REQUEST FOR PROPOSAL (RFP)

for

DESIGN, PROCUREMENTOF MATERIALS AND SUB-SYSTEMS, MANUFACTURE, INSPECTION &TESTING AT VENDOR'S SITE, TRANSPORTATION, ERECTION, ON-SITE TESTING AND COMMISSIONING OF HOT AIR AUTOCLAVE PLANT AT U2 SMPC, SDSC-SHAR

September-2024

Satish Dhawan Space Centre SHAR
Indian Space Research Organization
Government of India
Sriharikota -524 124, AP

ACRONYMS

ISRO	**:**	**Indian Space Research Organization**
SDSC	**:**	**Satish Dhawan Space Centre**
CISF	**:**	**Central Industrial Security Force**
HIL	**:**	**Hardware Preparation & Insulation Lining Facility**
HF	**:**	**High Frequency**
LC	**:**	**Letter of Credit**
CCTV	**:**	**Close Circuit Television**
GA (drawing)	**:**	**General Arrangement (drawing)**
SS	**:**	**Stainless Steel**
IP	**:**	**Ingress Protection**
UPS	**:**	**Uninterrupted Power Supply**
ECS	**:**	**Electronic Clearance System**
RFP	**:**	**Request for Proposal**
GOI	**:**	**Government of India**
LOI	**:**	**Letter of Intent**
PO	**:**	**Purchase Order**
QAP	**:**	**Quality Assurance Plan**
TPI	**:**	**Third-Party inspection**

INDEX

PROPOSAL DOCUMENT

Proposals are invited from the interested Bidders for the enclosed scope of work as two-part bid.

Part-1: Technical and Unpriced part of the work

and

Part-2: Priced Commercial bid.

The RFP document is organized in four Sections as follows.

Section–A General Terms and Conditions of the Contract
Section–B Scope of Work
Section–C Technical Specifications
Section–D Annexure

Title of the Entity: HIL, U2 SMPC, SDSC SHAR / SRIHARIKOTA

Title of Proposal: Proposal for 'Design, Supply of Materials, Manufacture, Inspection & Testing at Vendor's Site, Transportation, Erection, On-Site Testing and Commissioning of Hot Air Autoclave Plant at HIL, U2 SMPC, SDSC-SHAR', as per the specifications, terms and conditions given in the document.

End Use: Hot Air Autoclave Plant is used to carryout vulcanization of insulation lined solid rocket motor hardware of Launch Vehicles.

1.	**0.**	**0.**	**PROPOSAL DOCUMENT**
1.	**0.**	**1.**	Overall specifications and functional requirements are detailed in the proposal document. Bidder shall sign and stamp each page of 'Original' in token of his acceptance.
1.	**0.**	**2.**	The proposal shall be completely filled in all respects and shall be tendered together with requisite information and Annexure. Any tender incomplete in any particulars shall be liable for rejection.
1.	**0.**	**3.**	If space in the proposal or any schedule or Annexure thereto, is insufficient, pages shall be separately added. These shall be consecutively page-numbered, also shall carry the proposal document number, shall be signed by the bidder and entered in the index for the proposal.
1.	**0.**	**4.**	Bidders shall submit their quotations in firm figures without variations or additions in the terms of the proposal documents. Proposals containing qualifying expressions such as 'subject to minimum acceptance' or 'subject to prior sale', or any other qualifying expressions or incorporating terms and conditions at variance with the terms and conditions incorporated in the proposal documents shall be liable for rejection.
1.	**1.**	**0.**	**Clarification requests by bidder**
1.	**1.**	**1.**	Although, details presented in the proposal document i.e., conditions of contract, scope of work and technical specifications have been compiled with all reasonable care, it is the bidder's responsibility to ensure that the information provided is adequate and clearly understood.
1.	**1.**	**2.**	Bidder shall examine the proposal document thoroughly in all respects and if any conflict, discrepancy, error or omission is observed, bidder may request clarification and submit the bid within the scheduled time. Such clarification requests shall be directed to Sr. Head, Purchase & Stores, SDSC SHAR, Sriharikota, in his mail **hps@shar.gov.in/manas@shar.gov.in/ satyach@shar.gov.in.**

1.	**1.**	**3.**	Any failure by bidder to comply with the aforesaid requirement shall not excuse the bidder, after subsequent award of contract, from performing the work in accordance with the agreement.
1.	**2.**	**0.**	**Corrigendum of Proposal Document**
1.	**2.**	**1.**	Department may, for any reason whether at its own initiative or in response to the clarification requested by the prospective bidder, issue amendment in the form of addendum/corrigendum during the bid period and subsequent to receiving the bids. Any addendum/ corrigendum thus issued shall become part of proposal document and bidder shall scan and upload as addendum / corrigendum duly signed and stamped in token of his acceptance.
1.	**2.**	**2.**	For addendum / corrigendum issued during the bid period, bidder shall consider the impact in his bid. For addendum / corrigendum issued subsequent to receiving the bids, bidder shall follow the instructions issued along with addendum / corrigendum.
2.	**0.**	**0.**	**PREPARATION OF BIDS**
2.	**1.**	**0.**	**Site Visit**
			The Bidder may visit SDSC SHAR and acquaint himself fully with the requirements and no claims whatsoever will be entertained on the plea of ignorance of difficulties in the execution of the work. Before submitting the tender, the Bidder shall be deemed to have clearly understood and satisfied himself regarding the work and services, all conditions liable to be encountered during the execution thereof and that prices quoted in the offer are adequate and all-inclusive with respect to all factors, circumstances and conditions likely to be incidental, both direct and indirect, to the work and services. If the bidder wishes to see the site, the bidder may do so within 15 days from the date of issue of tender enquiry.
2.	**2.**	**0.**	**Validity of offer**
			Bid shall remain valid for acceptance for a period of 180 days from the due date of opening of the bid. The bidder shall not be entitled during the said period to revoke or cancel his bid or to vary the bid except and to the extent required by Department. Bid shall be validated for extended period as required by Department. In such cases, unless otherwise specified, it is understood that validity is sought and provided without varying either the quoted price or any other terms and conditions of bid finalized till that time.
2.	**3.**	**0.**	**Cost of bidding**
			All direct and indirect costs associated with the preparation and submission of bid (including clarification meetings and site visit, if any), shall be to bidder's account and the Department will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bid process.
2.	**4.**	**0.**	**Applicable language**
			The bid and all correspondence incidentals to and concerning the bid shall be in English language. For supporting document and printing literature submitted in any other language, an accurate English translation shall also be submitted. Responsibility for correctness in translation shall lie with the bidder.

2.	**5.**	**0.**	**Arrangement of bid**
2.	**5.**	**1.**	The bid shall be neatly presented on white paper with consecutively numbered pages. It should not contain any terms and conditions which are not applicable to the bid. The bid and all details submitted by the bidder shall be signed and stamped on each page as token of acceptance by a legally authorized person, to enter into agreement on behalf of the bidder. Corrections / alteration, if any, shall also be signed by the same person. Bidder shall submit Power of Attorney in favor of the person who signs the bid and subsequent submissions on behalf of the bidder.
2.	**5.**	**2.**	Department will not be bound by any Power of Attorney granted by the bidder or changes in the constitution of the firm made subsequent to submission of the bid or after the award of the contract. Department may, however, recognize such Power of Attorney and changes after obtaining proper legal advice, the cost of which will be borne by the bidder.
2.	**5.**	**3.**	The cancellation of any document such as Power of Attorney, Partnership deed etc. should be communicated by the bidder to the Department in writing well in advance; failing which Department shall have no responsibility or liability for any action taken by bidder on the strength of the said documents.
2.	**5.**	**4.**	Should the bidder have a relative or relatives or in the case of firm or company, one or more of its shareholders or a relative or relatives of the shareholder (s) employed in a senior capacity in Department's organization, the authority inviting bids shall be informed of the fact at the time of submission of the bid, failing which the bid may be disqualified or, if such fact subsequently comes to light, Department reserves the right to take any action as it deems fit in accordance with any applicable law, rules and regulations of the like in force for the time being.
2.	**6.**	**0.**	**Compliance to proposal requirement**
			Department expects bidder’s compliance to requirement of proposal document without any deviation. Deviation on clauses, if felt absolutely necessary should be furnished in the Techno commercial part (and not in proposal document or Price part) as per the format in Section-D/Annexure-II. Department shall not take cognizance of any deviation stipulated elsewhere in the bid. Any willful attempt by the bidders to camouflage the deviations by giving them in the covering letter or in any other documents that are enclosed may render the bid itself as non-responsive. Department reserves the right to evaluate the offers containing deviations with financial implications after adding cost for such deviations as determined by Department.
2.	**7.**	**0.**	**Documents comprising the bid**
2.	**7.**	**1.**	This is e-procurement tender. All the documents need to be scanned and attached to the bid under “documents solicited from Vendor” form within due date.
2.	**7.**	**2.**	Bidder may note that Department intends to fully evaluate the technical and unpriced commercial submissions. It is important that bidder clearly demonstrates his experience and capability, giving to Department a high level of confidence that if awarded, the bidder will be able to perform the works

			within the stipulated time schedule and quoted price and meeting all other requirements listed in the proposal document.
2.	**7.**	**3.**	Bidder should furnish the complete and correct information required for evaluation of his bid. If the information with regard to resources or any other information / documentation forming basis of evaluation is found incomplete / incorrect, the same will be considered as adequate ground for rejection of the bid.
2.	**8.**	**0.**	**Schedule of price**
2.	**8.**	**1.**	The schedule of prices shall be read in conjunction with all the Sections of proposal document.
2.	**8.**	**2.**	The payment schedule shall be the basis of releasing milestone payments on pro-rata basis as applicable.
2.	**8.**	**3.**	The vendor has to provide cost details for the proposal as per **Section-D/Annexure- I**
2.	**8.**	**4.**	The quoted price shall include all costs of i. 'Design, Supply of Materials, Manufacture, Inspection & Testing at Vendor's Site, Transportation, Installation, On-Site Testing and Commissioning of Hot Air Autoclave Plant at U2 SMPC, SDSC-SHAR' as per specifications, terms & conditions given in the document. ii. Factory Acceptance Testing, packing, forwarding, transportation to purchaser's site, unloading, storage, all risk coverage, erection, installation, training, testing & evaluation and commissioning of equipment and minor civil works specific for the foundation, any other cost for proper and complete execution of the CONTRACT.
2.	**8.**	**5.**	Price shall be firm & fixed during the entire contract period. The price shall be filled in the format available in e-procurement portal. The bidder shall also fill up the format enclosed (Section-D/Annexure-I) without price figures and shall confirm by filling the appropriate fields as "QUOTED".
2.	**8.**	**6.**	The rate quoted shall be on the basis of F.O.R SDSC SHAR, Sriharikota.
2.	**8.**	**7.**	All rates of taxes/duties/levies applicable with details of percentage and applicable portion of the price should be spelt out clearly in the offer.
2.	**8.**	**8.**	The taxes as applicable for supply, erection, testing & commissioning shall be indicated separately in terms of percentage in the price bid. If the offers submitted by the bidders are silent on taxes, it will be presumed that quoted rates are inclusive of taxes & duties and no claim in this regard will be entertained later.
2.	**8.**	**9.**	The variation in the GST or applicable statutory taxes shall be paid on documentary evidence submitted by the bidder during this contract.
2.	**9.**	**0.**	**Online bids shall consist of the following:**
2.	**9.**	**1.**	**Part-1: Technical and unpriced commercial part**
			All the documents shall be scanned and uploaded in the ISRO e-procurement portal. Technical and unpriced commercial part shall comprise the attachments, specifying attachment number arranged in the order as follows: i. Submission of bid letter along with one set of proposal document duly signed and stamped as token of acceptance.

