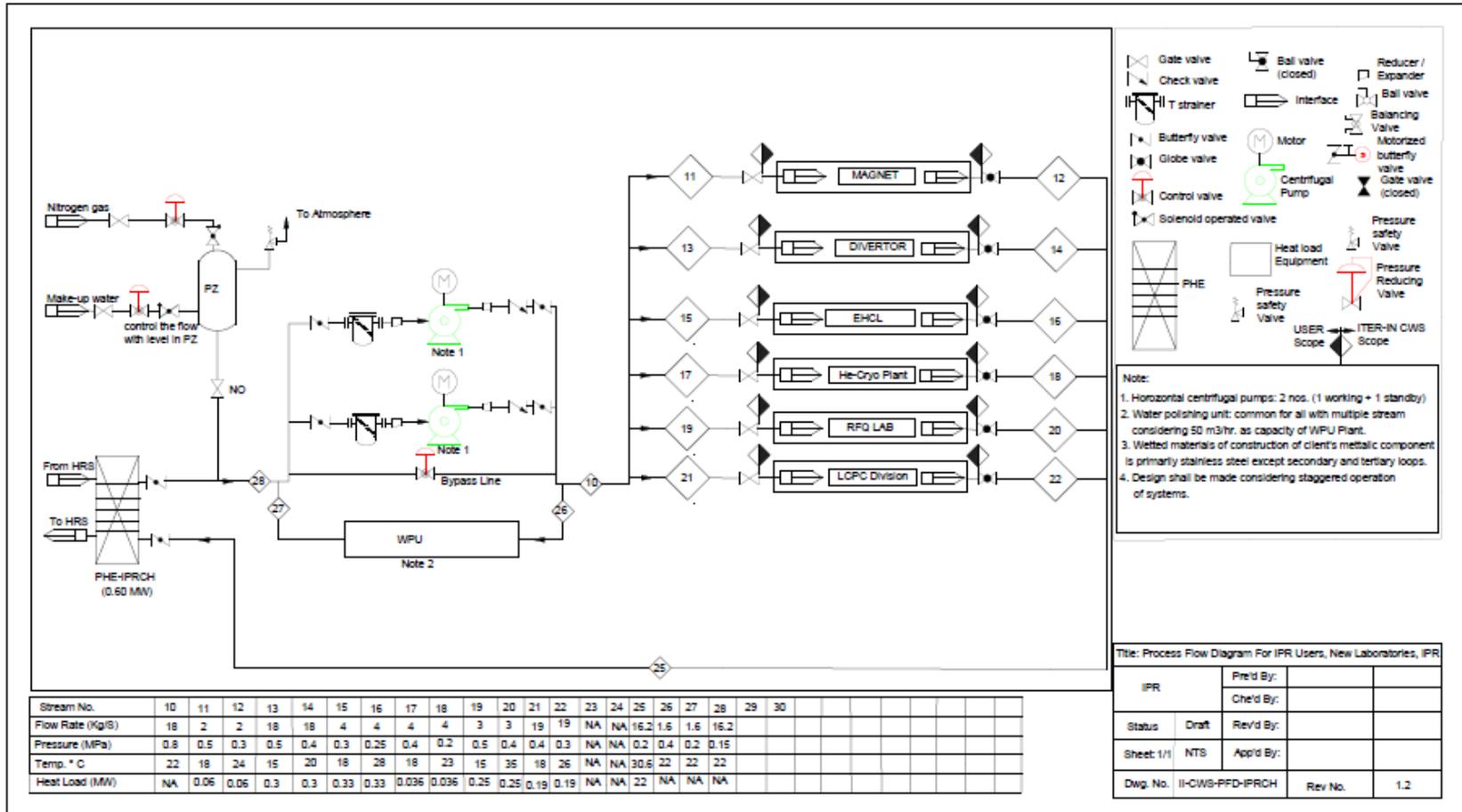
Annexure 21: ICECRH PFD



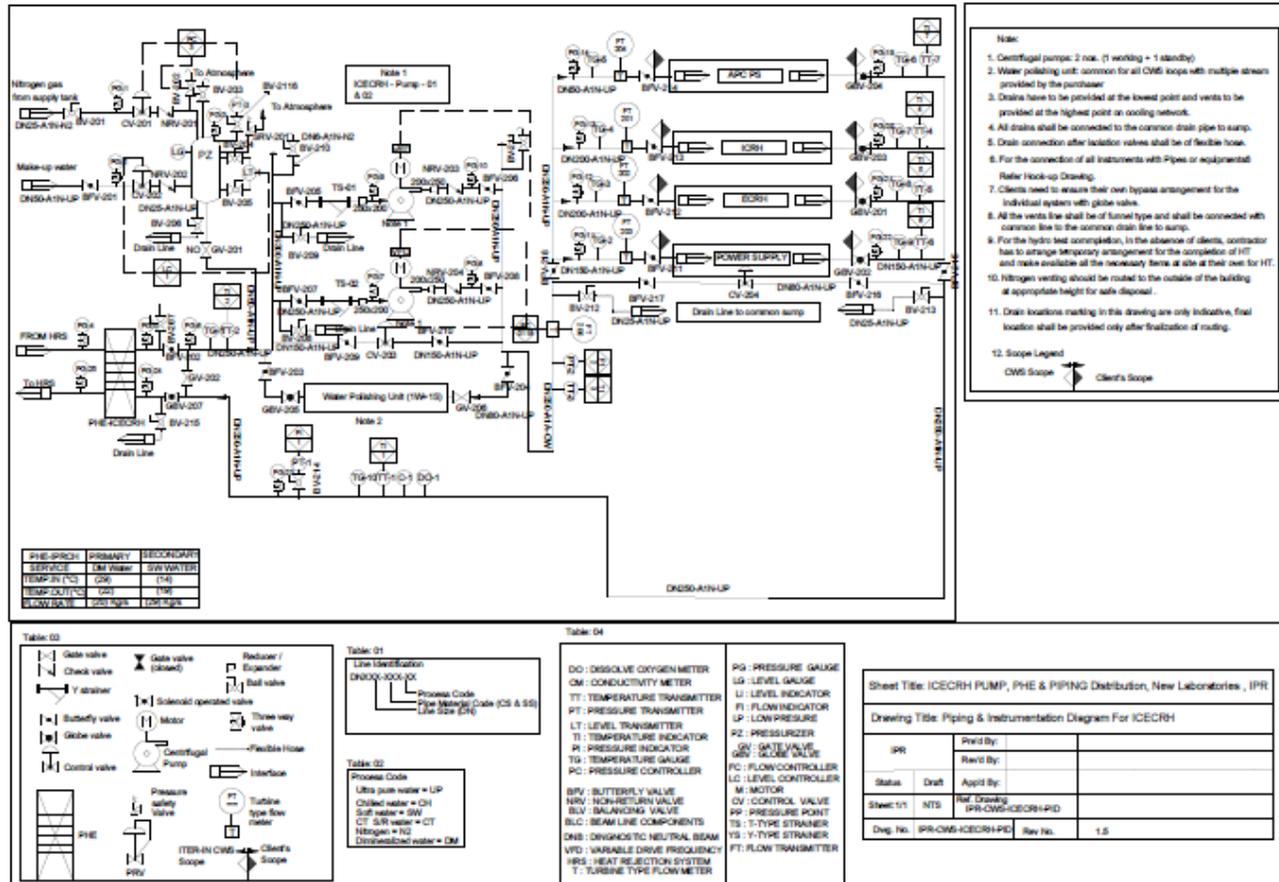
Annexure 22 : DNBHP PFD



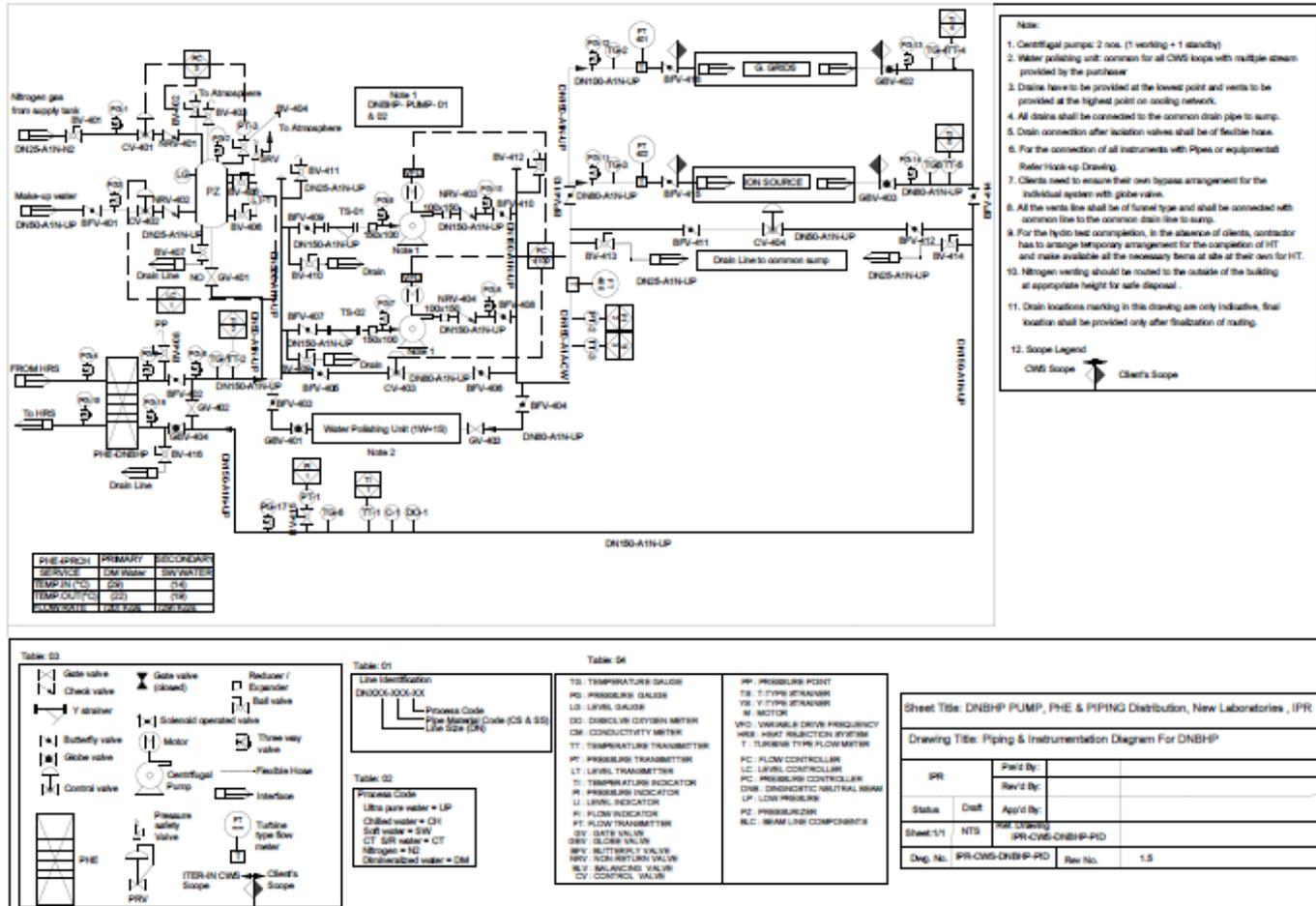
Annexure 25: IPRCH PFD



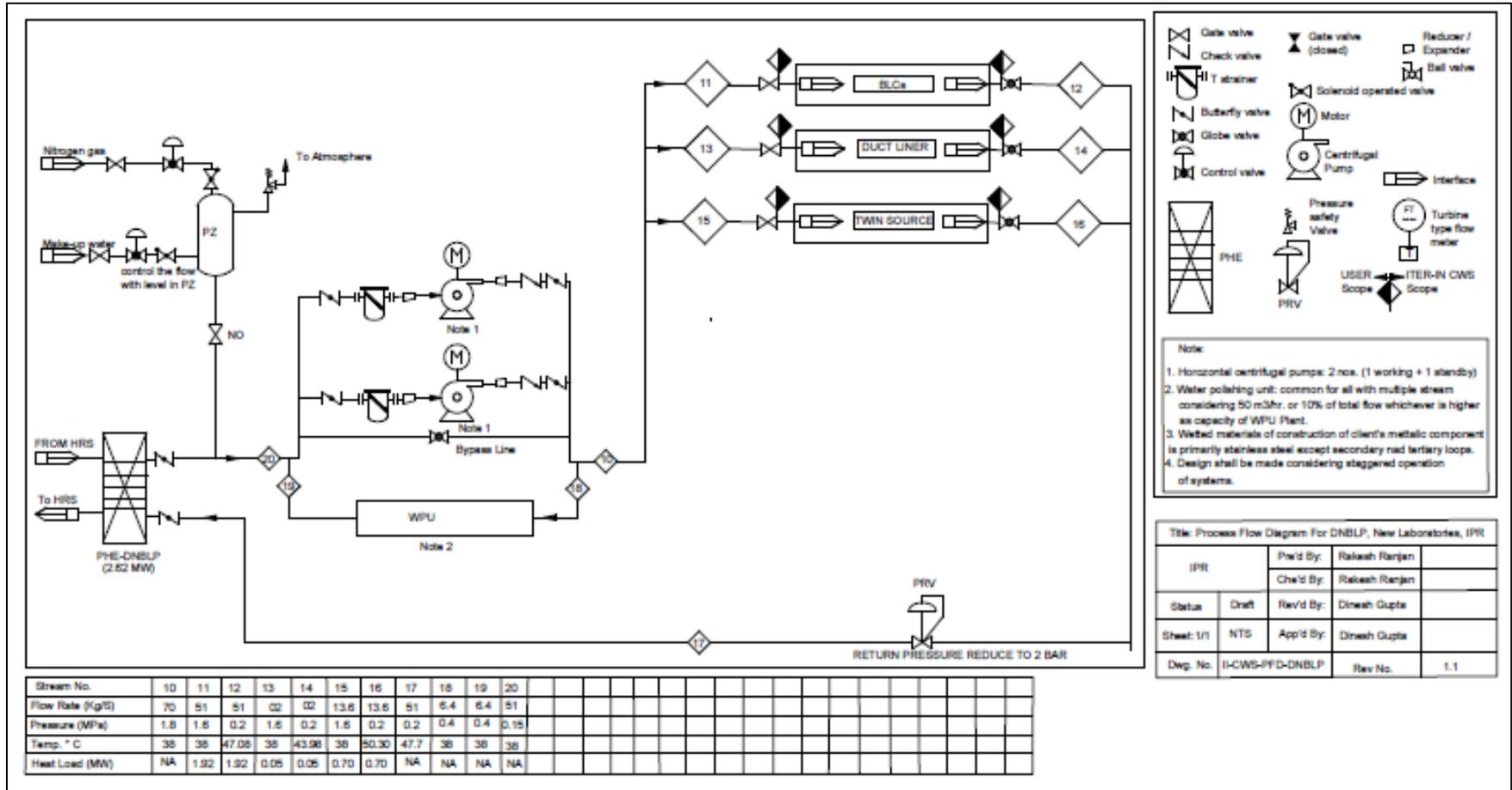
Annexure 27 : ICECRH PID