			ii. Bidder shall submit the compliance to the Section-B: Scope of work & Section-C: Technical specifications as per specified format in the Tender document. iii. Copy of Company's registration certificate. iv. Power of attorney in favour of authorized signatory of the bid / proposal documents. v. All the following Annexures in Section-D in proposal shall be duly filled and submitted with signature and seal. a. Unpriced copy of schedule of prices, Section-D/Annexure-I with all other commercial terms and conditions duly filled (Prices to be kept blank), signed and stamped b. Deviations on clauses in proposal document if any, filled as per Exceptions and Deviations format in Section-D/Annexure-II c. Bidder Qualification Criteria compliance in detail with all supporting documents as per Section-D/Annexure-III. d. Duly filled Bidder evaluation format as in Section-D/Annexure-IV e. Duly filled compliance statement as in Section-D/Annexure-V vi. Organization details: Following organization details shall be submitted a. In case of proprietorship firm, the name and address of proprietor and certified copy of "Certificate of Registration of firm". b. In case bidder is a partnership firm, certified copy of the partnership deed. c. In case of company (whether private or public), certificate copy of the "Certificate of Incorporation" together with certified Memorandum/ Articles of Association. vii. Audited balance sheet including profit and loss account for last three financial years ending with 31st March 2024 along with annual turnover statement of bidder. viii. Valid Income-Tax Clearance Certificate (ITCC) of bidder for last three financial years ending with 31st March 2024. In the absence of valid ITCC, bidder may not be considered for award of work. ix. Organization chart for the proposed work with bio data of key personnel. x. Submission of the following a. General Arrangement Drawing of Hot Air Autoclave Plant with all sub-systems along with Civil structure interface critical dimensions and overall dimensions, Weight of vessel with mountings, Volume of the vessel and useful space in autoclave, overall specifications of all the auxiliary equipment. b. Transportation plan from fabrication & testing unit to erection site of the purchaser. c. Details with scheme for erection like Vessel unloading & positioning on pedestals at purchaser's site, SDSC-SHAR. d. Technical offers and engineering details, if any, required as per proposal document. xi. Validity of offer as per requirement indicated under above stated Clause No.:2.2 of proposal document. xii. Schedule Bar chart and Execution plan of the project proposed.

			xiii. Any other relevant documents bidder desires to submit. **Note:** 1. All the above documents shall be uploaded in the ISRO e-procurement portal. 2. Price shall not be quoted in any of the documents as per Part-I. If indicated, the bid will be considered as invalid.
2.	**9.**	**2.**	**Part-II: Price bid:** Price bid shall contain **"Schedule of Price" marked "PRICE - BID"** duly filled in ISRO e-procurement portal as per price bid format given **Section-D/Annexure-I**. No stipulation, deviation, terms and conditions, presumption basis etc. shall be stipulated in price part of bid. Department shall not take cognizance of any such statement and may at their discretion reject such bids.
3.	**0.**	**1.**	**SUBMISSION OF BID**
3.	**0.**	**2.**	Bid duly filled shall be submitted in the following two parts in e- procurement portal only within stipulated time. **i.** Part -1: Techno-Commercial part of the Bid **ii.** Part-2: Price part of the Bid
3.	**0.**	**3.**	Offers should be submitted online using standard digital signature of Class - 3 with encryption/decryption options.
3.	**0.**	**4.**	The tenders authorized online on or before the open authorization date and time will only be considered as valid tenders.
3.	**0.**	**5.**	Prices shall be mentioned in the space/column provided in the ISRO.
3.	**0.**	**6.**	Department may open Part-I of the bid on the due date of opening at stipulated time. Price Bid (Part-II) of the bid of the technically and commercially acceptable bids shall be opened at a later date. Price-bid of technically and commercially suitable offer only shall be opened.
3.	**0.**	**7.**	Department reserves the right to reject any or all the Bids without assigning any reasons thereof.
3.	**0.**	**8.**	The Price shall be quoted in the on-line price bid in Indian rupees only.
3.	**1.**	**0.**	**Checklist for submission of bid**
3.	**1.**	**1.**	To assist bidder in ensuring the completeness of bid, a checklist for submission of various documents / details in 'Technical and unpriced commercial part of bid' is enclosed in Section-D/Annexure- V: Compliance statement. Bidder shall fill the check list and submit along with his bid for ready reference.
3.	**1.**	**2.**	In case of incomplete submissions, Department will not be under any obligation to give the bidder an opportunity to make good such deficiencies and Department may at its discretion treat such bids as incomplete and not consider for further evaluation.
3.	**2.**	**0.**	**Corrections and alterations**
			All corrections and alterations in the entries of proposal shall be signed in full by the bidder with date. No erasures or overwriting are permissible.
3.	**3.**	**0.**	**Pre-qualification criteria**
3.	**3.**	**1.**	Bidder shall meet the pre-qualification criteria as in Section-D/Annexure-III for submitting the bids.

3.	**3.**	**2.**	Bids received without meeting the pre-qualification criteria will be duly rejected and will not be considered for evaluation. Documentary proof for all the fulfilling pre-qualification criterion along with the filled format in Annexure-III shall be submitted by the Vendor in Part-1: Technical and Unpriced commercial part of the bid.
4.	**0.**	**0.**	**BID OPENING AND EVALUATION**
4.	**0.**	**1.**	The complete scope of work is defined in the tender document. Only those Bidders who undertake total responsibility for the complete scope of work as defined in the tender document will only be considered. Part/Spilt offer is NOT acceptable.
4.	**0.**	**2.**	Purchaser reserves right to visit Bidder's site for verification/validation.
4.	**0.**	**3.**	Performance of Bidder on similar nature of works executed/ under execution shall be taken into consideration before selecting the Bidder for opening his price bid.
4.	**0.**	**4.**	Clarification & additional information: During evaluation, Department may request Bidder for any clarification on the bid/ additional documents/ information required. Bidder shall submit all clarifications/ additional documents/ information requested in original. If not submitted within the stipulated time department has right to reject such bids.
4.	**0.**	**5.**	Department shall not be obliged to furnish any information / clarification to unsuccessful bidder as regard to **non-acceptance** of their bids.
4.	**1.**	**0.**	**General**
4.	**1.**	**1.**	Bid is the responsibility of bidder and no relief or consideration can be given for errors and omissions made by the bidder inadvertently or advertently. Bid with incomplete information is liable for rejection.
4.	**1.**	**2.**	The techno-commercial part of bid shall be evaluated as per bid evaluation criteria, wherever indicated in the proposal document.
4.	**1.**	**3.**	Non-submission of details / documents may lead to rejection of bid.
4.	**1.**	**4.**	The bid of the bidder quoting completion time more than the time schedule specified in the proposal document may not be considered for evaluation.
4.	**1.**	**5.**	In case the bid does not fully comply with the requirement of proposal document and the bidder stipulates / retains exceptions and deviation to the clauses of proposal document considered unacceptable or to any other clause considered unacceptable in the opinion of Department, the bid will be rejected.
4.	**2.**	**0.**	**Evaluation of price bid**
			Priced bids of technically suitable bidders will only be opened and considered for evaluation. Bids shall contain clearly indicated figures.
4.	**3.**	**0.**	**Process to be confidential**
4.	**3.**	**1.**	Information related to the examination, clarification, evaluation and comparison of bids and recommendations not be disclosed to bidder or other person not officially concerned with such process. Any effort by bidder to influence the Department in processing of bid or award decisions may result in rejection of such bidder's offer.
4.	**3.**	**2.**	Advertisements, press release or other specialized publicity documents, which are related to or reveal the existence of a tender and are intended by

			the Bidder for public distribution and/or the press, broadcasting, or television, shall be cleared/approved by the Department.
4.	**3.**	**3.**	Department may direct the Bidder to withhold such publicity or to require modifications to the publicity material. The Bidder shall comply with such direction.
4.	**4.**	**0.**	**Department's right to accept or reject a bid**
			Department reserves the right to accept a bid other than the lowest and to accept or reject any bid in whole or part, to annul the bid process or to reject all bids with or without notice or reasons. Such decisions by Department shall bear no liability whatsoever consequent upon such decisions.
5.	**0.**	**0.**	**DETERMINATION OF RESPONSIVENESS**
			SDSC SHAR will scrutinize the bids to determine whether the bid is substantially responsive to the requirements of the tender document. For the purpose of this clause, a substantially responsive bid is one which inter-alia conforms to all the terms and conditions of the entire Tender document without any deviations and reservations. The decision of Purchaser shall be final in this regard.
6.	**0.**	**0.**	**AWARD OF WORK**
			The bidder, whose bid is accepted by Department shall be issued Purchase Order (PO) from the Director, Satish Dhawan Space Centre, SHAR or his representative, Government of India, Department of Space, to proceed with the work prior to expiry of bid validity.

SECTION-A
GENERAL TERMS AND CONDITIONS OF CONTRACT

1.	**0.**	**0.**	**MAKE IN INDIA CLAUSE**
			For this procurement, bids from Class-I & class-II Local Suppliers are admissible. hence provisions contained in Public Procurement (Preference to Make in India), Order 2017 issued by Department for Promotion of Industry and Internal Trade (DIPP), Ministry of Commerce & Industries vide letter No. P-45021/2/2017-PP(BE-II) dated 04.06.2020 and subsequent amendment & directives shall be followed. Accordingly, offer will be evaluated & processed in conformation with above referred GOI order (Specially mentioned below). The bidder shall provide compliance and undertaking as per order and hereafter amendments:
1.	**1.**	**0.**	Order no: F.No.6/18/2019 PPD dated 23.07.2020 of Department of Expenditure), Ministry of Finance Under Public procurement division for the General Financial rule (GFRs).
1.	**2.**	**0.**	Class-I local supplier means a supplier or service provider, whose goods, service or works offered for procurement, has local content equal to or more than 50%, as defined under Order.
1.	**3.**	**0.**	Class-II local supplier means a supplier or service provider, whose goods, services or works offered for procurement, has local content more than 20% but less than 50%, as defined under this Order.
1.	**4.**	**0.**	**Verification of local content:** i. The Class I local supplier/ Class- II local supplier at the time to tender, bidding or solicitation shall be required to indicate percentage of local content and provide self-certification that the item offered meets the local content requirement for Class-I local supplier / Class II local supplier as the case may be. They shall also give details of the location(s) at which the local value addition is made. ii. In case bid value is in excess of INR 10 Cr., Class-I local supplier / Class-II local supplier shall be required to provide a certificate from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) giving the percentage of local content. iii. False declarations will be in breach of the code of Integrity under Rule 175(1)(i)(h) of the General Financial Rules (GFR) for which a bidder or its successors can be debarred for up to two years as per Rule 151(iii) of the general Financial Rules along with such other actions as may be permissible under Law. iv. A supplier who has been debarred by any procuring entry for violation of this order shall not be eligible for preference under this order for procurement by any other procuring entity for the duration of the debarment.
1.	**5.**	**0.**	The percentage of local content should be specifically mentioned in the offer, without which it will be summarily rejected.
1.	**6.**	**0.**	Preference will be given to Class-I Local supplier and in their absence, Class-II Local supplier will be considered.

2.	**0.**	**0.**	**PAYMENT TERMS**
2.	**1.**	**0.**	In general, our payment terms will be 100% within 60 days after receipt, commissioning and acceptance.
			or
2.	**2.**	**0.**	However, if Vendors/Supplier requests for advance payment, department may consider as given below **<u>On placement of confirmed Purchase Order:</u>** 30% of supply cost of the Purchase order is paid as advance against submission of bank guarantee for an equal amount from a nationalized/scheduled bank and shall be valid till Contract completion period plus 60 days. Format of Bank guarantee shall be obtained from Department after award of contract. **<u>On receipt of items and acceptance at SDSC SHAR, Sriharikota:</u>** a. 50% of supply cost of the Purchase order, on pro-rata basis as defined in the Section-D/Annexure-I: Schedule of Price along with 100% GST on 100% supply cost against receipt and acceptance of materials at Purchaser's site. b. 100% of Transportation Cost of the Purchase order along with applicable GST against receipt and acceptance of all the materials (i.e., full/complete supply) at Purchaser's site. **<u>After erection of items and acceptance at SDSC SHAR, Sriharikota:</u>** 10% of supply cost of the Purchase order is paid against erection of equipment at Purchaser's site. **<u>After commissioning of Hot Air Autoclave Plant at SDSC SHAR, Sriharikota:</u>** After testing, commissioning and acceptance by Department and submission of Performance bank guarantee of equal amount valid till warranty period plus 60 days following payment is done a. Balance 10% of supply cost of the Purchase order b. 100% of erection & commissioning charges of the Purchase order along with applicable GST.
2.	**3.**	**0.**	**Advance Payment:** Wherever advance payment is requested, bank guarantee from any Nationalized Bank/Scheduled Bank should be furnished. In case of advance payments, if the vendor/supplier is not supplying the material within the delivery schedule, the advance amount will be recovered and interest will be levied as per the Marginal Cost of Lending Rate (MCLR) of SBI plus 2% penal interest. Further wherever advance payments are requested, Interest will be loaded for advance payments/stage payments as per the MCLR of SBI and will be added to the landed cost for comparison purpose while arriving at L1. In case of different milestone payments submitted by the parties, a standard and transparent methodology like NPV will be adopted for evaluating the offers.
3.	**0.**	**0.**	**MODE OF PAYMENT**
			Bidders can submit the banker details and Payments can be made through NEFT/RTGS/ECS through PFMS.
4.	**0.**	**0.**	**DELIVERY TERMS**
4.	**1.**	**0.**	The rate quoted shall be on F.O.R SDSC SHAR, Sriharikota basis.

4.	**2.**	**0.**	Vendor is responsible for transportation of equipment to destination and erection, testing& commissioning at site and all the necessary works till the equipment is commissioned and accepted by Purchaser.		
4.	**3.**	**0.**	All risk in transit shall be exclusively borne by the contractor and the purchaser shall pay only for such items that are as actually received in good condition in accordance with the purchase order.		
5.	**0.**	**0.**	**DELIVERY SCHEDULE**		
5.	**1.**	**0.**	Vendor shall follow the following schedule for executing the total contract work. Supply, Installation testing & commissioning shall be completed within 27months from the date of release of Purchase Order.		
5.	**2.**	**0.**	**Delivery Schedule**		
			Mile Stone	**Duration**	**Expected completion**
5.	**2.**	**1.**	Technical Bid submission along with Configuration drawings & specification of Hot Air Autoclave Plant equipment.	T0	T0
5.	**2.**	**2.**	Purchase order placement date	T	T
5.	**2.**	**3.**	Submission of General Assembly Drawings, Configuration Drawings, Foundation Details, Design reports, Details of bought out items along with data sheets, Electrical circuit drawings and P&ID for all the Sub-systems of Hot Air Autoclave Plant.	5 months	T + 05 months
5.	**2.**	**4.**	Review & Clearance of submitted reports & drawings by SDSC SHAR	1 months	T + 06 months
5.	**2.**	**5.**	Readiness of items for pre-delivery inspection at party's site including inspection	15 months	T + 21 months
5.	**2.**	**6.**	Transportation of items to purchasers site	3 months	T + 24 months
5.	**2.**	**7.**	Erection, Testing & Commissioning	3 months	**T+ 27 months**
			Note: Micro schedule along with execution plan and detailed delivery schedule with bar chart shall be submitted by the bidder after placement of order		
6.	**0.**	**0.**	**LIQUIDATED DAMAGES/PENALTY CLAUSE**		
			In the event of the Vendor failing to complete the work within the delivery period specified in the contract agreement or any extension agreed thereto, the Purchaser shall reserve the right to recover from the Vendor as liquidated damages/penalty clause, a sum of **0.5** percentage per week or part thereof of the undelivered portion of the total contract price of equipment or work. The Total liquidated damages shall not exceed the **10.0** percentage of the total Contract price.		
7.	**0.**	**0.**	**TAXES AND DUTIES**		
7.	**1.**	**0.**	**GST:** As per the Notification No. 6/2018-Central Tax (Rate) and Notification No.7/2018-Integrated Tax (Rate) dt:25.01.2018 A(ix) S.No.243A as amended by Notification No.25/2018-Integrated Tax (Rate) Dt: 31.12.2018 b(viii) S.No.243B issued by Ministry of Finance (Dept. of Revenue), SDSC SHAR is		

			eligible to avail IGST @5% for the procurements related to Scientific and technical instruments, apparatus, equipment, accessories, parts, components, spares, tools, mock ups and modules, raw material and consumables required for launch vehicles and satellites and payloads. End User Certificate will be issued for claiming GST@5%. Hence, kindly submit your price quotation accordingly.
7.	**2.**	**0.**	**INCOME TAX** Income tax at the prevailing rate as applicable and if applicable from time to time shall be deducted from the supplier's bills as per Income Tax Act and a certificate issued (TDS Certificate).
8.	**0.**	**0.**	**RISK COVERAGE**
			SDSC SHAR will not pay any insurance taken by the vendor. The Vendor shall include the cost of arranging comprehensive risk coverage at his own cost covering the value of equipment including transportation to the site from manufacturer's works, storage at site, fabrication, erection, testing and commissioning at site. The period of such coverage shall be up to contractual completion period or any extension granted by Purchaser thereof.
9.	**0.**	**0.**	**RISK PURCHASE AND COST PURCHASE**
			Timely delivery of goods/services is of prime importance and where the vendor fails to fulfil their contractual obligations, the Procuring Entity is entitled, and it shall be lawful on his part, to procure Stores and/ or services similar to those ordered/cancelled, with such terms and conditions and in such manner as it deems fit at the RISK and COST of the Contractor and the Contractor shall be liable to the Procuring Entity for the extra expenditure, if any, incurred or accrued by the Procuring Entity for arranging such procurement. However, the Contractor shall not be entitled to benefits if any, from such procurements. Prior to resorting to risk purchase the Purchaser shall consider impact of the default by the contractor, proper notice to the contractor to invoke risk purchase clause and method of recovering the additional amount spent by the Purchaser. The cost as per risk purchase exercise shall be recovered from the Earnest Money Deposit/ Security Deposit/ Performance Security of the supplier and/or bills submitted by the supplier against the same contract or any other contract. GST will be charged / levied on Risk Purchase as per the provision of GST Act Rule thereon. Risk purchase action can be initiated under any of the following conditions. a. When the supplier fails to deliver the materials even after extending the delivery period. b. When the supplier fails to respond to purchases request for supply of the materials and fails to provide any genuine and bonafide reason for the delay in supply. c. When the supplier breaches any of the terms and conditions of the supply order/ contract and as a result fails to execute the order satisfactorily.
10.	**0.**	**0.**	**SECURITY DEPOSIT**
			If Order value exceeds Rs.5 Lakh, Security Deposit shall be submitted for 3% of the order value in single installment through Insurance Surety Bonds/ Account Payee Demand Draft/ Bankers Cheque/ Fixed Deposit Receipts or Bank Guarantee (including e-Bank Guarantee) from any of the commercial banks or payment online in an acceptable form within 10 days after receipt of