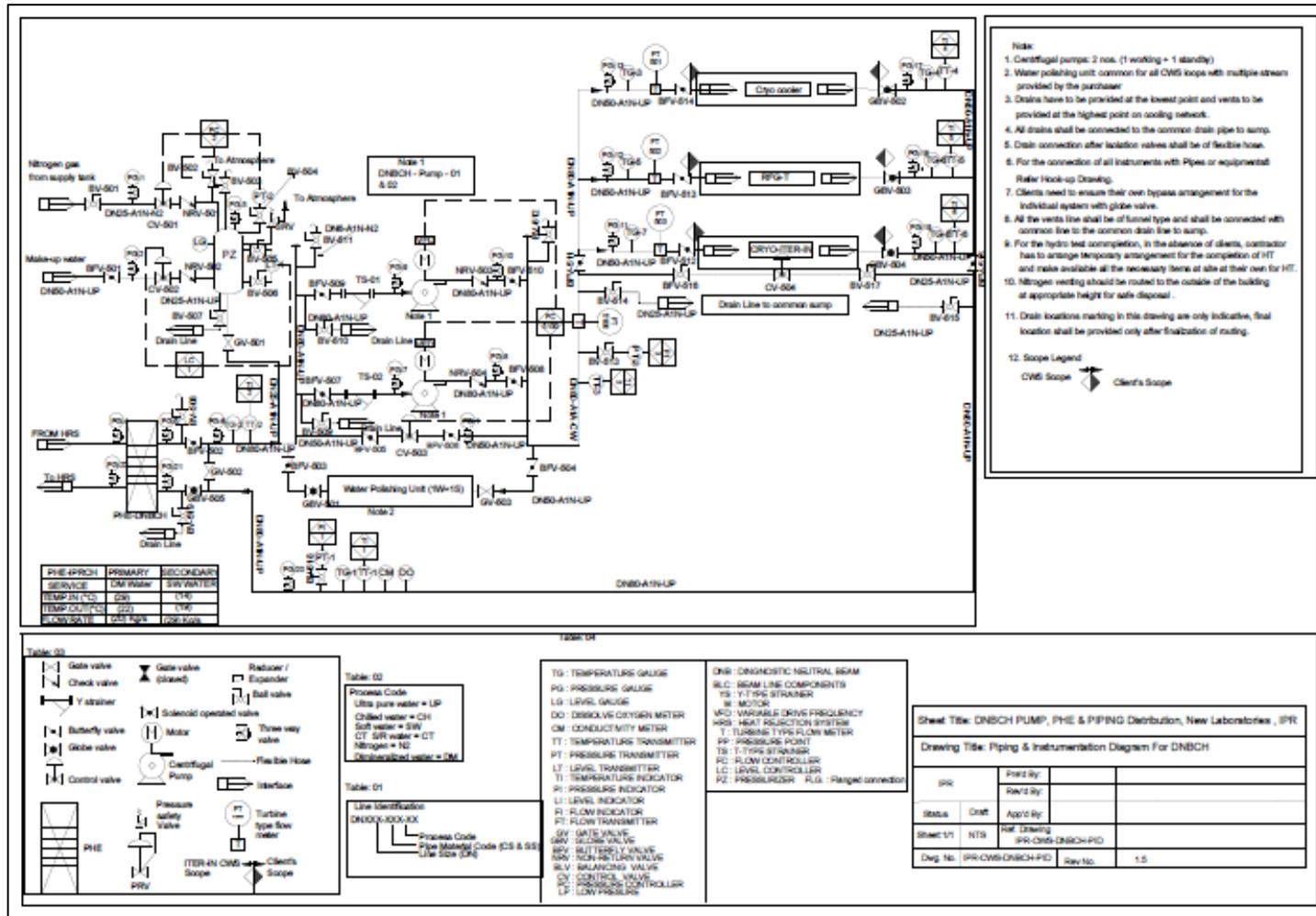
Annexure 28: DNBHP PID



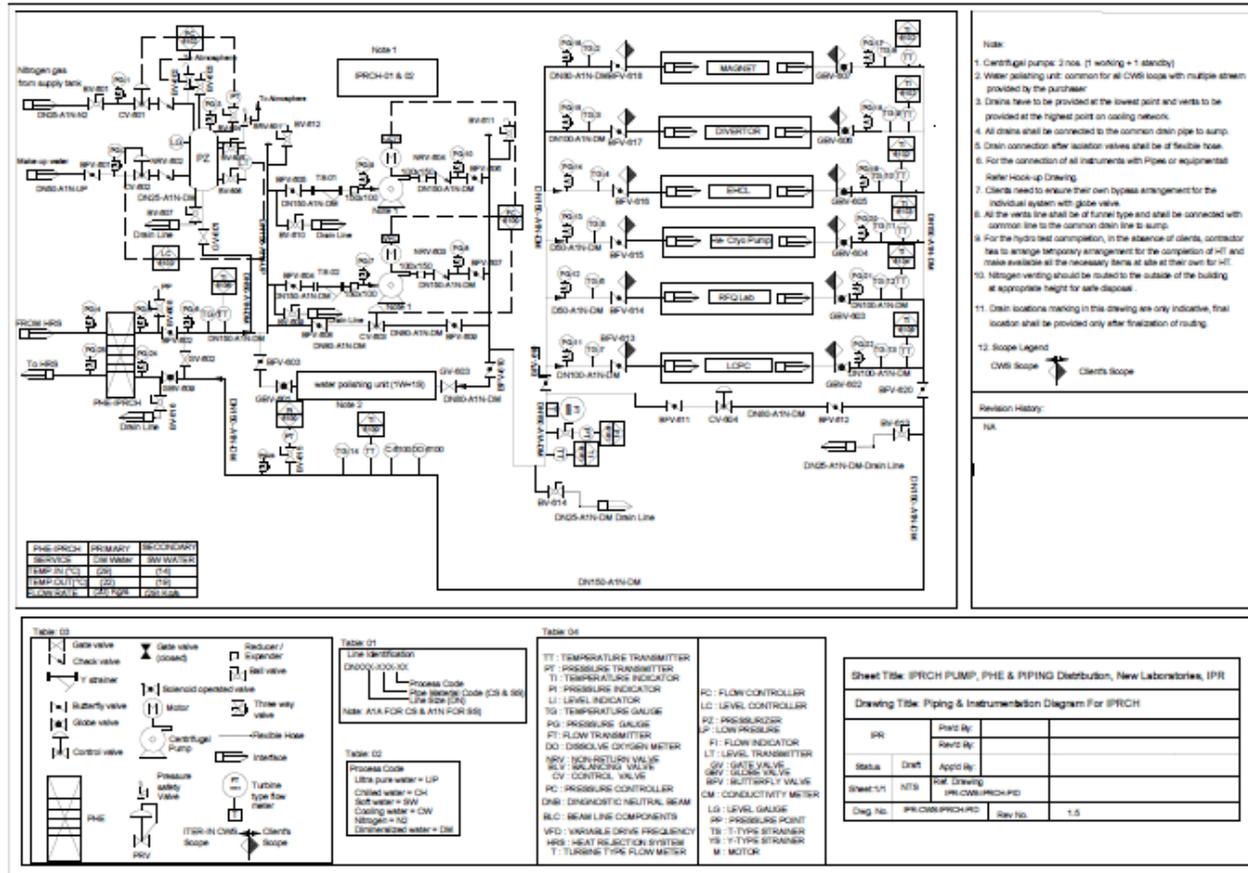
Annexure 29: DNBLP PID



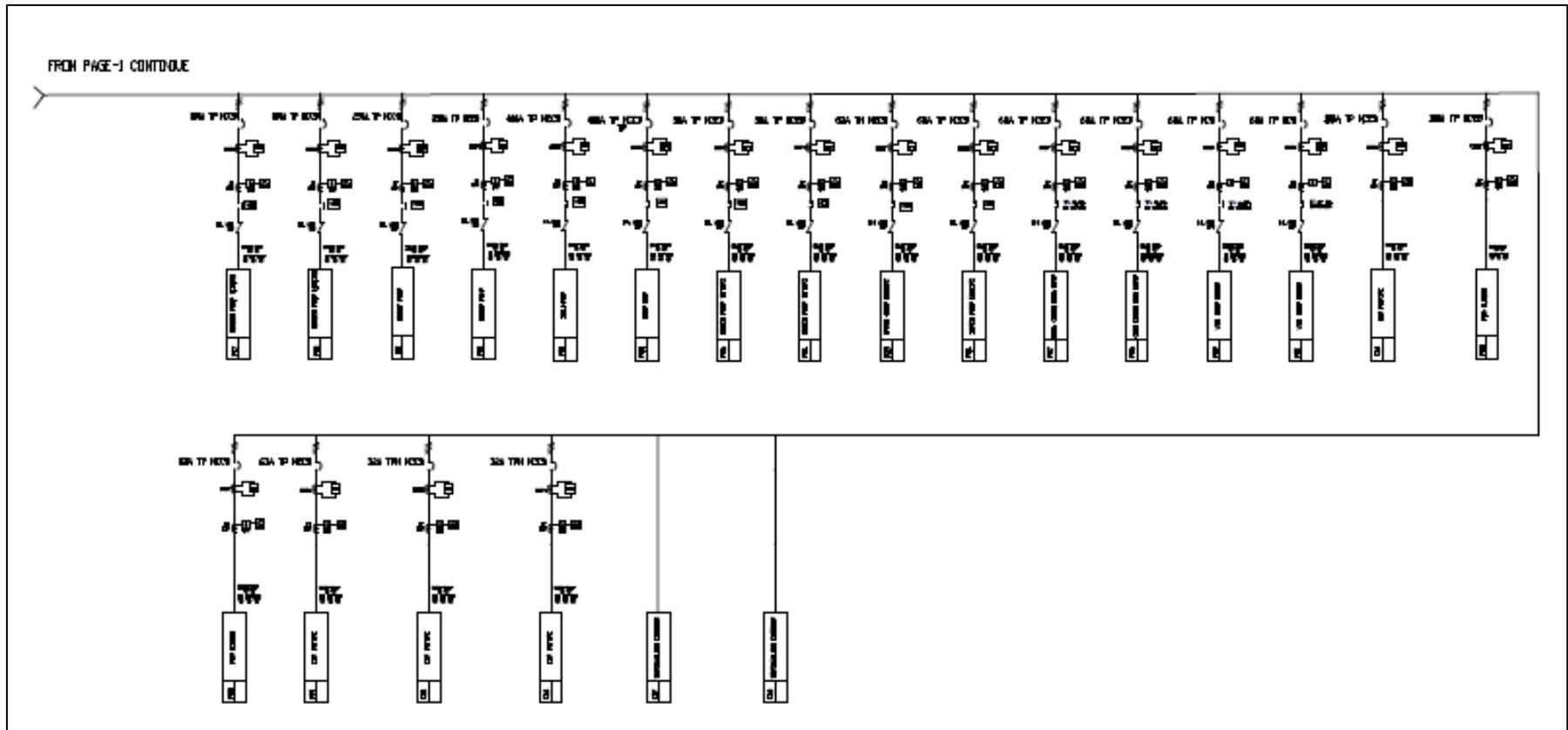
Annexure 30: DNBCH PID

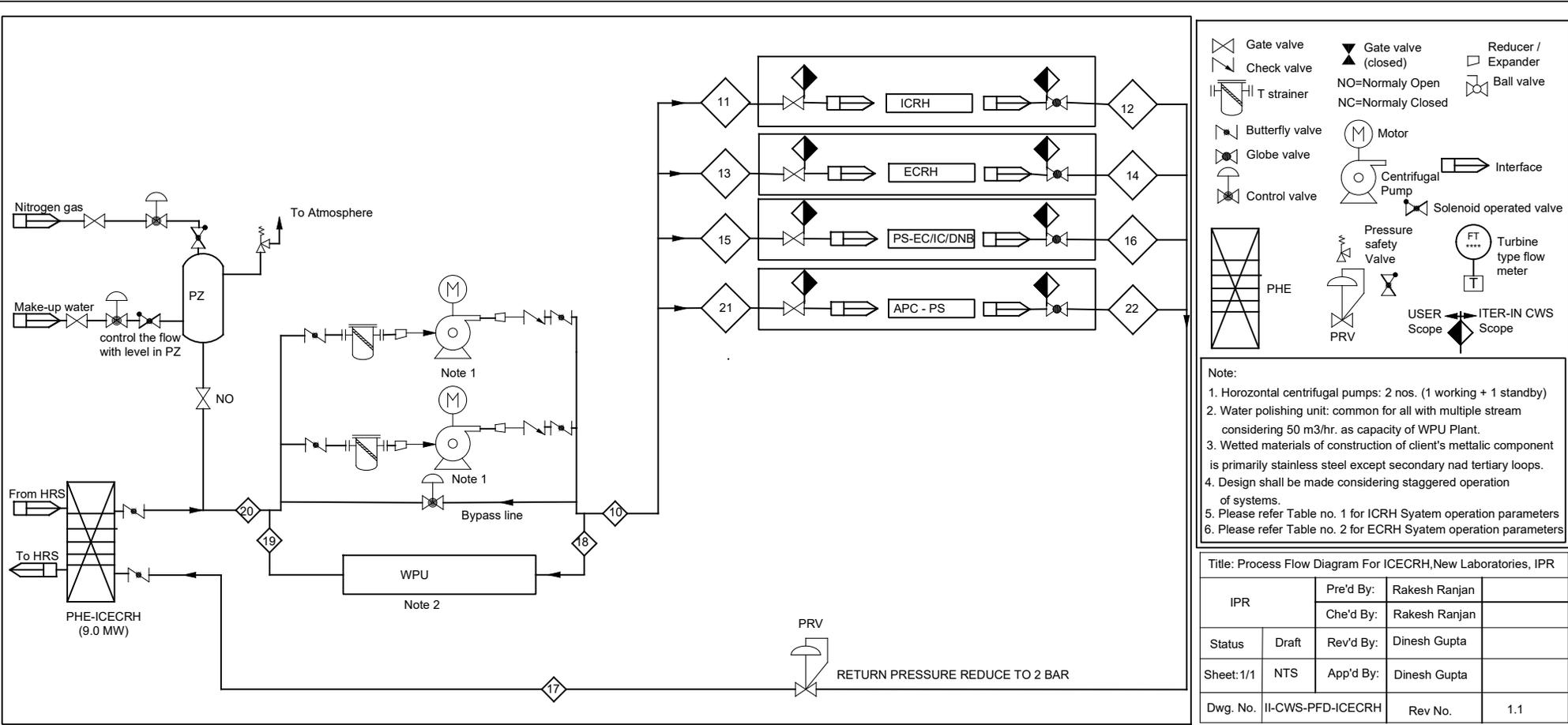


Annexure 31: IPRCH PID



SINGLE LINE DIAGRAM (CONTINUED)





Legend:

- Gate valve
- Check valve
- T strainer
- Butterfly valve
- Globe valve
- Control valve
- Gate valve (closed)
- NO=Normaly Open
- NC=Normaly Closed
- Reducer / Expander
- Ball valve
- Motor
- Centrifugal Pump
- Solenoid operated valve
- Interface
- Pressure safety Valve
- PRV
- PHE
- FT Turbine type flow meter
- USER Scope
- ITER-IN Scope

- Note:**
1. Horizontal centrifugal pumps: 2 nos. (1 working + 1 standby)
 2. Water polishing unit: common for all with multiple stream considering 50 m3/hr. as capacity of WPU Plant.
 3. Wetted materials of construction of client's mettalic component is primarily stainless steel except secondary nad tertiary loops.
 4. Design shall be made considering staggered operation of systems.
 5. Please refer Table no. 1 for ICRH System operation parameters
 6. Please refer Table no. 2 for ECRH System operation parameters

Title: Process Flow Diagram For ICECRH, New Laboratories, IPR

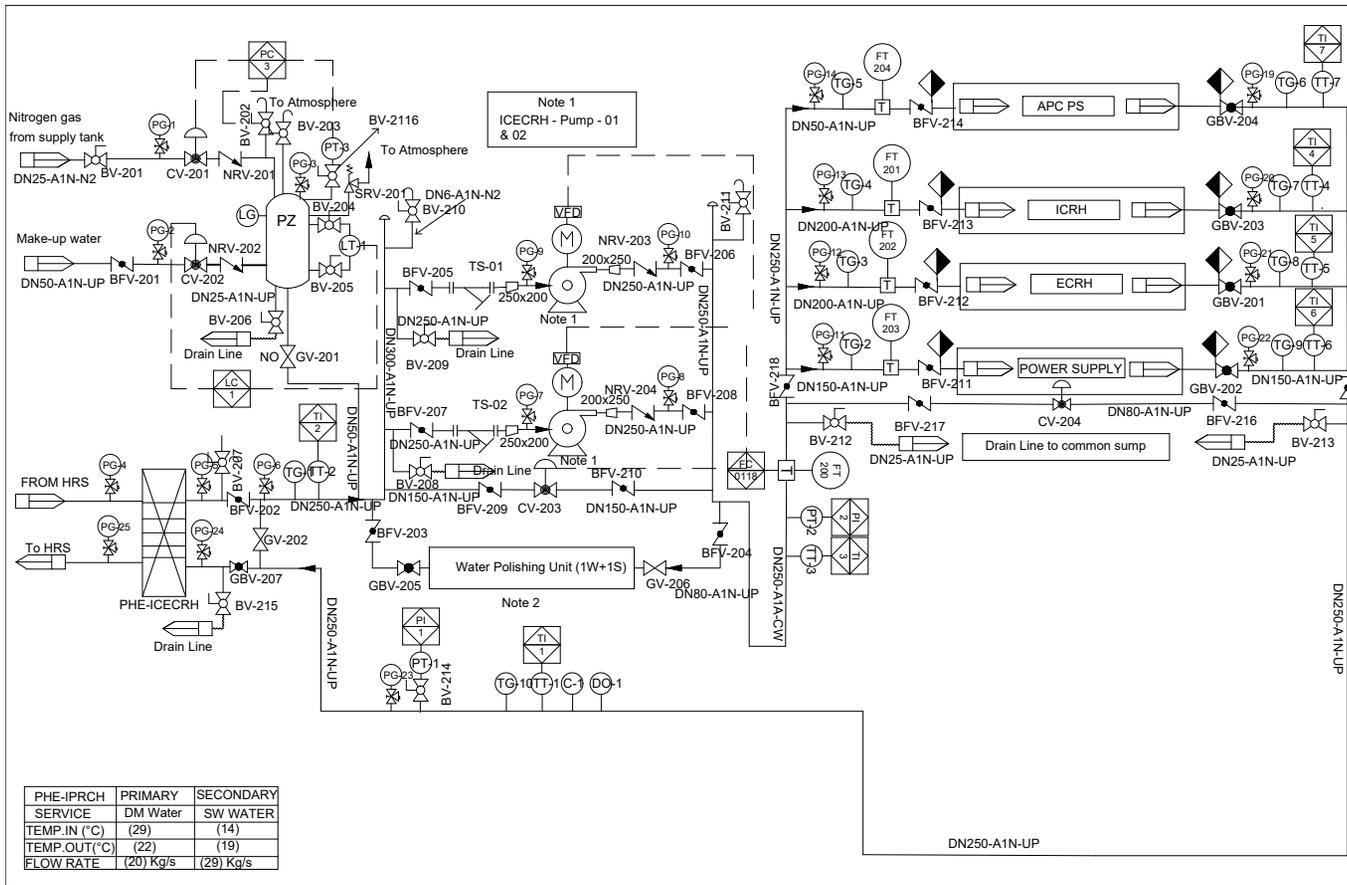
IPR		Pre'd By:	Rakesh Ranjan	
		Che'd By:	Rakesh Ranjan	
Status	Draft	Rev'd By:	Dinesh Gupta	
Sheet: 1/1	NTS	App'd By:	Dinesh Gupta	
Dwg. No.	II-CWS-PFD-ICECRH	Rev No.	1.1	

Table No. 1 (ICRH)

Stream No.	10	11	12	13	14	15	16	17	18	19	20	21	22
Flow Rate (Kg/S)	102	80	80	00	00	07	07	87	09	09	87	6.67	6.67
Pressure (MPa)	0.8	0.7	0.1	NA	NA	0.7	0.55	0.2	NA	NA	0.15	0.7	0.2
Temp. °C	35	35	58.12	NA	NA	35	45.24	57.15	NA	NA	35	35	42
Heat Load (MW)	NA	7.74	7.74	NA	NA	0.3	0.3	NA	NA	NA	NA	NA	NA

Table No. 2 (ECRH)

Stream No.	10	11	12	13	14	15	16	17	18	19	20	21	22
Flow Rate (Kg/S)	100	00	00	75	75	10	10	85	09	09	85	6.67	6.67
Pressure (MPa)	0.8	NA	NA	0.7	0.2	0.7	0.55	0.2	NA	NA	0.15	0.7	0.2
Temp. °C	35	NA	NA	35	50.3	35	47.09	59.5	35	35	35	35	42
Heat Load (MW)	NA	NA	NA	4.5	4.5	0.5	0.5	NA	NA	NA	NA	NA	NA



PHE-IPRCH SERVICE	PRIMARY DM Water	SECONDARY SW WATER
TEMP.IN (°C)	(29)	(14)
TEMP.OUT(°C)	(22)	(19)
FLOW RATE	(20) Kg/s	(29) Kg/s

- Note:
- Centrifugal pumps: 2 nos. (1 working + 1 standby)
 - Water polishing unit: common for all CWS loops with multiple stream provided by the purchaser
 - Drains have to be provided at the lowest point and vents to be provided at the highest point on cooling network.
 - All drains shall be connected to the common drain pipe to sump.
 - Drain connection after isolation valves shall be of flexible hose.
 - For the connection of all instruments with Pipes or equipments Refer Hook-up Drawing.
 - Clients need to ensure their own bypass arrangement for the individual system with globe valve.
 - All the vents line shall be of funnel type and shall be connected with common line to the common drain line to sump.
 - For the hydro test completion, in the absence of clients, contractor has to arrange temporary arrangement for the completion of HT and make available all the necessary items at site at their own for HT.
 - Nitrogen venting should be routed to the outside of the building at appropriate height for safe disposal .
 - Drain locations marking in this drawing are only indicative, final location shall be provided only after finalization of routing.
 - Scope Legend
- CWS Scope Client's Scope

Table: 03

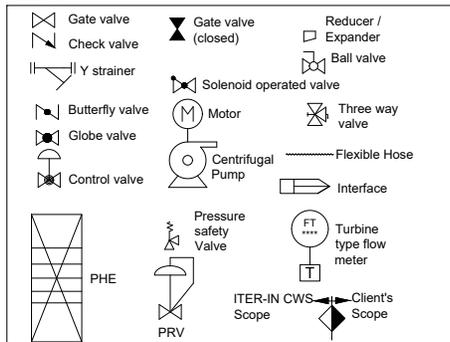


Table: 01

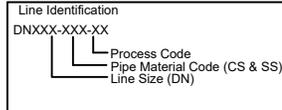


Table: 02

Process Code
Ultra pure water = UP
Chilled water = CH
Soft water = SW
CT S/R water = CT
Nitrogen = N2
Dimineralized water = DM

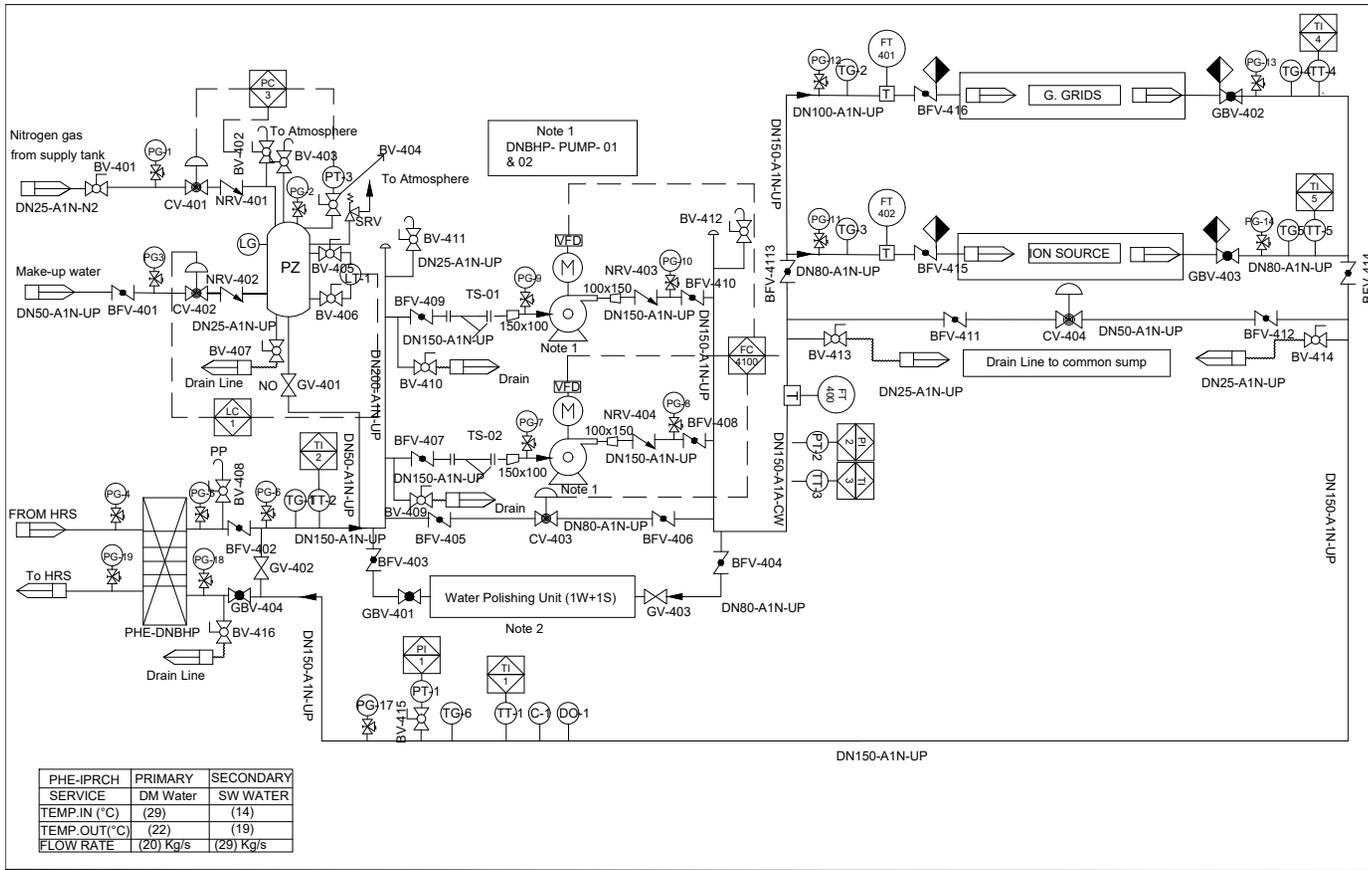
Table: 04

- DO : DISSOLVE OXYGEN METER
 CM : CONDUCTIVITY METER
 TT : TEMPERATURE TRANSMITTER
 PT : PRESSURE TRANSMITTER
 LT : LEVEL TRANSMITTER
 TI : TEMPERATURE INDICATOR
 PI : PRESSURE INDICATOR
 TG : TEMPERATURE GAUGE
 PC : PRESSURE CONTROLLER
- BFV : BUTTERFLY VALVE
 NRV : NON-RETURN VALVE
 BLV : BALANCING VALVE
 BLC : BEAM LINE COMPONENTS
 DNB : DINGNOSTIC NEUTRAL BEAM
 VFD : VARIABLE DRIVE FREQUENCY
 HRS : HEAT REJECTION SYSTEM
 T : TURBINE TYPE FLOW METER
- PG : PRESSURE GAUGE
 LG : LEVEL GAUGE
 LI : LEVEL INDICATOR
 FI : FLOW INDICATOR
 LP : LOW PRESURE
 PZ : PRESSURIZER
 GV : GATE VALVE
 GBV : GLOBE VALVE
 FC : FLOW CONTROLLER
 LC : LEVEL CONTROLLER
 M : MOTOR
 CV : CONTROL VALVE
 PP : PRESSURE POINT
 TS : T-TYPE STRAINER
 YS : Y-TYPE STRAINER
 FT : FLOW TRANSMITTER