			Purchase Order valid till completion of the Delivery period plus 60 days. This security deposit shall not carry any interest and shall be returned to you only after successful completion of delivery of item(s). In case of poor performance/ non-performance of the contractual obligation security deposit shall be forfeited. In case of non-submission of Security deposit within the stipulated period, this order shall be liable to be cancelled.
11.	**0.**	**0.**	**PERFORMANCE BANK GUARANTEE**
			A Bank Guarantee for 3% of the order value shall be provided along with supply towards the performance of the system. PBG may be furnished in the form of Insurance Security Bonds, Account Payee Demand Draft, Fixed Deposit Receipt from a commercial Bank, Bank Guarantee (including e-Bank Guarantee) from a Commercial bank executed on INR 100/- non-judicial stamp paper of appropriate value or online payment in an acceptable form valid till the successful completion of warranty period plus 60 days. This will not carry any interest and shall be returned to you after successful completion of warranty period against your request. In case of non-performance/poor performance the Bank Guarantee shall be forfeited.
12.	**0.**	**0.**	**COMBINED BANK GUARANTEE**
			In case, if Bidder is unable to provide two separate BGs, i.e., one for SD and one for PBG, Bidder can submit a combined BG for SD & PBG for 3% of the Order value valid till the completion of total contractual obligation (i.e. Total Delivery period including Installation & commissioning + Warranty period + 60 days).
13.	**0.**	**0.**	**PACKING AND FORWARDING**
13.	**1.**	**0.**	The Vendor shall arrange to have all the material suitably packed as per the standards & statutes and as specified in the contract. Unless otherwise provided for in the contract, all containers (including packing cases, boxes, tins, drums, and wrappings) used by the Vendor shall be non-returnable.
13.	**2.**	**0.**	All packing and transport charges, transit handling costs, transit risk coverage and transport fees of agents employed at the place of delivery or elsewhere, shall be deemed included in the price to be paid to the Vendor.
14.	**0.**	**0.**	**WARRANTY**
14.	**1.**	**0.**	The vendor shall provide **THIRY-SIX MONTHS warranty** for the entire Hot Air Autoclave plant including all sub-systems for a defect liability, after final official handing over and acceptance. During this period, vendor has to provide and adhere to the following:
14.	**2.**	**0.**	This period shall include maintenance, replacement of defective/failed parts at free of cost. Purchaser will not provide any transport/accommodation for this purpose.
14.	**3.**	**0.**	Upon oral or written notification of defects in or malfunctioning of the goods during the warranty period which require corrective action, Vendor shall send the necessary personnel to job site to supervise and assume responsibility for repairs and/or replacement, if necessary, of the defective goods or material at his own cost. If Vendor does not, within seven (7) days after receipt of notification, take steps to correct the breach, Purchaser may do so at the cost and expense of Vendor. Vendor shall reimburse Purchaser all expenses

			incurred by Purchaser to repair or replace malfunctioning or non-conforming goods.
14.	**4.**	**0.**	Where defect items are replaced by new ones, the full warranty period stipulated in the PO shall apply to such replacement items as from the date of their delivery.
14.	**5.**	**0.**	The vendor shall quote separately for "Non-Comprehensive Annual Maintenance Contract" for a period of 3 years after the completion of warrantee period. SDSC SHAR reserves the right to opt for AMC contract after warranty period.
15.	**0**	**0.**	**GUARANTEE**
15.	**1.**	**0.**	The Bidder shall guarantee that the equipment furnished by him are in conformance with the requirement of the specifications.
15.	**2.**	**0.**	Goods covered by the contract shall be free from defects in design, materials or workmanship for a period of twelve months from the date of successful commissioning & acceptance by Purchaser.
16.	**0.**	**0.**	**DISCLOSURE AND USE OF INFORMATION BY THE VENDOR**
16.	**1.**	**0.**	Vendor shall take all necessary steps to ensure that the requirements of the contract or any specification, plan, drawing, pattern, sample or information supplied by, or on behalf of, the Purchaser in connection therewith shall not be disclosed to any person other than a person employed or engaged by the Vendor, whether under sub-contract or otherwise, for the performance of the contract.
16.	**2.**	**0.**	Bidder shall guarantee that all information and data received during execution of Contract from Purchaser shall be classified as confidential within the meaning of the Official Secrets Act and will not be divulged to any third bidder without prior written permission of Purchaser. All drawings & documents shall be returned after execution of work.
17.	**0.**	**0.**	**ARBITRATION**
			In the event of any dispute/s, difference/s or claim/s arising out of or relating to the interpretation and application of the Contract, such dispute/s or difference/s or claim/s shall be settled amicably by mutual consultations of the good Offices of the respective Parties and recognizing their mutual interests attempt to reach a solution satisfactory to both the parties. If such a resolution is not possible, within 30 days from the date of receipt of written notice of the existence of such dispute/s, then the unresolved dispute/s or difference/s or claim/s shall be referred to the Sole Arbitrator appointed by the Parties by mutual consent in accordance with the rules and procedures of Arbitration and Conciliation Act 1996 as amended from time to time. The arbitration shall be conducted at Sriharikota as per its rules and regulations. The expenses for the Arbitration shall be shared equally or as may be determined by the Arbitrator. The considered and written decision of the Arbitrator shall be final and binding between the Parties. The applicable language for Arbitration shall be "English" only. Work under the Contract shall be continued by the CONTRACTOR during the pendency of arbitration proceedings, without prejudice to a final adjustment in accordance with the decision of the Arbitrator unless otherwise directed in writing by the DEPARTMENT or unless the matter is such that the works

			cannot be possibly continued until the decision (whether final or interim) of the Arbitrator is obtained. In case order is concluded on the Public-Sector Undertakings, the following Arbitration Clause will be applicable: In the event of any dispute(s) or difference(s) relating to the interpretation and application of the provisions of the commercial contracts between ISRO/SDSC SHAR & Central Public Sector Enterprises (CPSEs)/Port Trusts inter se and also between ISRO/SDSC SHAR & CPSEs and Government Departments/Organizations (excluding disputes concerning Railways, Income Tax, Customs & Excise Departments), such dispute(s) or difference(s) shall be taken by either party for resolution through the "Administrative Mechanism for Resolution of CPSEs Disputes (AMRCD)", as mentioned in the Office Memorandum F No. 4(1)/2013-DPE(GM)/FTS-1835 dated 22nd May, 2018 issued by the Director of the Department of Public Enterprises (DPE) under the Ministry of Heavy Industries and Public Enterprises, Government of India
18.	**0.**	**0.**	**IPR**
			Any IPR related issues arising out of infringement by the Vendor shall be totally to his account and SDSC SHAR shall not be held responsible in any manner.
19.	**0.**	**0.**	**APPLICABLE LAW AND JURISDICTION**
			The laws of India shall govern this contract for the time being in force. The Courts of Andhra Pradesh, India only shall have jurisdiction to be with and decide any legal matters or disputes what so ever arising out of the contract.
20.	**0.**	**0.**	**FORCE MAJEURE**
20.	**1.**	**0.**	Force Majeure is an event beyond the control of the bidder and not involving the bidder's fault or negligence and which is not foreseeable. Such events may include, but are not restricted to, acts of the purchaser either in its sovereign or contractual capacity, wars or revolutions, hostility, acts of public enemy, civil commotion, sabotage, fires, floods, explosions, epidemics, quarantine restrictions, strikes, lockouts, and freight embargoes.
20.	**2.**	**0.**	If there is delay in performance or other failures by the bidder to perform its obligation under its contract due to event of a Force Majeure i.e., if a Force Majeure situation arises, the bidder shall promptly notify the purchaser in writing of such conditions and the cause thereof within twenty-one (21) days of occurrence of such event. The Purchaser shall determine, in the light of circumstances reported, whether or not any respite or modification of the delivery requirements of the contract can be permitted on this account.
20.	**3.**	**0.**	Unless otherwise directed by the purchaser in writing, the bidder shall continue to perform its obligations under the contract as far as reasonably practical and shall seek all reasonable alternative means for performance not prevented by the Force Majeure event.
20.	**4.**	**0.**	An extension of the time limit for execution or postponement of delivery shall be granted only in the respect of delay, which is not attributable to the fault or the negligence of the Bidder. An extension of the time limit for execution shall be granted to the bidder to the extent that bidder establishes force majeure events.

20.	**5.**	**0.**	There may be a Force Majeure situation affecting the purchase organization only. In such a situation the purchase organization is to take up with the bidder on similar lines as above for further necessary action.
21.	**0.**	**0.**	**EXTENSION OF WORK COMPLETION PERIOD**
21.	**1.**	**0.**	If the completion of deliveries of equipment or site work is delayed due to reason of Force Majeure the Bidder shall without delay give notice to the Purchaser in writing of their claim for an extension of time. The Purchaser on receipt of such notice may agree to extend the Contract period or delivery date as may be reasonable but without prejudice to other terms and conditions of the Contract.
21.	**2.**	**0.**	Both parties shall keep a record of the circumstances referred to above which are responsible for causing delays in the execution of the services and shall give notice to the other bidder of any such cause as soon as it occurs. An event of Force Majeure, where so ever it occurs, provided it affects either bidder in fulfilling its obligations under this contract, shall justify the affected bidder's claim of Force Majeure. Should one or both the parties be prevented from fulfilling their contractual obligations by a state of Force Majeure lasting continuously for more than a month, the parties shall consult with each other regarding the future execution of the contract.
22.	**0.**	**0.**	**SAFETY AND SECURITY**
			Vendor shall follow the safety regulations / codes or safety instructions issued by PURCHASER and shall take necessary measures at his own cost. The contractor personnel have to undergo security checks by security force i.e., CISF. All the working personnel shall comply with code of conduct during their stay inside the SHAR campus.
23.	**0.**	**0.**	**SITE DETAIL**
23.	**1.**	**0.**	The indented HOT AIR AUTOCLAVE plant is to be erected inside a facility in SDSC SHAR, Sriharikota. The place" Sriharikota" is 20 km East of Sullurupeta (nearest town) which is 80 km North of Chennai, Tamil Nādu, INDIA.SDSC SHAR, Sriharikota is prohibited place. Hence, no contractor or working personnel will be allowed to stay within and the Contractor has to make own arrangements for accommodation and transport means for working personnel on day-to-day basis between erection site and stay area. Accommodation can be at Sullurupeta, the nearest town. Location of the site is worked out to be 25 km (approx.) from Sullurupeta.
23.	**2.**	**0.**	**Building Details for erection of Hot Air Autoclave Plant**
23.	**2.**	**1.**	Overall details of the building with indicative equipment layout, identified for Hot Air Autoclave Plant erection is shown in the building layout in Section-D/Annexure-VII.
23.	**2.**	**2.**	Based on the foundation loads received from the party for Hot Air Autoclave Plant sub-systems like Autoclave Vessel, Job feeding mechanism and auxiliary equipment, civil construction at the identified site will be completed by the Purchaser before giving site clearance to Supplier for erection of Hot Air Autoclave Plant as per the delivery schedule.
23.	**2.**	**3.**	No handling systems are available in the site identified for erection. Supplier has to install temporary mechanism to position the Autoclave vessel on the pedestals with prior approval of the purchaser.

24.	**0**	**0.**	**POWER SUPPLY**
			Electrical power provided by the purchaser during installation AUTOCLAVE plant is NOT chargeable subjected to availability & approval. Reasonable quality of normal power will be made available at one point (415V, 3 phases, 50 Hz). However, onward distribution shall be done by the vendor. All electrical installation by the vendor shall be as per safety regulation & standard and will be subjected to purchaser inspection & approval.
25.	**0.**	**0.**	**WORK RULES**
			Generally, NO work shall be carried out during night or public holidays unless a written permission is obtained from Purchaser.
26.	**0.**	**0.**	**SITE CLEARANCE**
			Upon completion of work, Vendor shall remove all his equipment and material from the site within one month or time mutually agreed. Vendor at all times shall keep site in clean condition and remove all unwanted material at regular intervals. In case vendor fails to remove all his equipment and material within the mutually agreed time it is deemed that Purchaser will arrange to remove the same at the vendor's cost besides imposing penalty for failure.
27.	**0.**	**0.**	**ACCOMMODATION**
27.	**1.**	**0.**	Very limited accommodation may be provided by Purchaser to senior supervisory staff of the Vendor on chargeable basis subject to availability.
27.	**2.**	**0.**	Vendor shall make his own arrangement for accommodation & canteen facility for all its staff, technicians, labor & workers. Transportation shall be arranged by Vendor at his own expenses for entire staff.
28.	**0.**	**0.**	**MEDICAL FACILITIES**
			No medical facilities will be provided by Purchaser at site for Vendor's site personnel. Vendor shall make his own arrangement at his own expenses for medical facilities for site personnel.
29.	**0.**	**0.**	**PROJECT EXECUTION AND MONITORING**
			Upon placement of purchase order, bidder shall prepare a detailed program schedule for review/approval by Purchaser. Bidder shall identify a project team with one senior official as a project leader. Bidder shall submit the project status report every 15 days giving the status of various activities with respect to planned schedule for realization of systems. Bidder shall depute their Project team/ engineers for monthly meeting to review the status and discuss/ resolve minor issues related to project execution at SDSC SHAR/ bidder's site based on mutual agreement on mutually agreeable dates.
30.	**0.**	**0.**	**SUB-CONTRACTS & OTHER TERMS**
30.	**1.**	**0.**	Whole of the work shall not be subcontracted.
30.	**2.**	**0.**	The portion of the work for which the bidder is not expert, may be sub-contracted to proven / reputed OEM in that field. Such sub- contract, if any, shall be given only after obtaining prior approval of the Purchaser.
30.	**3.**	**0.**	The bidder shall be wholly responsible for the proper execution of any sub-contract placed by him in connection with this contract.
30.	**4.**	**0.**	The conditions of the sub-contracts if any, shall be framed by the bidder such that interest of the Purchaser and its rights are protected in accordance with the original contract terms and conditions.

30.	**5.**	**0.**	Written permission, if given, shall not relieve Bidder from his obligations under the Contract and bidder shall take full responsibility for all work done by Sub-Contractors. Bidder shall be responsible for transmitting pertinent data of all Contract terms and conditions to Sub-Bidders. Bidder shall furnish to Purchaser, copies of all un-priced sub-orders showing promised delivery dates and places.
30.	**6.**	**0.**	Should there be any ambiguity or doubt as to the meaning of any of the tender clause/condition or if any further information is required, the matter shall be immediately brought to the notice of Head, Purchase & Stores, SDSC SHAR in writing for necessary clarifications prior to the opening of the tenders.
31.	**0.**	**0.**	**CHANGES & MODIFICATION to SPECIFICATIONS, DESIGNS, DRAWINGS and QUALITATIVE/ QUANTITATIVE REQUIREMENTS**
31.	**1.**	**0.**	Bidder shall obtain approval for the designs and drawings from the Purchaser before initiating the action for procurement / fabrication.
31.	**2.**	**0.**	Selection in make/model for bought item is NOT allowed unless approved by purchaser.
31.	**3.**	**0.**	Purchaser is free to modify the designs or drawings during design review. Bidder has to carry out minor modifications at each stage without any extra cost and must obtain the approval from Purchaser during Detailed Engineering design review to meet overall specification of the machine & sub systems.
31.	**4.**	**0.**	The Purchaser reserves the right at any time to modify the Quantitative Requirement, Specifications, patterns or drawings relating to the work covered by the contract. The Bidder shall inform the Purchaser, within 15 days, of any objection/reservation to the modifications required.
31.	**5.**	**0.**	Unless the Purchaser directs otherwise, the Bidder shall in either case, submit within a reasonable time limit to be specified by the Purchaser, an estimate of the effect of any such modification in the cost of performance of the contract and/ or on the delivery schedule.
31.	**6.**	**0.**	Any amendment to the contract, which may be necessary in this respect, will be established within a reasonable time in the form of an Amendment to Contract to be signed by both parties.
32.	**0.**	**0.**	**ACCEPTANCE AND REJECTION**
32.	**1.**	**0.**	On completion of the work or part of the work as specified in the contract by the bidder, bidder shall inform the same to the Purchaser as soon as possible. The Purchaser / its representative shall inspect as per mutually agreeable schedule.
32.	**2.**	**0.**	If the ordered systems, sub-systems etc., do not meet the prescribed specifications or are damaged at the time of delivery or fail during inspection/testing, they shall be rejected and the Bidder / manufacturer shall replace them at their own cost.
32.	**3.**	**0.**	Purchaser has the right to reject the goods on receipt at site during final inspection though the goods have already been inspected and cleared at pre-dispatch stage by the purchaser's inspector, if they found not meeting the overall performance requirements.
32.	**4.**	**0.**	Goods accepted by the purchaser at initial inspection and in final inspection in terms of the contract shall in no way dilute purchaser's right to reject the same later, if found deficient in terms of the warranty clause of the contract.

33.	**0.**	**0.**	**SUSPENSION**
33.	**1.**	**0.**	Purchaser may notify the Bidder to suspend performance of any or all of his obligations under the Contract. Such notice will specify the reasons for suspension and the effective date of suspension. Bidder there upon shall suspend the performance of such obligations until ordered in writing to resume performance of Contract by Purchaser.
33.	**2.**	**0.**	If Bidder's performance or his obligations remain suspended or the rate of progress is reduced, then, the time of completion will be suitably extended and all costs incurred by Bidder as a result of suspension or reduction in rate of progress will be paid to Bidder provided that the suspension or reduction in the rate of progress is not by reasons of Bidder's default or breach of Contract.
34.	**0.**	**0.**	**CANCELLATION**
34.	**1.**	**0.**	**GENERAL RULE:** The Purchaser shall have the right at any time to cancel a contract either wholly or in part by giving written notice by registered mail. From the time of receipt of the written notice the Bidder shall undertake to observe the instructions of the Purchaser as to the winding up of the contract both on his own part and on the part of his sub-bidders.
34.	**2.**	**0.**	**WITHOUT FAULT OF BIDDER**: In the case of cancellation of a contract by the Purchaser without any fault of the Bidder, the Bidder shall on receipt of Purchaser's instructions forthwith take the necessary steps to implement them. The period to be allowed to implement them shall be fixed by the Purchaser after conclusion with the Bidder and, in general, shall not exceed three months. Subject to the Bidder confirming, Purchaser shall take over from the Bidder at a fair and reasonable price all finished parts not yet delivered to the Purchaser, all unused and undamaged material, bought-out components and articles in course of manufacture in the possession of the bidder and property obtained by or supplied to the Bidder for the performance of the contract, except such material, bought-out components and articles in course of manufacture as the bidder shall, with the agreement of the Purchaser, elect to retain.
34.	**3.**	**0.**	**WITH FAULT OF BIDDER**: The Purchaser reserves the right, after full consideration of all relevant circumstances, including the observations of the bidder, to cancel a contract in any of the following circumstances.
34.	**3.**	**1.**	In the event of the Bidder's failure to meet requirement of the purchase order. 1) The Technical requirements of the Bidder. The Progress and/or delivery requirements.
34.	**3.**	**2.**	If the Bidder has not observed the provisions of the contract concerning the disclosure and use of information provided by the Purchaser.
34.	**3.**	**3.**	If the Bidder fails to comply with the provisions of the contract concerning the equipment, supplies and technical documents made available by the Purchaser.
34.	**3.**	**4.**	If the Bidder transfers his contract without the Purchaser's authorization or concludes sub-contracts against the Purchaser's explicit directives.
34.	**3.**	**5.**	In the event that Bidder unjustifiably repudiates the Contract or fails to ship or dispatch all or part of the goods ordered for reasons other than those attributed to the Purchaser's actions or as provided in the Force Majeure clause, the Purchaser may, by giving an appropriate notice in writing to the Bidder, fix a Date of Essence by which the Bidder shall complete the dispatch in full. If the

			Bidder fails to do so, the Purchaser, in addition to his right to recover Liquidated Damages in terms of the Contract, shall also have the right to cancel this Contract and make substitute purchases from other sources. If the goods are in a partial state of fabrication, Purchaser may have the fabrication completed by other means, in which event Bidder shall be liable to the Purchaser for the additional expenses incurred thereby, but shall not have any claim on savings, if any, in such cases.
34.	**3.**	**6.**	In the event of such cancellation, the Purchaser shall unless otherwise specified in the contract, there is no obligation on the Purchaser to pay losses incurred by the bidder.
34.	**3.**	**7.**	In the event of such cancellation, the Purchaser shall unless otherwise specified in the contract, only pays. 1) In the case of a fixed-cost contract for the supply of equipment or material – The contractual value of items delivered and accepted under the contract before receipt of notification of cancellation, or to be accepted under the special conditions of cancellation. 2) In the other cases – A fair and reasonable price in respect of such work as has been carried out prior to the receipt by the Vendor of notification of cancellation.
35.	**0.**	**0.**	**PURCHASE PREFERENCE TO MICRO AND SMALL ENTERPRISES (MSES)**
			Purchase preference will be given to MSEs as defined in Public Procurement Policy for Micro and Small Enterprises (MSEs) Order, 2012 dated 23.03.2012 issued by Ministry of Micro, Small and Medium Enterprises and its subsequent Orders/Notifications issued by concerned Ministry. If the bidder wants to avail the Purchase preference, the bidder must be the manufacturer of the offered product in case of bid for supply of goods. Traders are excluded from the purview of Public Procurement Policy for Micro and Small Enterprises. In respect of bid for Services, the bidder must be the Service provider of the offered Service. Relevant documentary evidence in this regard shall be uploaded along with the bid in respect of the offered product or service. If L-1 is not an MSE and MSE Seller (s) has/have quoted price within L-1 plus 15% (Selected by Buyer) of margin of purchase preference/price band defined in relevant policy, such Seller shall be given opportunity to match L-1 price and contract will be awarded for 25% (selected by Buyer) percentage of total QUANTITY. Please specify whether you belong to MSE or not. If YES, supporting documents shall be uploaded. Latest Udayam registration certificate for the current Financial year shall be submitted. MSE Purchase preference will be applicable only to the manufacturers of the items offered and supporting documents to that shall be submitted. Traders are not eligible for MSE Purchase preference.