Sheet Title : ICECRH PUMP, PHE & PIPING Distribution, New Laboratories , IPR

Drawing Title : Piping & Instrumentation Diagram For ICECRH

IPR		Pre'd By:	
Status		Rev'd By:	
Sheet: 1/1	Draft	App'd By:	
Ref. Drawing		IPR-CWS-ICECRH-PID	
Dwg. No.	IPR-CWS-ICECRH-PID	Rev No.	1.5



- Note:
- Centrifugal pumps: 2 nos. (1 working + 1 standby)
 - Water polishing unit: common for all CWS loops with multiple stream provided by the purchaser
 - Drains have to be provided at the lowest point and vents to be provided at the highest point on cooling network.
 - All drains shall be connected to the common drain pipe to sump.
 - Drain connection after isolation valves shall be of flexible hose.
 - For the connection of all instruments with Pipes or equipments Refer Hook-up Drawing.
 - Clients need to ensure their own bypass arrangement for the individual system with globe valve.
 - All the vents line shall be of funnel type and shall be connected with common line to the common drain line to sump.
 - For the hydro test completion, in the absence of clients, contractor has to arrange temporary arrangement for the completion of HT and make available all the necessary items at site at their own for HT.
 - Nitrogen venting should be routed to the outside of the building at appropriate height for safe disposal .
 - Drain locations marking in this drawing are only indicative, final location shall be provided only after finalization of routing.
 - Scope Legend
 Client's Scope

PHE-IPRCH SERVICE	PRIMARY DM Water	SECONDARY SW WATER
TEMP.IN (°C)	(29)	(14)
TEMP.OUT(°C)	(22)	(19)
FLOW RATE	(20) Kg/s	(29) Kg/s

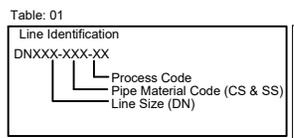
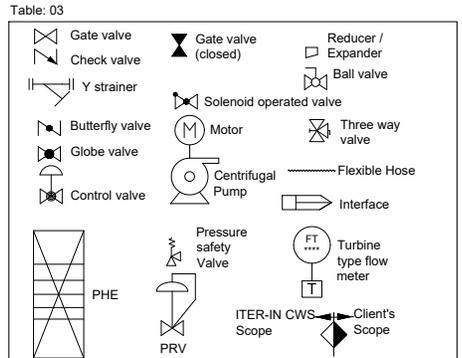


Table: 02

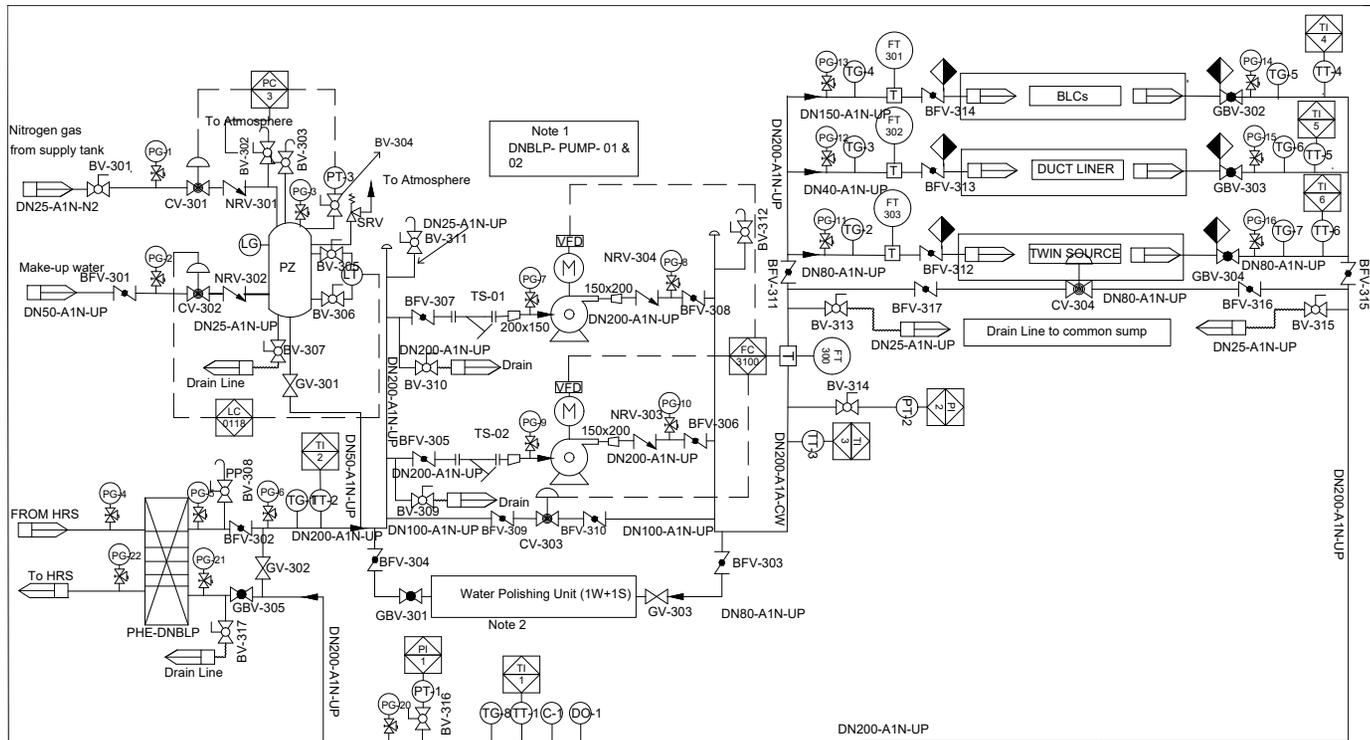
Process Code	Ultra pure water = UP
Chilled water = CH	
Soft water = SW	
CT S/R water = CT	
Nitrogen = N2	
Dimineralized water = DM	

- Table: 04
- | | |
|--|--|
| TG : TEMPERATURE GAUGE
PG : PRESSURE GAUGE
LG : LEVEL GAUGE
DO : DISSOLVE OXYGEN METER
CM : CONDUCTIVITY METER
TT : TEMPERATURE TRANSMITTER
PT : PRESSURE TRANSMITTER
LT : LEVEL TRANSMITTER
TI : TEMPERATURE INDICATOR
PI : PRESSURE INDICATOR
LI : LEVEL INDICATOR
FI : FLOW INDICATOR
FT : FLOW TRANSMITTER
GV : GATE VALVE
GBV : GLOBE VALVE
BFV : BUTTERFLY VALVE
NRV : NON-RETURN VALVE
BLV : BALANCING VALVE
CV : CONTROL VALVE | PP : PRESSURE POINT
TS : T-TYPE STRAINER
YS : Y-TYPE STRAINER
M : MOTOR
VFD : VARIABLE DRIVE FREQUENCY
HRS : HEAT REJECTION SYSTEM
T : TURBINE TYPE FLOW METER
FC : FLOW CONTROLLER
LC : LEVEL CONTROLLER
PC : PRESSURE CONTROLLER
DNS : DIAGNOSTIC NEUTRAL BEAM
LP : LOW PRESURE
PZ : PRESSURIZER
BLC : BEAM LINE COMPONENTS |
|--|--|

Sheet Title: DN80 PUMP, PHE & PIPING Distribution, New Laboratories , IPR

Drawing Title: Piping & Instrumentation Diagram For DN80 PHE

IPR	Pre'd By:	
	Rev'd By:	
Status	Draft	App'd By:
Sheet: 1/1	NTS	Ref. Drawing IPR-CWS-DNBHP-PID
Dwg. No.	IPR-CWS-DNBHP-PID	Rev No.
		1.5



Note 1
DNBLP- PUMP- 01 & 02

Note 2
Water Polishing Unit (1W+1S)

- Note:
- Centrifugal pumps: 2 nos. (1 working + 1 standby)
 - Water polishing unit: common for all CWS loops with multiple stream provided by the purchaser
 - Drains have to be provided at the lowest point and vents to be provided at the highest point on cooling network.
 - All drains shall be connected to the common drain pipe to sump.
 - Drain connection after isolation valves shall be of flexible hose.
 - For the connection of all instruments with Pipes or equipments Refer Hook-up Drawing.
 - Clients need to ensure their own bypass arrangement for the individual system with globe valve.
 - All the vents line shall be of funnel type and shall be connected with common line to the common drain line to sump.
 - For the hydro test completion, in the absence of clients, contractor has to arrange temporary arrangement for the completion of HT and make available all the necessary items at site at their own for HT.
 - Nitrogen venting should be routed to the outside of the building at appropriate height for safe disposal .
 - Drain locations marking in this drawing are only indicative, final location shall be provided only after finalization of routing.
 - Scope Legend



PHE-IPRCH SERVICE	PRIMARY DM Water	SECONDARY SW WATER
TEMP.IN (°C)	(29)	(14)
TEMP.OUT(°C)	(22)	(19)
FLOW RATE	(20) Kg/s	(29) Kg/s

Table: 03

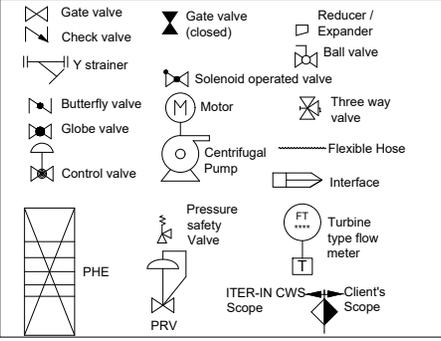


Table: 01

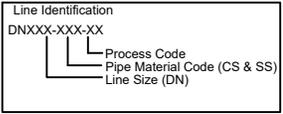


Table: 02

Process Code
 Ultra pure water = UP
 Chilled water = CH
 Soft water = SW
 CT S/R water = CT
 Nitrogen = N2
 Dimineralized water = DM

Table: 04

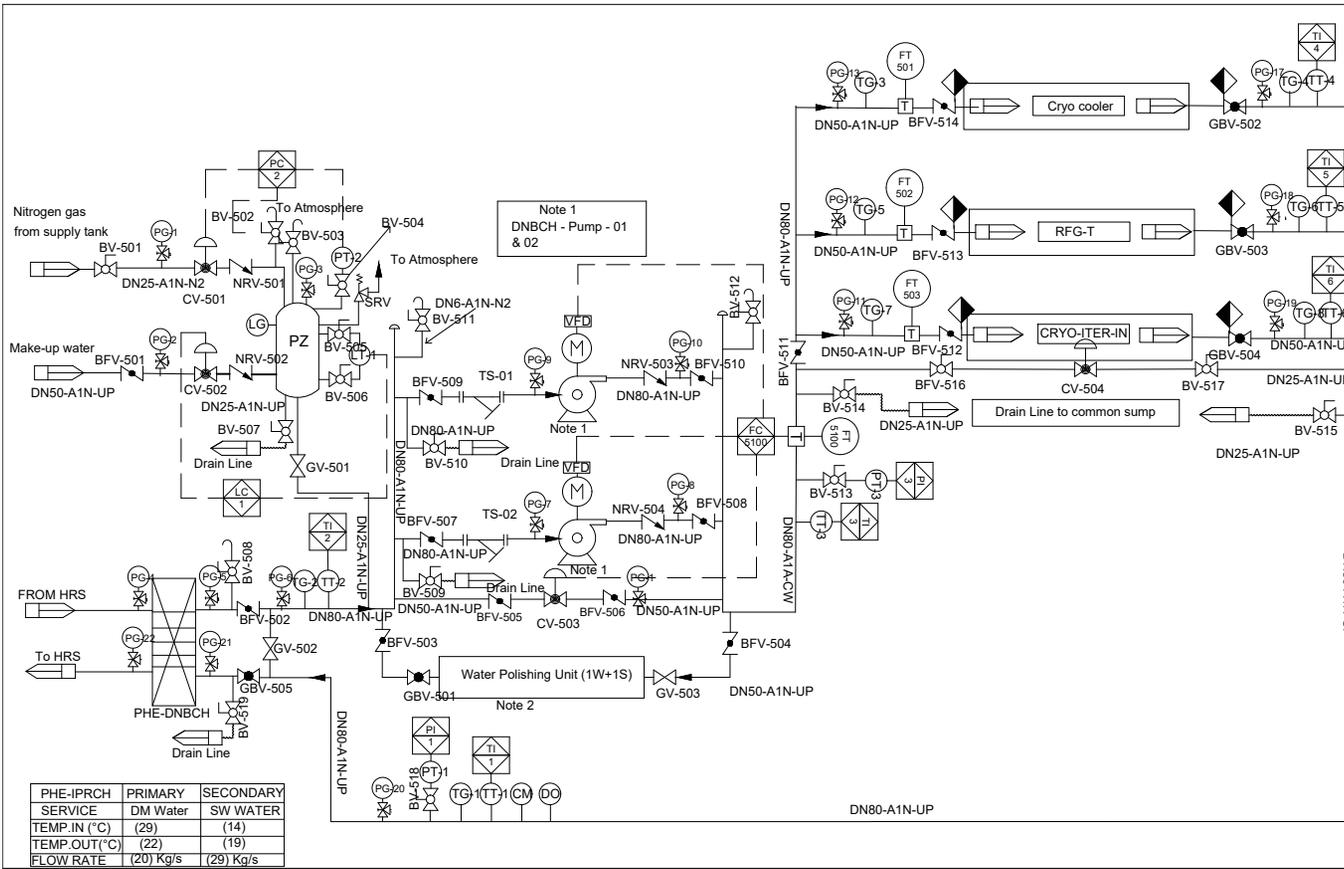
TG : TEMPERATURE GAUGE
 PG : PRESSURE GAUGE
 LG : LEVEL GAUGE
 DO : DISSOLVE OXYGEN METER
 CM : CONDUCTIVITY METER
 TT : TEMPERATURE TRANSMITTER
 PT : PRESSURE TRANSMITTER
 LT : LEVEL TRANSMITTER
 TI : TEMPERATURE INDICATOR
 PI : PRESSURE INDICATOR
 LI : LEVEL INDICATOR
 FI : FLOW INDICATOR
 FT : FLOW TRANSMITTER
 GV : GATE VALVE
 GBV : GLOBE VALVE
 BFV : BUTTERFLY VALVE
 NRV : NON-RETURN VALVE
 BLV : BALANCING VALVE
 CV : CONTROL VALVE

PP : PRESSURE POINT
 FC : FLOW CONTROLLER
 LC : LEVEL CONTROLLER
 PC : PRESSURE CONTROLLER
 DNB : DINGNOSTIC NEUTRAL BEAM LP : LOW PRESURE
 PZ : PRESSURIZER
 BLC : BEAM LINE COMPONENTS
 TS : T-TYPE STRAINER
 YS : Y-TYPE STRAINER
 M : MOTOR
 VFD : VARIABLE DRIVE FREQUENCY
 HRS : HEAT REJECTION SYSTEM
 T : TURBINE TYPE FLOW METER

Sheet Title: DNBLP PUMP, PHE & PIPING Distribution, New Laboratories, IPR

Drawing Title: Piping & Instrumentation Diagram For DNBLP

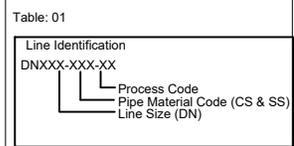
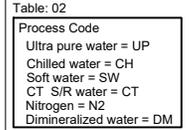
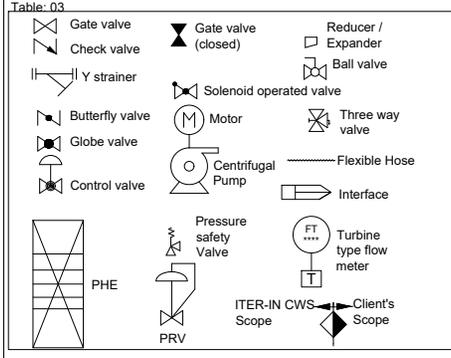
IPR		Pre'd By:	
IPR		Rev'd By:	
Status	Draft	App'd By:	
Sheet:1/1	NTS	Ref. Drawing	IPR-CWS-DNBLP-PID
Dwg. No.	IPR-CWS-DNBLP-PID	Rev No.	1.5



- Note:
- Centrifugal pumps: 2 nos. (1 working + 1 standby)
 - Water polishing unit: common for all CWS loops with multiple stream provided by the purchaser
 - Drains have to be provided at the lowest point and vents to be provided at the highest point on cooling network.
 - All drains shall be connected to the common drain pipe to sump.
 - Drain connection after isolation valves shall be of flexible hose.
 - For the connection of all instruments with Pipes or equipments Refer Hook-up Drawing.
 - Clients need to ensure their own bypass arrangement for the individual system with globe valve.
 - All the vents line shall be of funnel type and shall be connected with common line to the common drain line to sump.
 - For the hydro test completion, in the absence of clients, contractor has to arrange temporary arrangement for the completion of HT and make available all the necessary items at site at their own for HT.
 - Nitrogen venting should be routed to the outside of the building at appropriate height for safe disposal .
 - Drain locations marking in this drawing are only indicative, final location shall be provided only after finalization of routing.
 - Scope Legend

PHE-IPRCH SERVICE	PRIMARY DM Water	SECONDARY SW WATER
TEMP.IN (°C)	(29)	(14)
TEMP.OUT(°C)	(22)	(19)
FLOW RATE	(20) Kg/s	(29) Kg/s

Table: 04



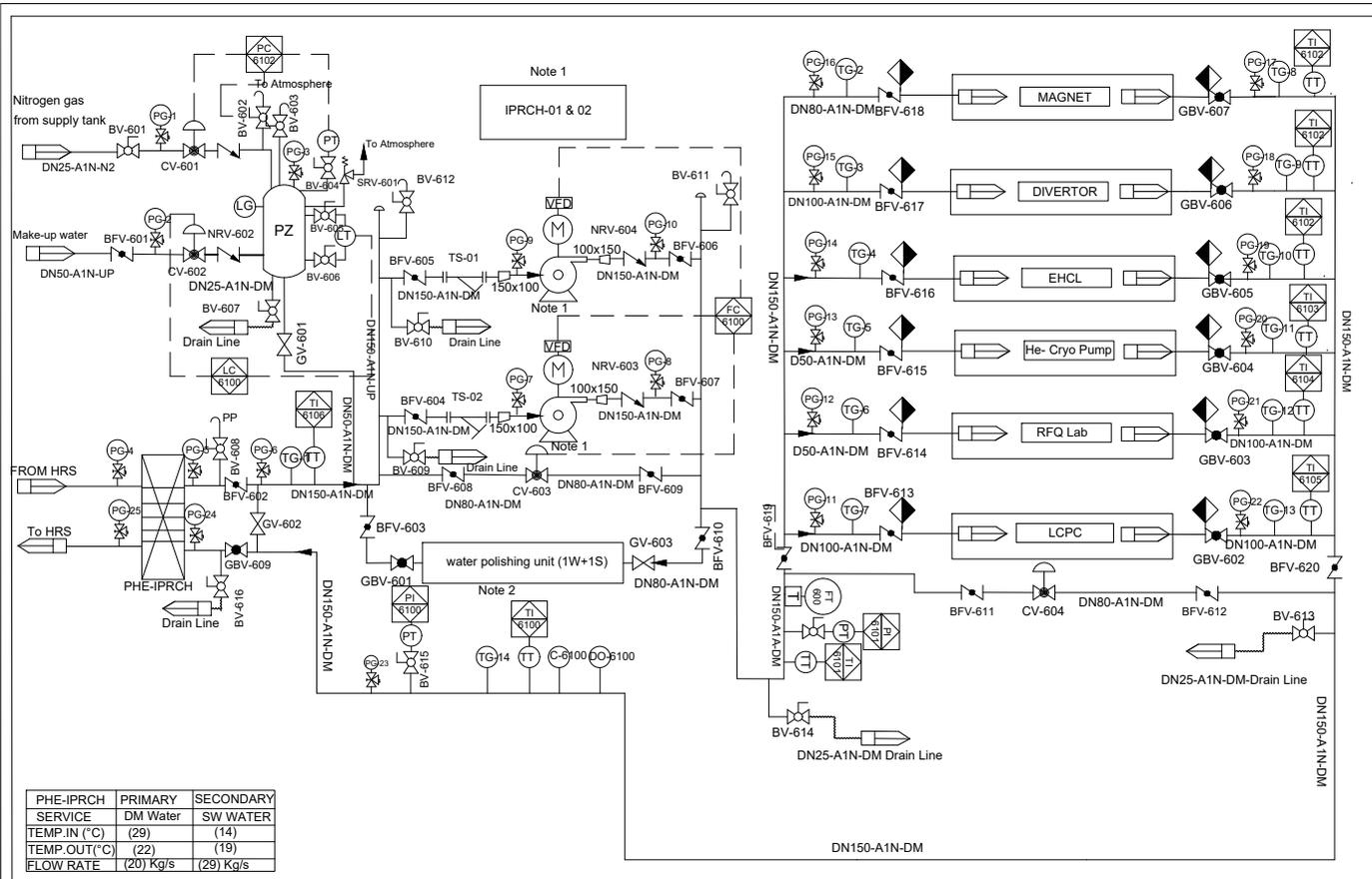
- TG : TEMPERATURE GAUGE
 PG : PRESSURE GAUGE
 LG : LEVEL GAUGE
 DO : DISSOLVE OXYGEN METER
 CM : CONDUCTIVITY METER
 TT : TEMPERATURE TRANSMITTER
 PT : PRESSURE TRANSMITTER
 LT : LEVEL TRANSMITTER
 TI : TEMPERATURE INDICATOR
 PI : PRESSURE INDICATOR
 LI : LEVEL INDICATOR
 FI : FLOW INDICATOR
 FT : FLOW TRANSMITTER
 GV : GATE VALVE
 GBV : GLOBE VALVE
 BVFV : BUTTERFLY VALVE
 NRV : NON-RETURN VALVE
 BLV : BALANCING VALVE
 CV : CONTROL VALVE
 PC : PRESSURE CONTROLLER
 LP : LOW PRESSURE

- DNB : DINGNOSTIC NEUTRAL BEAM
 BLC : BEAM LINE COMPONENTS
 YS : Y-TYPE STRAINER
 M : MOTOR
 VFD : VARIABLE DRIVE FREQUENCY
 HRS : HEAT REJECTION SYSTEM
 T : TURBINE TYPE FLOW METER
 PP : PRESSURE POINT
 TS : T-TYPE STRAINER
 FC : FLOW CONTROLLER
 LC : LEVEL CONTROLLER
 FLG : Flanged connection

Sheet Title: DNBCH PUMP, PHE & PIPING Distribution, New Laboratories , IPR

Drawing Title: Piping & Instrumentation Diagram For DNBCH

IPR	Pre'd By:		
	Rev'd By:		
Status	Draft	App'd By:	
Sheet: 1/1	NTS	Ref. Drawing	IPR-CWS-DNBCH-PID
Dwg. No.	IPR-CWS-DNBCH-PID	Rev No.	1.5



PHE-IPRCH SERVICE	PRIMARY DM Water	SECONDARY SW WATER
TEMP. IN (°C)	(29)	(14)
TEMP. OUT (°C)	(22)	(19)
FLOW RATE	(20) Kg/s	(29) Kg/s

- Note:
- Centrifugal pumps: 2 nos. (1 working + 1 standby)
 - Water polishing unit: common for all CWS loops with multiple stream provided by the purchaser
 - Drains have to be provided at the lowest point and vents to be provided at the highest point on cooling network.
 - All drains shall be connected to the common drain pipe to sump.
 - Drain connection after isolation valves shall be of flexible hose.
 - For the connection of all instruments with Pipes or equipments Refer Hook-up Drawing.
 - Clients need to ensure their own bypass arrangement for the individual system with globe valve.
 - All the vents line shall be of funnel type and shall be connected with common line to the common drain line to sump.
 - For the hydro test completion, in the absence of clients, contractor has to arrange temporary arrangement for the completion of HT and make available all the necessary items at site at their own for HT.
 - Nitrogen venting should be routed to the outside of the building at appropriate height for safe disposal.
 - Drain locations marking in this drawing are only indicative, final location shall be provided only after finalization of routing.
 - Scope Legend
 CWS Scope
 Client's Scope

Revision History:

Rev No.	Description
NA	

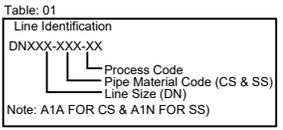
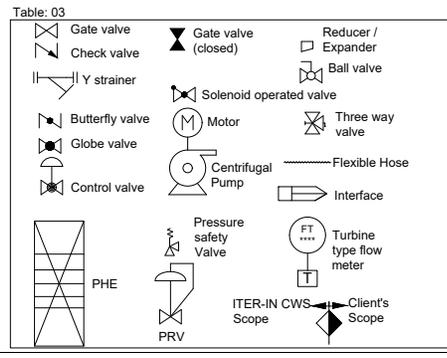


Table: 02

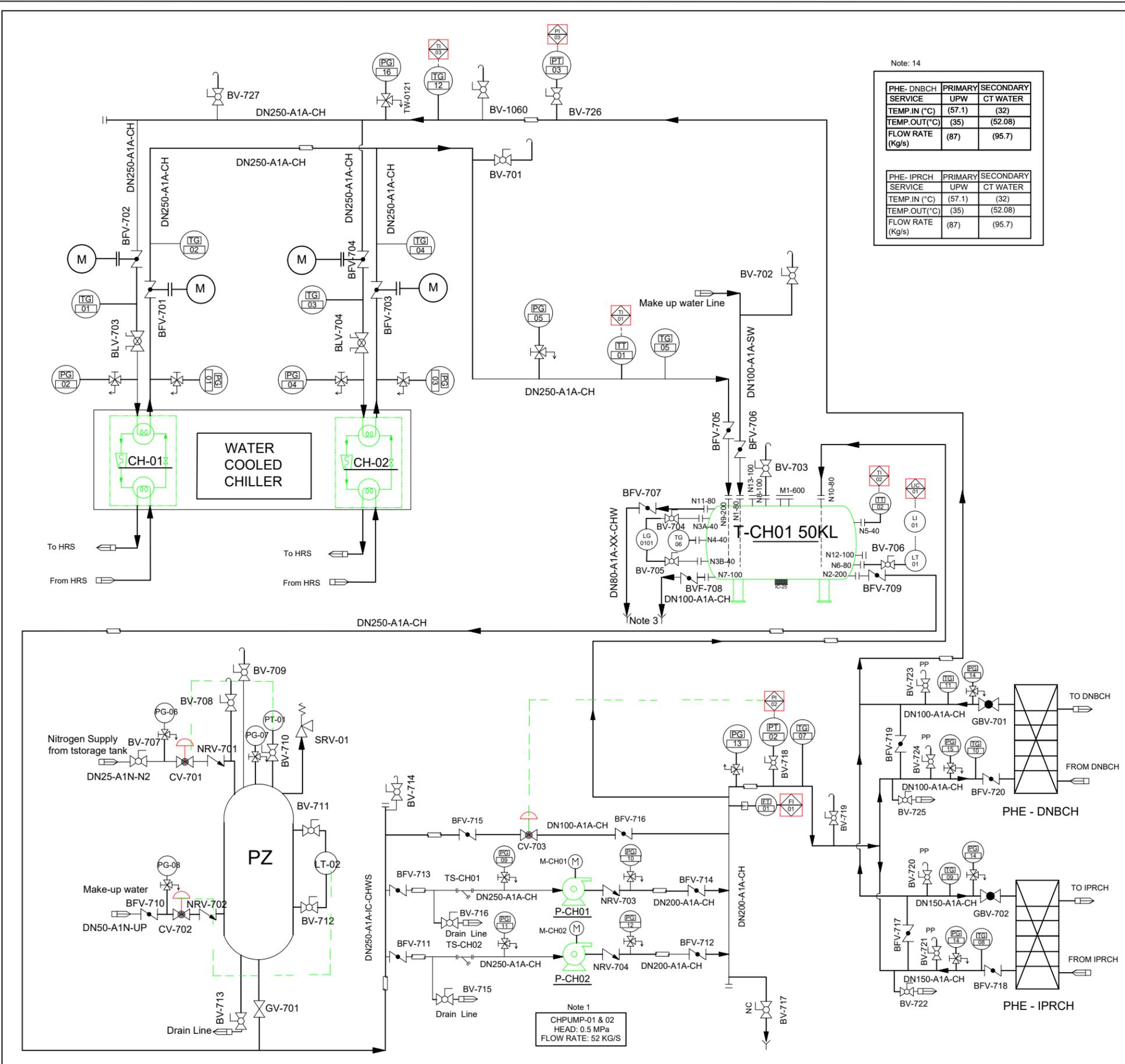
Process Code	Ultra pure water = UP
	Chilled water = CH
	Soft water = SW
	Cooling water = CW
	Nitrogen = N2
	Dimineralized water = DM