SECTION B
SCOPE OF WORK

				Bidder's Compliance (Yes/No)
1.	**0.**	**0.**	**INTRODUCTION**	
1.	**1.**	**0.**	Hot Air Autoclave Plant is an integration of an Internally insulated horizontal Pressure Vessel fit with electrically operated door, blower& air circulation duct, modular type heat exchanger and heater banks connected with compressed air circuit, cooling water circuit, vacuum suction lines and a job feeding mechanism.	
1.	**2.**	**0.**	'Hot Air Autoclave plant' constitutes the following sub-systems **A.** Autoclave Vessel with dished ends **B.** Job feeding system **C.** Air circulation system **D.** Pressurization & De-pressurization system **E.** Heating system **F.** Cooling system **G.** Vacuum system **H.** Safety systems **I.** Instrumentation & Control systems **J.** Power Supply & Electrical Systems Refer Section-C for details of each sub-system of Hot Air Autoclave Plant	
2.	**0.**	**0.**	**VENDOR'S SCOPE**	
2.	**1.**	**0.**	Vendor's scope includes, Design, Supply of Materials, Manufacturing, Inspection & Testing at Vendor's Site, Supply, Erection, On-Site Testing and Commissioning of Hot Air Autoclave Plant with all sub-systems at Purchaser's site to meet the functional requirement as per Section-C. Refer the following clauses for details of the Hot Air Autoclave Plant	
2.	**2.**	**0.**	Micro schedule along with execution plan and detailed delivery schedule with bar chart shall be submitted by the Vendor after placement of order indicating tentative dates for design reviews, pre-inspection meetings and inspection& testing.	
2.	**3.**	**0.**	Vendor shall submit foundation load distribution drawings for all equipment of Hot Air Autoclave Plant sub-systems at Purchaser's site.	
2.	**4.**	**0.**	**Design Reviews & Approvals:** i. Vendor shall submit general arrangement drawings, design & fabrication drawings, P&I diagram indicating all details, power & control drawings, detailed design reports for all the equipment, detailed reports supporting the specifications of sub-systems of Hot Air Autoclave Plant, fabrication methodology, detailed quality assurance plan (QAP), surface preparation & painting scheme, transportation plan,	

				Bidder's Compliance (Yes/No)
			erection, testing& commissioning methodology to the purchaser for preliminary review. ii. Documents & drawings to be submitted by the Vendor for review and approval shall be as per Section-C clauses. iii. Detailed QAPs, fabrication methodology, transportation plan, surface preparation & painting scheme, erection, testing& commissioning plan, submitted by the Vendor shall be in-line/complying with the indicative QAPs, methodologies and schemes of each sub-system of Section-C clauses. iv. Documents & drawings revised after incorporating suggestions from preliminary review of the purchaser shall be submitted for final approval of the purchaser before proceeding further. Wherever third-party approval is required as per Section-C for drawings & documents, final approval of the purchaser shall be taken only after the approval of the third party. Third party shall approve the documents & drawings only after preliminary review by the purchaser.	
2.	**5.**	**0.**	Purchaser is free to incorporate minor changes in the design or drawings during fabrication. Bidder has to carry out minor modifications at each stage without any additional cost and obtain the approval of the purchaser during detail engineering and design review to meet overall functional requirements of the system.	
2.	**6.**	**0.**	**Inspection & Testing**	
2.	**6.**	**1.**	Vendor shall carry out inspection at identified stages as per approved detailed QAPs for each and every equipment of the Hot Air Autoclave Plant and the copies of such reports after inspection shall be forwarded to Purchaser. The original copies of certificates shall be produced at any time after the inspection and shall be submitted along with other documents at the time of acceptance testing.	
2.	**6.**	**2.**	**Third Party Inspection** as per the approved detailed QAPs shall be arranged by the Vendor.	
2.	**6.**	**3.**	**Pre- Inspection meetings** shall be convened at every phase of the order execution and it shall be at least before 10 days of each stage of inspection of the project with the following agenda. 1. Approved drawings & documents, clearances by third party & purchaser related to that particular inspection stage shall be consolidated and submitted to the purchaser. 2. Details of bought-out items related to that particular stage inspection.	

				Bidder's Compliance (Yes/No)
			3. Details of Stage inspection to be carried out by the Third-party inspector. 4. Details of Stage inspection to be carried out by the Purchaser.	
2.	**6.**	**4.**	No stage inspection shall be carried out without pre-inspection meetings.	
2.	**6.**	**5.**	Minutes of all pre-inspection meetings along with inspection reports shall be submitted to the purchaser during acceptance testing	
2.	**6.**	**6.**	Refer Section-C for details on inspection & testing of Hot Air Autoclave Plant systems	
2.	**7.**	**0.**	**Surface Preparation and Painting** of all sub-systems of Hot Air Autoclave Plant as detailed in Section-C	
2.	**8.**	**0.**	**Delivery and Storage:**	
2.	**8.**	**1.**	Dispatch of the consignments related to Hot Air Autoclave Plant shall be only after clearance from the purchaser. Dispatch Instructions given in the Contract shall be strictly followed. Failure to comply with the instructions may result in delay in payment apart from imposing any other charges as may be deemed to fit.	
2.	**8.**	**2.**	The Vendor shall be responsible for transporting all the equipment to site, unloading and storage. No equipment shall be delivered without obtaining dispatch clearance from Purchaser. All the equipment shall be properly packed to avoid any damage during transportation / handling / storage.	
2.	**8.**	**3.**	Party shall undertake the responsibility of the equipment and its components during transportation to Sriharikota and during erection, testing and commissioning of the same at suitable location identified by SDSC, SHAR and until handing over the machine to SDSC, SHAR after its acceptance. Vendor shall take proper care while storing the equipment and shall provide watch and ward at his own cost.	
2.	**9.**	**0.**	**Transportation & Unloading at Purchaser's Site:**	
2.	**9.**	**1.**	All the sub systems of Hot Air Autoclave plant are to be transported to SDSC SHAR by the Vendor.	
2.	**9.**	**2.**	Unloading at work site of SDSC SHAR shall be carried out by Vendor's team. No crane or other handling equipment is available at Hot Air Autoclave plant erection site. Temporary mechanisms can be installed for unloading & positioning vessel on pedestals. Work site of SDSC-SHAR is as per building layout given in Section-D/ Annexure-VII. Clear opening of 12.0 m height x 11.0 m width is available for the movement of the vessel into the building.	
2.	**9.**	**3.**	It is to be noted that, Autoclave vessel shall be completely fabricated & tested at Vendor's site. No hot work on the vessel	

				Bidder's Compliance (Yes/No)
			is permitted after hydro test on the vessel. However, access platform on the Vessel can be welded onto the reinforcement pads on the vessel at purchaser's site for ease in handling only with the prior approval of the purchaser at acceptance testing.	
2.	**9.**	**4.**	Handling systems for Loading, Transportation & Un-loading of all the equipment of Hot Air Autoclave plant at Purchaser's site in scope of vendor.	
2.	**10.**	**0.**	i. **Installation, Erection, testing at purchaser's site, Painting and commissioning** of the Hot Air Autoclave Plant as per Section-C. ii. Site Acceptance Tests at Purchaser's site as per the approved detailed QAPs for all sub-systems of the Hot Air Autoclave Plant.	
2.	**11.**	**0.**	**Spares**	
2.	**11.**	**1.**	Commissioning spares are in the scope of the Vendor	
2.	**11.**	**2.**	List of essential spares/consumables with detailed specifications needed for trouble free operation in 24-hour x 7 days weekly working basis is to be provided by the Vendor.	
2.	**11.**	**3.**	Supply of List of essential spares as per Section-C. Any other critical spare not mentioned in list has to be suggested by the vendor.	
2.	**11.**	**4.**	Category/Sub-system wise list of spares/consumables with detailed specifications & suppliers' details shall be worked out during detailed engineering and shall be submitted to the purchaser.	
2.	**12.**	**0.**	**Documents & Drawings** shall be submitted by the Vendor at every stage as per the Section-C.	
2.	**13.**	**0.**	**Training**	
			Vendor shall organize training for purchaser's authorized persons for operation, maintenance and troubleshooting of the Hot Air Autoclave plant and its sub-systems.	
3.	**0.**	**0.**	**PURCHASER'S SCOPE**	
3.	**1.**	**0.**	Civil construction based on the foundation loads & details given by the Vendor in erection site of Hot Air Autoclave Plant as shown in overall building layout for Autoclave plant bay and service room in Section-D/ Annexure-III.	
3.	**2.**	**0.**	Supply of 415V power supply from main will be made available at a distance of 50m from the Autoclave Bay.	
3.	**3.**	**0.**	Organizing Review & Pre-Inspection meetings in coordination with Vendor and clearance by Purchaser expert's committee.	
3.	**4.**	**0.**	Preliminary review of all the documents and drawings submitted by the Vendor.	
3.	**5.**	**0.**	Final approval of all the documents and drawings after review & clearance by the Third-party inspector.	