- Table: 04
- TT : TEMPERATURE TRANSMITTER
 - PT : PRESSURE TRANSMITTER
 - TI : TEMPERATURE INDICATOR
 - PI : PRESSURE INDICATOR
 - LI : LEVEL INDICATOR
 - TG : TEMPERATURE GAUGE
 - PG : PRESSURE GAUGE
 - FT : FLOW TRANSMITTER
 - DO : DISSOLVE OXYGEN METER
 - NRV : NON-RETURN VALVE
 - BLV : BALANCING VALVE
 - CV : CONTROL VALVE
 - PC : PRESSURE CONTROLLER
 - DNB : DINGNOSTIC NEUTRAL BEAM
 - BLC : BEAM LINE COMPONENTS
 - VFD : VARIABLE DRIVE FREQUENCY
 - HRS : HEAT REJECTION SYSTEM
 - T : TURBINE TYPE FLOW METER
 - FC : FLOW CONTROLLER
 - LC : LEVEL CONTROLLER
 - PZ : PRESSURIZER
 - LP : LOW PRESURE
 - FI : FLOW INDICATOR
 - LT : LEVEL TRANSMITTER
 - GV : GATE VALVE
 - GBV : GLOBE VALVE
 - BFV : BUTTERFLY VALVE
 - CM : CONDUCTIVITY METER
 - LG : LEVEL GAUGE
 - LT : PRESSURE POINT
 - TS : T-TYPE STRAINER
 - YS : Y-TYPE STRAINER
 - M : MOTOR

Sheet Title: IPRCH PUMP, PHE & PIPING Distribution, New Laboratories, IPR

Drawing Title: Piping & Instrumentation Diagram For IPRCH

IPR		Pre'd By:	
Status	Draft	Rev'd By:	
Sheet: 1/1	NTS	Ref. Drawing	IPR-CWS-IPRCH-PID
Dwg. No.	IPR-CWS-IPRCH-PID	Rev No.	1.5



Note: 14

PHE- DNBC	PRIMARY	SECONDARY
SERVICE	UPW	CT WATER
TEMP.IN (°C)	(57.1)	(32)
TEMP.OUT(°C)	(35)	(52.08)
FLOW RATE (Kg/s)	(87)	(95.7)

PHE- IPRCH	PRIMARY	SECONDARY
SERVICE	UPW	CT WATER
TEMP.IN (°C)	(57.1)	(32)
TEMP.OUT(°C)	(35)	(52.08)
FLOW RATE (Kg/s)	(87)	(95.7)

- Note:
- Centrifugal pumps: 2 nos. (1 working + 1 standby)
 - Drains have to be provided at the lowest point and vents to be provided at the highest point on cooling network.
 - Chilled water overflow and drain line to main drain header.
 - All drains shall be connected to the common drain pipe to sump.
 - Drain connection after isolation valves shall be of flexible hose.
 - For the connection of all instruments with Pipes or equipments Refer Hook-up Drawing.
 - Clients need to ensure their own bypass arrangement for the individual system with globe valve.
 - All the vents line shall be of funnel type and shall be connected with common line to the common drain line to sump.
 - For hydro test completion, in the absence of clients, contractor has to arrange temporary arrangement for the completion of HT & make available all the necessary items at site at their own for HT.
 - Nitrogen venting should be routed to the outside of the building at appropriate height for safe disposal .
 - Drain locations marking in this drawing are only indicative, final location shall be provided only after finalization of routing.
 - Water Cooled Chillers Two nos. (one working and one stanby)
 - PHE primary & secondary side process specification are provided.

Table: 01

Line Identification	Process Code	Pipe Material Code (CS & SS)	Line Size (DN)
DNXXX-XXX-XX			

Table: 02

Process Code	Soft water = SW	Chilled water = CH	CT S/R water = CT	Dimineralized water = DM	Nitrogen = N2
Ultra pure water = UP					

Table: 03

Gate valve	Motor	Flexible Hose
Check valve	Centrifugal Pump	Interface
Butterfly valve		
Globe valve	Reducer / Expander	
Control valve	Thermal Insulation	
Ball valve	Turbine type flow meter	
Three way valve		
Pressure safety Valve	PHE	
Y type strainer	Balancing Valve	

Table: 04

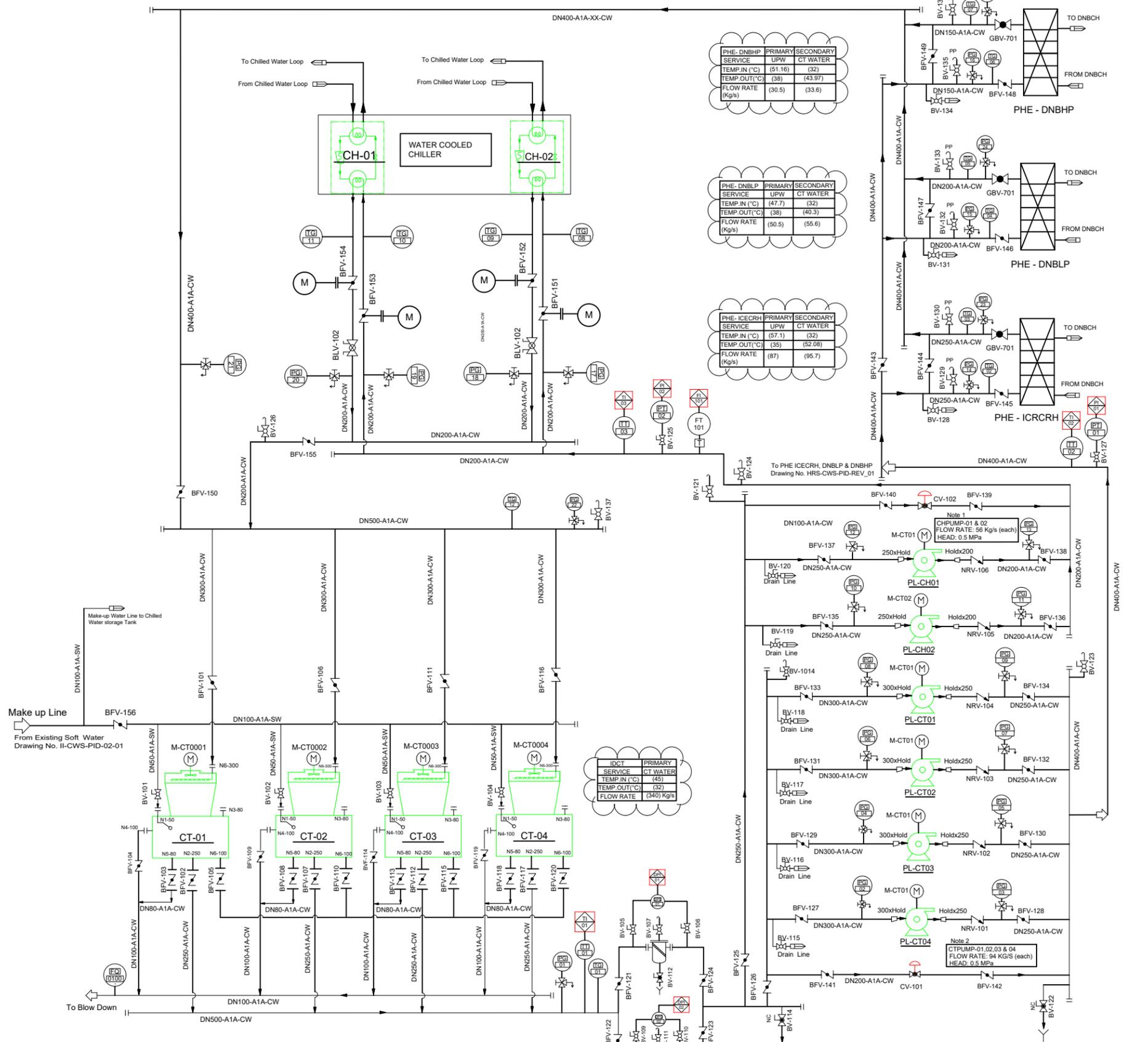
TG : TEMPERATURE GAUGE	BLV : BALANCING VALVE
PG : PRESSURE GAUGE	CV : CONTROL VALVE
LG : LEVEL GAUGE	PP : PRESSURE POINT
DO : DISSOLVE OXYGEN METER	TS : T-TYPE STRAINER
CM : CONDUCTIVITY METER	YS : Y-TYPE STRAINER
TT : TEMPERATURE TRANSMITTER	M : MOTOR
PT : PRESSURE TRANSMITTER	HRS : HEAT REJECTION SYSTEM
LT : LEVEL TRANSMITTER	T : TURBINE TYPE FLOW METER
TI : TEMPERATURE INDICATOR	FC : FLOW CONTROLLER
PI : PRESSURE INDICATOR	LC : LEVEL CONTROLLER
LI : LEVEL INDICATOR	PC : PRESSURE CONTROLLER
FI : FLOW INDICATOR	LP : LOW PRESURE
FT : FLOW TRANSMITTER	PZ : PRESSURIZER
GV : GATE VALVE	NC : Normally Closed
GBV : GLOBE VALVE	NRV : NON-RETURN VALVE
	BFV : BUTTERFLY VALVE

Note 1
 CHPUMP-01 & 02
 HEAD: 0.5 MPa
 FLOW RATE: 52 KG/S

Sheet Title: Chiller, Chiller water tank, Chilled water Pump & PHEs

Drawing Title: Piping & Instrumentation Diagram For Chiller Loop

IPR	Pre'd By:	
Status	Rev'd By:	
Sheet: 1/1	Draft	App'd By:
NTS	Ref. Drawing :	IPR-CHWS-PID
Dwg. No.	IPR-CHWS-PID	Rev No.
		1.4



PHE-DNBHP	PRIMARY	SECONDARY
SERVICE	UPW	CT WATER
TEMP IN (°C)	(51.16)	(32)
TEMP OUT (°C)	(38)	(43.97)
FLOW RATE (Kg/s)	(30.5)	(33.6)

PHE-DNBLP	PRIMARY	SECONDARY
SERVICE	UPW	CT WATER
TEMP IN (°C)	(47.7)	(32)
TEMP OUT (°C)	(38)	(40.3)
FLOW RATE (Kg/s)	(50.5)	(55.6)

PHE-ICRCH	PRIMARY	SECONDARY
SERVICE	UPW	CT WATER
TEMP IN (°C)	(57.1)	(32)
TEMP OUT (°C)	(35)	(52.08)
FLOW RATE (Kg/s)	(87)	(95.7)

IDCT	PRIMARY
SERVICE	CT WATER
TEMP IN (°C)	(45)
TEMP OUT (°C)	(32)
FLOW RATE (Kg/s)	(340)

- Note:
- Centrifugal pumps: 2 nos. (1 working + 1 standby)
 - Centrifugal pumps: 4 nos. (3 working + 1 standby)
 - Drains have to be provided at the lowest point and vents to be provided at the highest point on cooling network.
 - Chilled water overflow and drain line to main drain header.
 - All drains shall be connected to the common drain pipe to sump.
 - Drain connection after isolation valves shall be of flexible hose.
 - For the connection of all instruments with Pipes or equipments Refer Hook-up Drawing.
 - Clients need to ensure their own bypass arrangement for the individual system with globe valve.
 - All the vents line shall be of funnel type and shall be connected with common line to the common drain line to sump.
 - For hydro test completion, in the absence of clients, contractor has to arrange temporary arrangement for the completion of HT & make available all the necessary items at site at their own for HT.
 - Nitrogen venting should be routed to the outside of the building at appropriate height for safe disposal.
 - Drain locations marking in this drawing are only indicative, final location shall be provided only after finalization of routing.
 - Water Cooled Chillers Two nos. (one working and one stanby)
 - PHE primary & secondary side process specification are provided.