				Bidder's Compliance (Yes/No)
3.	**6.**	**0.**	Approval for finalized and detailed Quality Assurance Plan (QAP).	
3.	**7.**	**0.**	Stage Clearances/Approvals/Reviews as per the Quality Assurance Plan (QAP)	
3.	**8.**	**0.**	Stage/Pre-delivery inspection, acceptance and dispatch clearance.	
3.	**9.**	**0.**	Clearance of stages prior to Third Party Inspection (TPI) as per approved detailed QAPs	
3.	**10.**	**0.**	Final acceptance of fully commissioned Hot Air Autoclave Plant	
3.	**11.**	**0.**	Other than the mentioned purchaser's scope, total scope detailed in technical specification of this document required to establish the intended functionality of Autoclave plant lies with the Vendor.	
4.	**0.**	**0.**	**GENERAL TERMS & CONDITIONS**	
4.	**1.**	**0.**	**Finalized documents:** Approved design documents, design and fabrication drawings, finalized list & details of bought-out items, detailed approved QAPs with clear indications of revisions/ amendments with approval from Purchaser and verified by TPI shall be followed for execution and submitted in final documentation.	
4.	**2.**	**1.**	Vendor shall carry out detailed engineering, manufacture / procure and supply the equipment in accordance with the scope, technical specifications, approved detailed QAP and terms & conditions of contract.	
4.	**2.**	**2.**	All these goods or materials used in fabrication of autoclave shall be new and of first quality. Where ever imported or partly imported goods or material are offered or intended to be used, the fact must be specifically stated and brought to the notice of Purchaser.	
4.	**3.**	**0.**	Vendor has to select the bought-out items of all the sub-systems within the preferred makes mentioned in the Section-C with the approval of the purchaser. Acceptance of any other make selection for bought-out items for Hot Air Autoclave Plant by the Purchaser is subjected to proper justification from the Vendor.	
4.	**4.**	**0.**	Vendor shall incorporate modifications suggested by Purchaser during the design review, QAP, FAT and SAT phases, without any additional cost.	
4.	**5.**	**0.**	All fasteners used in Hot Air Autoclave shall be of Class 8.8 or higher	
4.	**6.**	**0.**	Bidder shall obtain clearance for panel engineering drawings, IOs wiring schemes and technical specifications of all the items from Purchaser prior to the commencement of supply, erection and commissioning activities.	

				Bidder's Compliance (Yes/No)
4.	**7.**	**0.**	The vendor shall ensure that the technology/item selected shall be from latest versions such that spares for all the systems of Hot Air Autoclave Plant are available for at least next 30 years.	
4.	**8.**	**0.**	Much care has been taken in arriving the list of equipment and quantities, however if any equipment or components which is not mentioned explicitly but essentially required for the completion of system to meet the functional requirement stated, is in the scope of the Bidder.	
5.	**0.**	**0.**	**MAINTENANCE AND SERVICE CONTRACT**	
5.	**1.**	**0.**	The party shall undertake the maintenance of the equipment on 'Annual Maintenance Contract' basis as per mutually agreed terms.	
5.	**2.**	**0.**	The party shall submit quote for AMC for a period of 3 years separately as per Section-D/ Annexure-I: Schedule of Price. SDSC SHAR reserves the right to opt for AMC contract after warranty period.	

SECTION C
TECHNICAL SPECIFICATIONS FOR HOT AIR AUTOCLAVE PLANT

				Bidder's Compliance (Yes/No)
			Hot Air Autoclave plant' constitutes the following sub-systems **1.** Autoclave Vessel with dished ends **2.** Job feeding system **3.** Air circulation system **4.** Pressurization & De-pressurization system **5.** Heating system **6.** Cooling system **7.** Vacuum system **8.** Safety systems **9.** Instrumentation & Control systems **10.** Power Supply & Electrical Systems	
1.	**0.**	**0.**	**AUTOCLAVE VESSEL WITH DOOR &DISHED ENDS FOR HOT AIR AUTOCLAVE PLANT**	
1.	**1.**	**0.**	**Autoclave Vessel with Dished Ends** constitutes **i.** Autoclave-Horizontal Pressure Vessel with door & rear dish ends **ii.** Quick closing - front open-able side-ways articulation door **iii.** Vessel supports **iv.** Insulation of the Vessel **v.** Illumination inside Autoclave **vi.** Access Platform	
1.	**2.**	**0.**	**FUNCTIONAL REQUIREMENT:**	
1.	**2.**	**1.**	Autoclave Vessel shall be horizontal pressure vessel with cylindrical shell portion that accommodates Job mounted on a trolley and Vessel rear end accommodates heat exchanger, heater banks, blower fan with motor, with a quick closing front open-able door. Autoclave shall have air circulation duct that runs throughout the vessel ensuring uniform air circulation from the blower fan. Vessel along with dished ends shall be insulated to minimize the energy losses. Vessel shall be mounted on supporting saddles. Saddles (Vessel supports) shall be positioned such that the vessel withstand all types of loads on the Vessel along with the charge/job.	
1.	**2.**	**2.**	Autoclave shell thickness, as well as position of saddles/ supports of the Autoclave vessel shall be designed for internal pressure and to take the load of the job feeding trolley on rails ensuring proper air circulation in the vessel.	
1.	**2.**	**3.**	The manufacturer shall consider the allowable spatial variation into account while designing air circulation duct, placement of heaters,	

					Bidder's Compliance (Yes/No)
			control of heaters, location of sensors, capacity of fan (KW, flow m^3/h) and velocity of air inside the Autoclave.		
1.	**2.**	**4.**	Refer Section-D/ Annexure-VI for General Arrangement drawing of Autoclave Vessel with internals		
1.	**2.**	**5.**	Refer Section- C/Clause No.: 9,10 & 11 along with P&I Diagram in Annexure-VII for Operation, Control & Monitoring.		
1.	**3.**	**0.**	**Autoclave Operating Conditions and Design Parameters**		
1.	**3.**	**1.**	Design and construction code for Autoclave Vessel including dished ends	ASME, Section -VIII, Division-1	
1.	**3.**	**2.**	Dimensions of plates for Shell	Thickness of the shell plate shall be achieved as per ASME Sec VIII Div.1, considering thinning (12.5%) and corrosion allowance (3.0 mm) and the minimum nominal thickness of the shell plate shall not be less than 28 mm. Width of the plates shall be selected such no. of weld joints shall be minimum. Plates shall be used for fabrication with the approval of the purchaser only.	
1.	**3.**	**3.**	Dimensions of plates for dished ends	Thickness of the selected dish end plates shall be of one order higher thickness than shell plate to ensure minimum design thickness all over after forming the dished ends. Width of the plates shall be selected such no. of weld joints/petals shall be minimum on dished ends. Plates shall be used for fabrication with the approval of the purchaser only.	
1.	**3.**	**4.**	Design pressure	8.5 bar g	
1.	**3.**	**5.**	Design Temperature	150^oC	
1.	**3.**	**6.**	Maximum allowable working pressure (MAWP)	8.0 bar g at coincident air temperature of 150^oC.	
1.	**3.**	**7.**	Hydro-test Pressure	11.05 bar g (as per ASME Sec VIII Div.1 on design pressure)	
1.	**3.**	**8.**	Pneumatic Test Pressure	9.35 bar g (as per ASME Sec VIII Div.1 on design pressure)	
1.	**3.**	**9.**	Corrosion Allowance	3.0 mm	

					Bidder's Compliance (Yes/No)
1.	**3.**	**10.**	Rate of pressurization	3 bar/h (continuously adjustable) with regulation accuracy of ± 0.1 bar	
1.	**3.**	**11.**	Rate of Depressurization	5 bar/h (continuously adjustable) with regulation accuracy of ± 0.1 bar	
1.	**3.**	**12.**	Maximum achievable heat up rate	1.5^0C/min (continuously adjustable)	
1.	**3.**	**13.**	Maximum achievable cooling speed	1.5^0C/min (continuously adjustable)	
1.	**3.**	**14.**	Maximum allowable spatial temperature variation	± 2^0C from the set temperature (Maximum Value - Minimum Value of all the monitoring sensors) after 10 min of stabilization without pressurization inside Autoclave	
1.	**3.**	**15.**	Safety relief Valves(SRVs)	2 Nos. of Safety relief valves shall be mounted on the vessel. First SRV shall be set at 6.05 bar g and the second SRV shall be set at 9.35 bar g. Refer Section-C/Clause-8 for more details	
1.	**3.**	**16.**	Burst disc	1 Nos. of burst disc of pressure 10.20 bar g shall be assembled on the vessel in addition to 2 Nos. of SRVs. Refer Section-C/Clause-8 for more details	
1.	**4.**	**0.**	**Autoclave Vessel Specifications**		
1.	**4.**	**1.**	Autoclave Vessel shall be U-Stamped.		
1.	**4.**	**2.**	**Usable diameter:** 5000 mm		
1.	**4.**	**3.**	**Job diameter:**4500 mm a. No sensor tip or any other fittings should project more than 50mm into useful and clear diameter. b. Space needed for Autoclave operational requirements, like-thermal insulation, annular channels for air re-circulation, sensor tips, vacuum or any other fittings, shall be considered additional to arrive at inner diameter of shell.		
1.	**4.**	**4.**	**Useful Length** of Rail Bogie (Motorized job feeding Trolley) shall be 11.0 m.		
1.	**4.**	**5.**	A Job/Tool of 4500mm diameter and 11000mm long shall be able to be accommodated over bogie.		
1.	**4.**	**6.**	The Job/Tool shall be loaded on suitable saddles, placed on the Rail Bogie. Necessary clearance between bogie and Autoclave inner body has to be worked out to meet the desired function of Autoclave.		