Table: 01

Line Identification

DNXXX-XXX-XX
 L-Process Code
 - Pipe Material Code (CS & SS)
 Line Size (DN)

Table: 02

Process Code

Ultra pure water = UP Soft water = SW
 Chilled water = CH CT S/R water = CT
 Dimineralized water = DM Nitrogen = N2

Table: 03

Gate valve (M) Motor (M) Flexible Hose (—)
 Check valve (CV) Centrifugal Pump (P)
 Butterfly valve (BV) Reducer / Expander (R)
 Globe valve (GV) Thermal Insulation (I)
 Control valve (CV) Turbine type flow meter (T)
 Ball valve (BV) Three way valve (3W)
 Pressure safety Valve (PSV) PHE
 Y type strainer (YS) Balancing Valve (BLV)

Table: 04

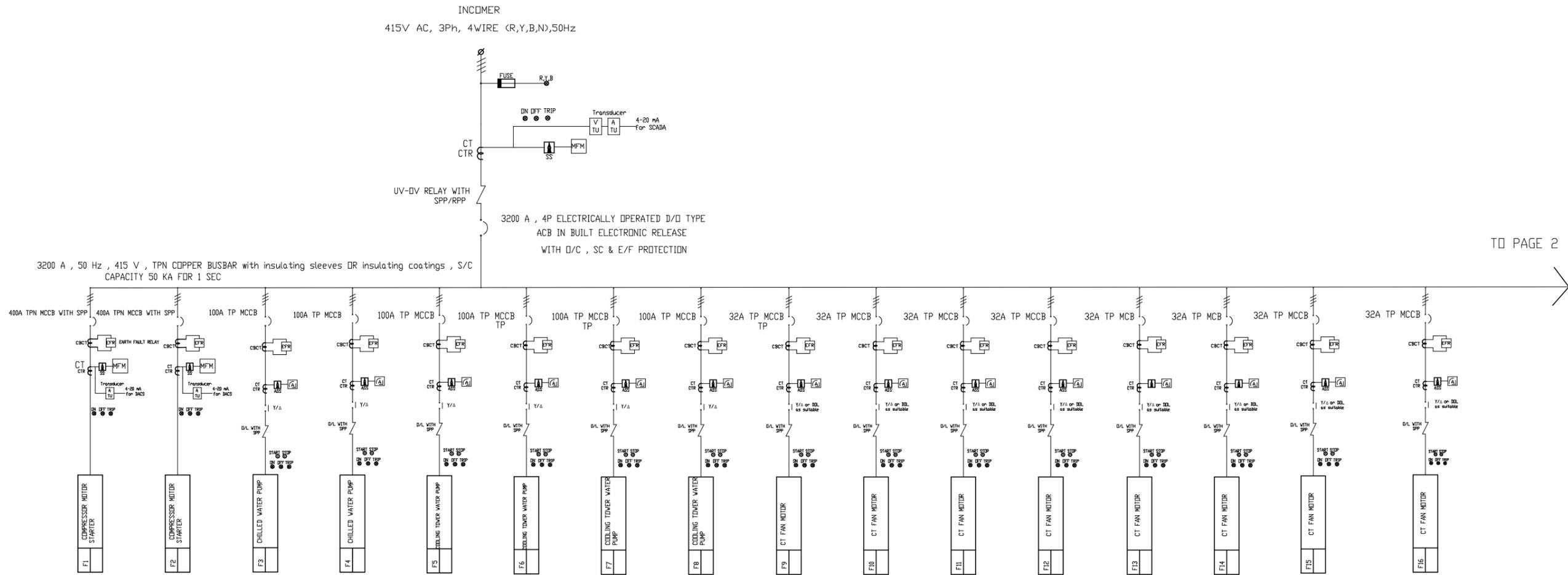
TG : TEMPERATURE GAUGE	BLV : BALANCING VALVE
PG : PRESSURE GAUGE	CV : CONTROL VALVE
LG : LEVEL GAUGE	PP : PRESSURE POINT
DO : DISSOLVE OXYGEN METER	TS : T-TYPE STRAINER
CM : CONDUCTIVITY METER	YS : Y-TYPE STRAINER
M : MOTOR	
HRS : HEAT REJECTION SYSTEM	
T : TURBINE TYPE FLOW METER	
FC : FLOW CONTROLLER	
LC : LEVEL CONTROLLER	
PC : PRESSURE CONTROLLER	
LP : LOW PRESURE	
PZ : PRESSURIZER	
NC : Normally Closed	

Sheet Title: Chiller, Chiller water tank, Chilled water Pump & PHEs

Drawing Title: Piping & Instrumentation Diagram For HRS Loop

IPR	Pre'd By:
Status	Rev'd By:
Draft	App'd By:
Sheet: 1/1 NTS	Ref. Drawing : IPR-HRS-PID
Dwg. No.	IPR-HRS-PID
Rev No.	1.4

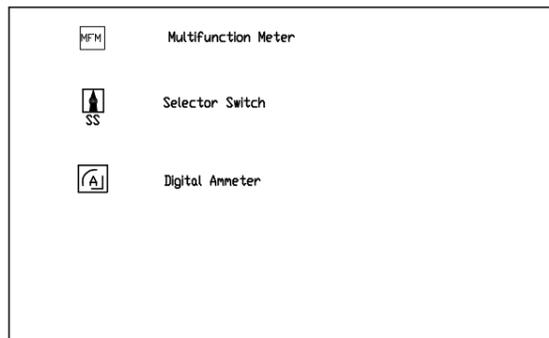
Proposed Electrical SLD for CWS for new laboratories



TO PAGE 2

NOTE:

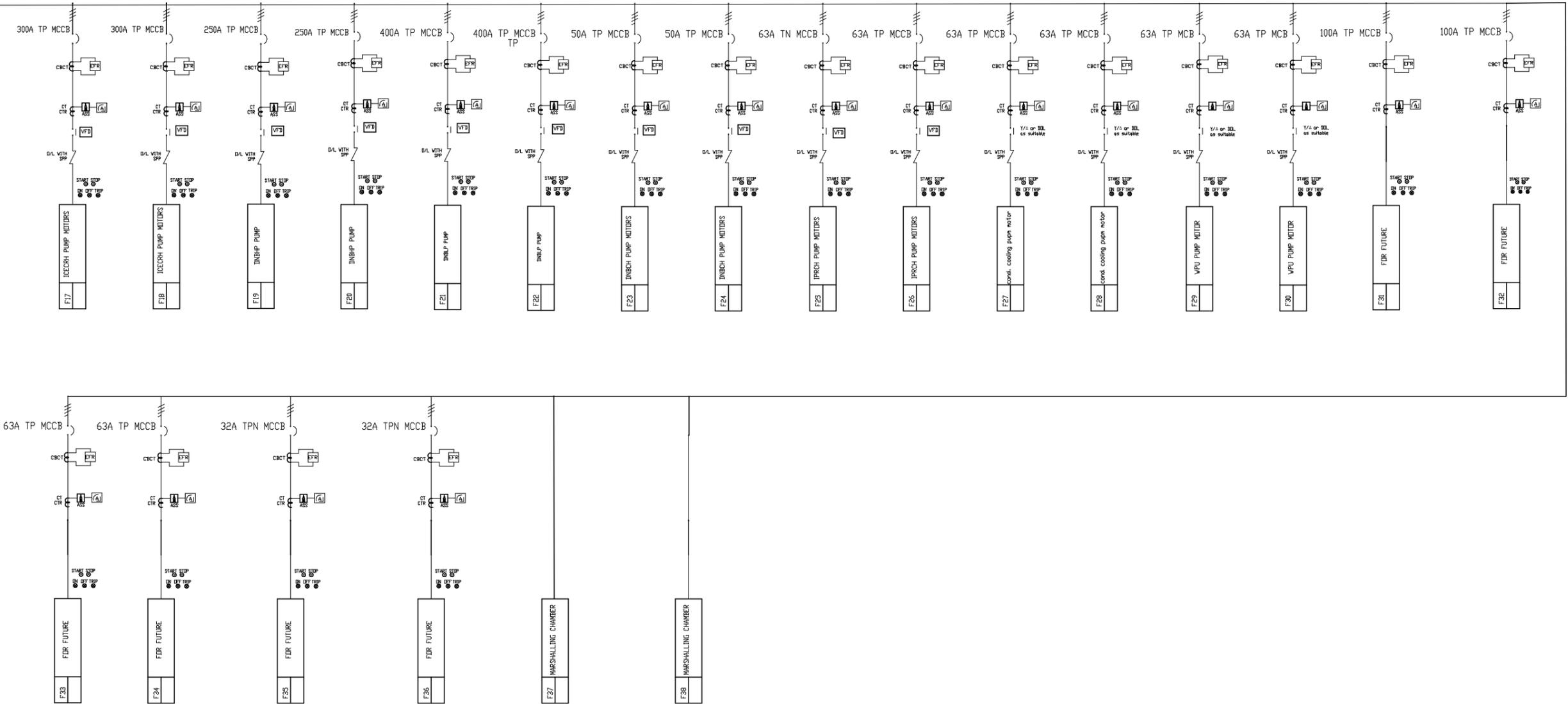
- A) This drawing is proposed as per system requirement. Refer tender specifications and BOQ for more detail.
- B) The basic enclosure shall be fabricated from Cold rolled sheet steel material, of thickness not less than 2 mm in all sides. For all the load bearing application sheet steel thickness shall not be less than 2 mm. Doors and covers shall be made of cold rolled sheet steel of thickness not less than 1.6mm. Stiffeners shall be provided wherever required. The panel frames shall be fabricated using cold rolled sheet steel of thickness not less than 2.5 mm.
- C) Control wiring shall be done using 650 V grade PVC standard wire 1.5 sq.mm for control and 2.5 sq.mm for CT circuit. Internal power wiring of panel shall be done with minimum 2.5 sq.mm Cu wire 1100 V grade.
- D) Bus bars shall be of Electrolytic Copper material. The bus bars should have rectangular section. The current density shall not exceed 1.2 A/sq.mm while calculating the size of the bus bars.
- E) A copper earth bus of size not less than 35 x 6 mm² continuously runs at the top / bottom of the panel shall be provided.
- F) Suitable Cu terminals shall be provided for termination of incoming cable to ACB.



ASS'Y GROUP: IIIS.		ITER-INDIA INSTITUTE FOR PLASMA RESEARCH BHAT, GANDHINAGAR-382 428.	
ALL DIMENSIONS ARE IN 'MM' UNLESS OTHERWISE STATED			TITLE: ELECTRICAL SINGLE LINE DIAGRAM FOR CWS
SCALE			
DRAWN	MGC		
DESIGN		REF DRG NO: ITER-INDIA/CWS/ELE/01	REV:00
APPROVED		DRG.NO: ITER-INDIA/CWS/ELE/01	SHEET 1 OF 2

Proposed Electrical SLD for CWS for new laboratories

FROM PAGE-1 CONTINUE



- NOTE:**
- A) This drawing is proposed as per system requirement. Refer tender specifications and BOQ for more detail.
 - B) The basic enclosure shall be fabricated from Cold rolled sheet steel material, of thickness not less than 2 mm in all sides. For all the load bearing application sheet steel thickness shall not be less than 2 mm. Doors and covers shall be made of cold rolled sheet steel of thickness not less than 1.6mm. Stiffeners shall be provided wherever required. The panel frames shall be fabricated using cold rolled sheet steel of thickness not less than 2.5 mm.
 - C) Control wiring shall be done using 650 V grade PVC standard wire 1.5 sq.mm for control and 2.5 sq.mm for CT circuit. Internal power wiring of panel shall be done with minimum 2.5 sq.mm Cu wire 1100 V grade.
 - D) Bus bars shall be of Electrolytic Copper material. The bus bars should have rectangular section. The current density shall not exceed 1.2 A/sq.mm while calculating the size of the bus bars.
 - E) A copper earth bus of size not less than 35 x 6 mm² continuously runs at the top / bottom of the panel shall be provided.
 - F) Suitable Cu terminals shall be provided for termination of incoming cable to ACB.

	Multifunction Meter
	Selector Switch
	Digital Ammeter

ASS'Y GROUP: IIIS.		ITER-INDIA	
ALL DIMENSIONS ARE IN 'MM' UNLESS OTHERWISE STATED		INSTITUTE FOR PLASMA RESEARCH	
		BHAT, GANDHINAGAR-382 428.	
SCALE			TITLE:
DRAWN	MGC		ELECTRICAL SINGLE LINE DIAGRAM FOR CWS
DESIGN		REF DRG NO:	ITER-INDIA/CWS/ELE/01
APPROVED		DRG.NO	ITER-INDIA/CWS/ELE/01
			REV:00
			SHEET 2 OF 2

Institute for Plasma Research
(An Autonomous Institute of Dept. of Atomic Energy)
Bhat, Gandhinagar

TERMS & CONDITIONS

ITEM DESCRIPTION	Design, Supply, Fabrication, Installation, Testing, and Commissioning of Cooling Water System for New Laboratories at IPR campus, Ahmedabad as per the specifications mentioned in the tender documents	
Sl. No.	PARTICULARS	REMARKS
I	Name of the Supplier	
II	IPR Equity NO & Date	IPR/TN/PUR/TPT/ET/20-21/1 DATED 1-6-2020
III	Vendor Offer No & Date	
IV	Postal address	
V	Contact with STD code	
VI	Fax with STD code	
VII	Name of Contact person	
VIII	Mobile No.	
IX	e-mail ID	
X	Currency of offer/quotation	
	SCANNED COPY OF THE BELOW MENTIONED DOCUMENTS NEED TO UPLOAD AT www.tenderwizard.com/DAE AT THE TIME OF PARTICIPATION OF TENDER WITHIN THE PERIOD OF SUBMISSION.	
1	Certificates:	
	i) Registration Certificate if Any, with DGS&D/NSIC/MSME	
	ii) PAN (Permanent Account Number) Registration	
	iii) Certificates of Registration for Sales Tax/ VAT/ WCT or Service Tax	
	iv) Authorization certificate/ Agency Agreement from Manufacturer (if not manufacturer)	
	Commercial Terms for Quoted items (Please Provide Commercial terms and conditions in the below form)	
2	Price Shall be firm and fixed through out the currency of contract, in the event of placement of purchase order.	
3	Please select the CURRENCY OF OFFER / QUOTATION first	
4	Goods and Services Tax: Have you specified HSN / SAC Code for Goods and Services Tax in Price Bid? Goods and Service Tax for Supply Items only: In the event of issuance of GST Concessional Certificate as per Ministry of Finance Notification No. 47/2017 Integrated Tax (Rate) dated 14/11/17 (for IGST) and (CGST @ 2.5% and SGST @ 2.5%) as per Notification No. 45/2017-Central Tax (Rate) dated 14/11/17 and Notification No. 45/2017-State Tax (Rate) dated 15/11/17 you will charge GST @5% only	
5	Delivery period (as per Sr. No.31 of Section-A of Form No. IPR_LP_ET_02.V5 (Terms and Conditions) attached with the tender/enquiry). (Also refer document named "Deferred_terms_IPR_LP_ET_02.V5" for amended delivery terms)	
6	Installation and commissioning charges : Have you offered Installation & Commissioning Charges? (if applicable)	
7	Liquidated Damages:- as per Sr. No. 22 of Section B of Form No IPR-LP-ET-02.V5 (Terms and Conditions) attached with the tender/enquiry	
8	Terms of Payment:- as per Sr. No.35 of Section B of Form No. IPR_LP_ET_02.V5 (Terms and Conditions) attached with the tender/enquiry. (Also refer document named "Deferred_terms_IPR_LP_ET_02.V5" for amended payment terms)	
9	Guaranty / Warranty:-as per Sr. No. 34 of Section B of Form No. IPR_LP_ET_02.V5 (Terms and Conditions) attached with the tender/enquiry	
10	Validity of offer/quotation:- 120 days from the date of opening of tender (Part-I)	
	QUESTIONNAIRE TO BE FILLED BY BIDDER IN AND SENT ALONG WITH OFFER DULY SIGNED	

11	In the event of a purchase order/contract vendor has to provide Security Deposit in the form of Bank Guarantee for 10% of contract/ order value from SBI/nationalized banks or any one of the scheduled banks mentioned in the bracket (Axis Bank, HDFC Bank, ICICI Bank and IDBI Bank) valid till final acceptance of the supplied goods at IPR, wherever applicable shall be submitted .	
12	In the event of a purchase order/contract Performance Bank Gurantee for 10% of the contract/order value from SBI/nationalized banks or any one of the scheduled banks mentioned in the bracket (Axis Bank, HDFC Bank, ICICI Bank and IDBI Bank) valid throughout the guarantee period, wherever applicable shall be submitted.	
13	I/We hereby offer to supply the stores detailed in the schedule hereto at the price given in the said schedule and agree to hold this offer open till expiry of quotation. I/We shall be bound to supply the stores hereby offered upon issue of purchase order communicating the acceptance thereof on or before the expiry of the last mentioned date. You will be at liberty to accept any one or more of the items of stores tendered for or portion of any or more of the items of such stores and I/We notwithstanding that the offer in the tender has not been accepted in whole shall be bound to supply to you- such item or items and such portion or portions of one or more of the items as may be specified in the said Purchase Order communicating the acceptance.	
14	I/we have understood the General Conditions of all Contracts and special conditions of contract governing supplies of plant and machinery in the Form No.IPR_LP_ET_ 02.V5, included in the General Conditions of all Contracts and special conditions of contract governing of plant and machinery applicable to contracts placed by the Institute for Plasma Research and the instructions to Tenderer annexed to the invitation to tender Form and have thoroughly examined the specification / drawing and / or pattern quoted or referred to in the Schedule hereto and am/are fully aware of the nature of the stores required any my/our offer is to supply stores strictly in accordance with subject tender to the terms and conditions stipulated in your above Form No. IPR_LP_ET_ 02.V5 and also contained in the Purchase Order Communicating acceptance of this Tender.	
15	Whether All Documents Related to tender Viewed?	
16	Vendor should upload the complete technical details (Tehnical specifications with product data sheet	
17	In case of two part tender whether unpriced quotation has been uploaded (Failing which offer will not be considered for technical evaluation)	
18	Free Issue Material: Successful tenderer will have to arrange insurance showing beneficiary as "Institute for Plasma Research" at their risk and cost towards adequate security for the materials/property provided/issued by the Purchaser as Free Issue Material for the due execution of the contract, wherever applicable.	

Institute for Plasma Research
(An Autonomous Institute of Dept. of Atomic Energy)
Bhat, Gandhinagar

Eligibility Criteria (Annexure-A)

ITEM DESC RIPTI ON	Design, Supply, Fabrication, Installation, Testing, and Commissioning of Cooling Water System for New Laboratories at IPR campus, Ahmedabad as per the specifications mentioned in the tender documents		
Sl. No.	PARTICULARS	REMARKS	
I	Name of the Vendor		
II	IPR Enquiry NO & Date	IPR/TN/PUR/TPT/ET/20-21/1 DATED 1-6-2020	
III	Vendor Offer No & Date		
Sr. No.	Criteria	Documents required to upload	Status of Documents (Uploaded/ Not-Uploaded in e-Tender Portal)
1	Should have minimum average annual turnover of Rs. 15 crores (Fifteen Crores) during the last Three years ending 31st March, 2019 i.e. FY2016-2017, FY 2017-2018 and FY 2018-2019. The bidder should not have incurred any loss in more than one year during the last three financial years i.e. FY16-17, FY17- 18 and FY 18-19	Bidder should submit Audited balance sheet and Profit & Loss Account for the past 3 financial years (i.e. 2016-17 to 2018-19) as a proof	
2	Minimum value of similar* project completed within the last five years shall be as per following on or before 31st March, 2019. I. At least one project with minimum value of Rs. 11.00 crores OR II. At least two projects with minimum value of Rs. 9.00 crores each OR III. At least three projects with minimum value of Rs.6.00 crores each *Similar project- refer serial -3	Copy of Purchase orders with technical details and completion certificate duly certified by the Engineer-in-Charge or Consultant/Architect should be submitted as proof	
3	Should have satisfactorily completed SITC (Supply, Installation, Testing and Commissioning) project consisting of Water-cooled chiller of minimum 100 TR capacity with pump, and heat exchanger in last five years from the date of tender publication. AND/OR Should have satisfactorily completed SITC (Supply, Installation, Testing and Commissioning) project consisting of Cooling Tower of minimum 4 MW cooling capacity with pump, Heat exchanger in last five years from the date of tender publication	Copy of Purchase orders with technical details and completion certificate duly certified by the Engineer-in-Charge or Consultant/Architect should be submitted as proof	

Note-1:	
1	The bidder shall be single entity. The bidder, who fulfills the following requirements on their own (i.e. Works carried under joint ventures/ consortium shall not be considered), shall only be eligible to apply
2	Bids meeting the mandatory Eligibility Qualification Criteria (EQC) as mentioned in table 1 shall only be considered as "eligible bids" and will be shortlisted for further evaluation.
3	Relevant documents shall be submitted as an evidence of fulfilment of eligibility qualification criteria. However, meeting the eligibility criteria in itself does not automatically qualify through the technical bid evaluation process.
4	Bidders who meet the EQC mentioned under Sr.No.1 to 3 above are invited to submit their offer along with requisite documents

Note-2:	
a	The response to tender without submission of proof of above points will summarily be rejected without further communication
b	The bidder shall not be under a declaration of ineligibility for corrupt or fraudulent practices or blacklisted with any of the Government agencies
c	Original documents shall be produced for verifications, if required

PRICE SCHEDULE (SECTION-D)

IPR Enquiry NO & Date : **IPR/TN/PUR/TPT/ET/20-21/1 DATED 1-6-2020**

From

NAME OF THE CONTRACTOR :
Offer no & date:

Sl.No	Item Description	Tendered Quantity	Unit of Measurement (UOM)	Rate in INR For Supply					Rate in INR For Installation, testing & Commissioning					Remarks
				HSN Code (*1)	Basic Unit Rate	Discount (in amount)	Basic Unit rate after discount	GST rate	SAC Code (*1)	Basic Unit Rate	Discount (in amount)	Basic Unit rate after discount	GST rate	
1	COOLING TOWER Supply, installation, testing and commissioning of FRP Induced draft, counter-flow, multicell type cooling tower complete with FRP basin, supports, propeller fans, fills, eliminators, HDPE / suitable sump distribution system, induction motor, drain, make up, float valve, quick fill, equalizer connection and vibration isolation etc. as per detailed technical specification forming part of tender. Tower selection: On following design conditions: • WBT: 28.7 Deg C. • Water temperature range of 12 (44-32) Deg C. • Water flow rate: ~305kg/s	1	Nos.				0.00					0.00		
2	SCREW CHILLERS (WATER COOLED) Supply, Factory testing, installation, testing and commissioning of Screw chiller unit of 300 TR actual Refrigeration capacity. Each machine complete with Semi – hermetic type Screw compressor, Factory fitted unit mounted motor with VFD Starters microprocessor based control panel along with required hardware & software for integration with a 3rd party BMS (Open protocol), water cooled condenser, insulated evaporator, integral refrigerant piping, first charge of refrigerant, incomer switchgear with terminations box suitable for terminations of bus duct/Cable , earth terminations etc. all mounted on a steel frame, wiring with all accessories with necessary instruments and controls, including vibration isolation, differential pressure switches, etc. suitable for design conditions mentioned in the tender documents 1.IPLV (IKw/TR) value: ≤ 0.56 2.COP: ≥ 5.5 3.Refrigerant: Non-CFC, R-134a 4.Evaporator / Chiller. a)Chilled water entering Temp.: ≥ 19 °C b)Chilled water leaving Temp.: ≤14 °C 5.Condenser: a)Condenser water entering Temp.: ≥ 32 °C	2	Nos.				0.00					0.00		

3	<p>CENTRIFUGAL PUMPS FOR WATER CIRCULATION</p> <p>Supply, installation, testing and commissioning of centrifugal pump with mechanical seal, impeller, motor, Variable Frequency Drive (applicable only to primary cooling loop pump-motors) base frame for pump & motor, coupling, coupling guard, vibration isolators and TEFC induction motor for water circulation in the cooling loop as per detailed technical specification forming part of the tender. The various cooling loops pumps are listed as under:</p> <p>NOTE: - All pumps of Primary cooling loops namely, ICECRH, DNBHP, DNBLP, DNBCH, IPRCH shall be equipped with Variable Frequency Drive (VFD) suitable to respective pump set.</p>												
3.1	<p>CHILLER WATER PUMP SETS</p> <p>For circulation of chilled water for screw chillers as per detailed technical specification forming part of tender.</p> <p>a. Differential Head:40 MWC b. Water flow rate:52kg/sec c. Pump type: Back Pull Out (BPO) d. Motor kW (Minimum): 45 Pump set as described above: (1W+1S)</p>	2	Nos.					0.00					0.00
3.2	<p>CONDENSER WATER PUMP SETS</p> <p>For circulation of condenser water for screw chillers as per detailed technical specification forming part of tender.</p> <p>a. Differential Head: 40 MWC b. Water flow rate:56kg/sec c. Pump type: Back Pull Out (BPO) d. Motor kW (Minimum): 45 Pump set as described above: (1W+1S)</p>	2	Nos.					0.00					0.00
3.3	<p>COOLING TOWER PUMP SETS</p> <p>For circulation of Cooling Tower water to secondary side of client's PHE, as per detailed technical specification forming part of tender.</p> <p>a. Differential Head: 40 MWC b. Water flow rate:94kg/sec c. Pump type: Back Pull Out (BPO) d. Motor kW (Minimum):75 Pump set as described above: (3W+1S)</p>	4	Nos.					0.00					0.00
3.4	<p>ICECRH-PRIMARY COOLING PUMP SETS</p> <p>For circulation of cooling water on primary side of PHE, as per detailed technical specification forming part of tender.</p> <p>a. Differential Head: 90 MWC b. Water flow rate:120kg/sec c. Pump type: Back Pull Out (BPO) d. Motor kW (Minimum): 150 e. With suitable Variable Frequency Drive (VFD) Pump set as described above: (1W+1S)</p>	2	Nos.					0.00					0.00

3.5	DNBHP- PRIMARY COOLING PUMP SETS For circulation of cooling water on primary side of PHE, as per detailed technical specification forming part of tender. a. Differential Head: 240 MWC b. Water flow rate:31 kg/sec c. Pump type: HSC/Vertical in Line d. Motor kW (Minimum): 125 e. With suitable Variable Frequency Drive (VFD) Pump set as described above: (1W+1S)	2	Nos.																
3.6	DNBLP- PRIMARY COOLING PUMP SETS For circulation of cooling water on primary side of PHE, as per detailed technical specification forming part of tender. a. Differential Head: 150 MWC b. Water flow rate:66 kg/sec c. Pump type: HSC/Vertical in Line d. Motor kW (Minimum): 200 e. With suitable Variable Frequency Drive (VFD) Pump set as described above: (1W+1S)	2	Nos.																
3.7	DNBCH- PRIMARY COOLING PUMP SETS For circulation of cooling water on primary side of PHE, as per detailed technical specification forming part of tender. a. Differential Head: 70 MWC b. Water flow rate:10kg/sec c. Pump type: Back Pull Out (BPO) d. Motor kW (Minimum): 22 e. With suitable Variable Frequency Drive (VFD) Pump set as described above: (1W+1S)	2	Nos.																
3.8	IPRCH- PRIMARY COOLING PUMP SETS For circulation of cooling water on primary side of PHE, as per detailed technical specification forming part of tender. a. Differential Head: 70 MWC b. Water flow rate:25kg/sec c. Pump type: Back Pull Out (BPO) d. Motor kW (Minimum): 30 e. With suitable Variable Frequency Drive (VFD) Pump set as described above: (1W+1S)	2	Nos.																
3.9	DRAIN PUMPSET Supply, installation, testing and commissioning of self-priming, non-clogging Monobloc / submersible type Drain /Sump pump with foot valve suitable for 1Ø, 230±10%V, 50Hz, AC supply, factory mounted on MS base plate, suction & discharge valve, NRV, level switch / level sensor with cable (for pump auto start) and other accessories as per detailed technical specification forming part of tender a. Differential Head: 15 MWC b. Water flow rate:2kg/sec c. Motor kW (Minimum):1.5 Pump set as described above: (1W+1S)	2	Nos.																
4	PLATE TYPE HEAT EXCHNAGER Supply, installation, testing and commissioning of Plate type heat exchanger as per detailed technical specification forming part of tender for following primary cooling loops:																		
4.1	ICECRH-Loop, 9.0 MW Capacity	1	Nos.																

(This need to be printed in Tenderer's letter head)

To
The Purchase Officer
Institute for Plasma Research
Near Indira Bridge
Bhat
Gandhinagar-382428 (INDIA)

Ref: Tender Notice No.IPR/TN/PUR/TPT/ET/20-21/1 dated 1-6-2020

Dear Sir,

I/We have gone through the tendering conditions pertaining to the Two Part Tender and General Conditions of Contracts and Special Conditions of Contracts contained in Section "B" of Form No: IPR-LP-ET-02.V5. I/We hereby agree to supply the stores conforming to the tender specifications and also agree to abide by your General Conditions of all Contracts and Special Conditions of Contract contained in Section "B" of the Tender document.

- You will be at liberty to accept any one or more of the items of stores offered by us and I/We shall be bound to supply you the stores as may be specified in the Purchase Order/Contract.
- I/We hereby agree to keep the price valid for your acceptance for a period of 120 days from the date of opening of the tender (Part-I).
- Deviations to technical specifications of the tender documents are detailed in Annexure-A of the tender form while deviations proposed to the General/Special Conditions of Contract are detailed in Annexure "B" to this tender.
- I/We are also uploaded all the leaflets/catalogue, etc. pertaining to the stores offered.

Yours faithfully
Stamp and Signature of the Tenderer