				Bidder's Compliance (Yes/No)
			All the heating and pressurization operations shall be suitable for processing the above Job/Tool. A Schematic diagram depicting the arrangement of the Autoclave and Job/Tool with indicated dimensions and arrangement is enclosed as Figure-2&3, in Annexure-VI. The party shall submit actual dimensions of the Autoclave with the Job/Tool placed on the saddle located on the Rail Bogie along with the bid.	
1.	**4.**	**7.**	**Maximum charge weight** is 40,000 Kg (Typical 36,000 Kg of Steel + 4000 Kg of NBR Rubber)	
1.	**4.**	**8.**	**Job dimensions:** Many objects – single object of Ø 4.50m and 11.0 m length or multiple objects of lower diameter and length or combination thereof will undergo pre-defined vulcanization and pre-heating cycles.	
1.	**4.**	**9.**	**Autoclave Shell:** Autoclave shell shall be made of least possible no. of plates only with minimum possible welds.	
1.	**4.**	**10.**	**Ports on the Vessel:** a. Ports shall be available on the vessel for purpose of operation of Hot Air Autoclave Plant i. Air Inlet & Outlet (Refer Section-C/Clause No.:4) ii. Cooling water Inlet & Outlet for fine cooling & Coarse cooling (Refer Section-C/Clause No.:6) iii. Vacuum suction ports (Refer Section-C/Clause No.:7) iv. Ports for SRVs (Refer Section-C/Clause No.:8) v. Port for Burst Disc (Refer Section-C/Clause No.:8) vi. Ports for temperature sensors, pressure sensors, gauges, heater banks. vii. Spare Ports b. Locations of ports for cooling water, air, SRVs & Burst disc shall be on the top portion of the vessel, so that there is no much congestion in the pathway around Autoclave Vessel. Locations of all the spare ports shall be finalized during detailed engineering with the approval of the purchaser. c. Ports shall be at a distance of minimum 500 mm from each other. d. 4 Nos. of spare ports of 125 mm diameter nominal bore through flanged pipe ports to be provided as spare for meeting any further requirement. 2 Nos. of spare through connectors of suitable size, quick sealed (threaded and screw plugged) or similar type for a temperature sensing device to be introduced for additional measurement requirements. e. A through port of suitable size shall be provided on the vessel for additional pressure measurements. This is in addition to the required ports for measurement and control of pressure during operation.	

				Bidder's Compliance (Yes/No)
			f. One spare flanged nozzle, similar to the nozzle provided for spring loaded safety pressure relief valve, shall be provided on the top of autoclave shell. g. All the spare ports shall be blanked by means of bolted blind flanges with leak proof seals to withstand the maximum rated pressure and temperature.	
1.	**4.**	**11.**	**Autoclave Door & Rear Dish end:** Thickness of the selected dish end plates shall be of one order higher thickness than shell plate to ensure minimum design thickness all over after forming the dished ends. Width of the plates shall be selected such no. of weld joints/petals shall be minimum on dished ends. Plates shall be used for fabrication with the approval of the purchaser only. Centre closure plate shall be used for avoiding any weld mis-match at the center of door dished end petal configuration.	
1.	**4.**	**12.**	**Door & Shell Ring/Flange, Rear dish end ring/flange for blower motor:** a. Forged and machined rings are welded to Door dish end & Shell. These interlocking rings enables leak tight closure during Autoclave operation. b. Similarly, forged rings/flanges are used for mounting blower at the rear dish end of the autoclave vessel enabling leak tight closure during Autoclave operation	
1.	**4.**	**13.**	**Door & Rear dished end Seal:** Door shall have effective sealing in Autoclave operating condition. Lip seal (of material EPDM/Viton or better) for door sealing and Viton gasket for rear end dish sealing, withstanding hydro test pressure of vessel and temperature up to 300^0C shall be provided. These seals shall also be hydro tested prior to use in the Autoclave. The manufacturer shall submit test certificate along with the supply.	
1.	**4.**	**14.**	**Autoclave Door:** Quick closing - front open-able with side-ways articulation, electro mechanically operated through a system of actuators properly sequenced through suitable limiting devices, shall be provided. Door operation shall be possible only with local HMI panel station in field (near Autoclave door). Refer Section C- Clause 9,10 & 11 for details.	
1.	**4.**	**15.**	**Door operating mechanism (electro mechanical):** The door has to be turned for locking and unlocking with shell ring with electrically operated cover turning device. Swinging of the door into the shell ring and out of the shell ring is to done by electrical slewing device. Door should have a gripping device that allows the door to be opened in two steps – During first operating step any possibly existing residual pressure in the vessel has to escape through the gap between the	

				Bidder's Compliance (Yes/No)
			gasket and contact device (provision to be given by door design) whereas door itself is still held in the shell ring. This may be achieved by holding the door in intermediate position for certain time before complete opening of the door in the second step after total de-pressurization of the vessel.	
1.	**4.**	**16.**	**Door opening should be by side wise articulation** (Davit arm mechanism) and provisions should be made available for smooth operation of the door.	
1.	**4.**	**17.**	a. **Door position adjustment:** Suitable hook shall be provided for lifting/handling the door in upright position using crane. Provision shall be available for i. Vertical height adjustment of door in case of sagging or creep. ii. Lateral alignment of door for proper pitching of door in a vertical plane, passing through the Autoclave longitudinal axis. b. Support structure around the Autoclave Shell near door end shall accommodate systems for operating the electro-mechanically actuated door for its swinging as well as turning motion. A jack shall be provided to support the hanging door in parking position to avoid door mis alignment over the time. c. Support pads/Reinforcement pads may be welded on the Autoclave Vessel for welding the door operating mechanism after hydro-test at Vendor's site for ease during transportation of Autoclave Vessel. Prior approval of the purchaser shall be obtained for executing the option at design as well as acceptance testing phase.	
1.	**4.**	**18.**	**Door locking mechanism & Safety:** Door movement shall be arrested with a **simple detent wheel mechanism**. Detent mechanism configuration shall be approved by the purchaser. Door lock opening shall be such that, residual pressure inside the vessel at the end of process cycle escapes out smoothly without any risk to operator while opening the door.	
1.	**4.**	**19.**	**Door lock Safety:** Necessary provision shall be made available such that the door opening operation is not accessible until the autoclave is completely depressurized. A door lock with indication light shall be provided. Flashing light along with audio alarm shall be provided to indicate the movement of door movement/position, rail bridge, rail bogie etc. shall be provided.	
1.	**4.**	**20.**	**Autoclave Vessel & Operation safety:** Refer Section-C/Clauses-2,8,9,10,11 and wherever applicable for safety interlocks, mechanical safety devices, alarms for Autoclave vessel & operational safety.	

				Bidder's Compliance (Yes/No)
1.	**4.**	**21.**	**Vessel handling pins/trunnions:** Pressure Vessel shall be welded with suitable handling pins/trunnions at all the corners. Vessel handling configuration shall be submitted to the purchaser.	
1.	**4.**	**22.**	**Vessel Saddle Supports:** Horizontal pressure vessel integrated with all sub-systems shall be supported with saddles at suitable locations to accommodate any combination of thermal load and maximum charge.	
1.	**4.**	**23.**	**Supports for junction boxes:** Suitable channels shall be welded on the Vessel to fix the junction boxes for sensors & transmitters for cleaner cabling. Welding of these supports shall be done before hydro testing of the Vessel as no hot work is permitted on the vessel after hydro test.	
1.	**4.**	**24.**	a. **Insulation for Autoclave:** The autoclave vessel with rear and door dished ends shall be provided with interior insulation in the form of matting/boards of suitable thickness, such that the skin temperature of Autoclave body in operation @ 8.0 bar g/150^{0}C shall not exceed 10^{0}C above ambient temperature (30^{0}C - 45^{0}C). As the requirement fully depends on the class and thickness of insulation, the manufacturer shall indicate, after design re-check, the actual thickness and material of insulation that will be provided for the vessel. b. Superior class and quality of insulation material shall be used which is proven for at least 30 years of operational life. Insulation shall be pre-molded slab/Sections. c. Insulation thickness for the vessel shall be optimized with the selection of superior property insulation materials.	
1.	**4.**	**25.**	a. **Insulation Retainer Ring:** The insulation lining shall be covered by means of AISI 316 stainless steel sheet of minimum 3 mm thick such that the plate shall not distort due to pressure, temperature and velocity of air flow during operation. Selected sheet thickness shall be finalized shall be intimated to purchaser for approval. b. Studs or Rods used for holding the insulation intact inside the Vessel shall be positioned such that the heat is not transferred to the shell through it directly during operation.	
1.	**4.**	**26.**	a. **Modular Construction of Autoclave Internals:** All the internal sheets, insulation materials and internal auxiliary equipment shall be designed for modular construction for ease in dismantling, servicing and assembly. b. Heat Exchanger shall be mounted on a trolley like structure to aid maintenance of Heat exchanger as well as the blower fan from inside the autoclave.	

				Bidder's Compliance (Yes/No)
1.	**4.**	**27.**	**Illumination Inside Autoclave:** Autoclave internal chamber shall be illuminated with necessary focus lamps fit in appropriate positions autoclave for complete interior illumination. Control switch shall be provided in field HMI panel. Refer Section C - Clause 10 & 11.	
1.	**4.**	**28.**	a. **Access Platform:** Necessary provision shall be incorporated on the autoclave body externally to mount access platforms, handrails, stairs, ladders etc. for the purpose of maintenance of pressure relief valves, burst disc, vent pipes, service lines, door operating mechanism etc. b. Along with the Autoclave layout, the detailed drawing for the access platform, ladder shall be sent to purchaser for a utility assessment and clearance for fabrication. c. Support pads/Reinforcement pads may be welded on the Autoclave Vessel for welding the access platform after hydro-test at Vendor's site for ease during transportation of Autoclave Vessel. Prior approval of the purchaser shall be obtained for executing the option at design as well as acceptance testing phase.	
1.	**4.**	**29.**	**Rails inside Autoclave:** Rails shall be installed inside Autoclave for Job Trolley (SWL 40T) movement. Rails shall be load tested at 1.25 times SWL, i. e. 50T. Strain measurement is taken at critical locations during the test. Critical locations shall be identified during the analysis and shall be marked on the rails for strain gauge mounting and deflection measurement.	
1.	**5.**	**0.**	**Documentation – Autoclave Vessel with Dished Ends** Refer Section-C Clause 15 in conjunction with the below	
1.	**5.**	**1.**	Following reports shall be submitted to the purchaser a. **Detailed design Report along with CAD model files** for all configuration drawings of Autoclave vessel with dished ends of Hot Air Autoclave Plant. Each detail of configuration drawing shall be supported by respective Design report along with CAD model files. All load cases for all configuration drawings shall be covered in Design Report of Autoclave vessel with dished ends of Hot Air Autoclave Plant. b. **Report on selection criteria, detailed specifications** of each and every bought-out item, supported with detailed calculations as per relevant codes of practice & compliance with PO specifications document. c. **Report on design & location of all Ports** on the Autoclave Vessel. d. **Report on MAP, MAWP,** Centre of Gravity, Weight & Volume of Vessel for all **pressure components** as per the code.	

					Bidder's Compliance (Yes/No)
			e. **Design data sheet** as per ASME Sec VIII Div.1 for Autoclave Vessel f. **Report on torque requirement** for each and every fastener of Autoclave Vessel assemblies. g. **Report on design of insulation for Vessel** as per ASTM C1696, thermal analysis report at all operating & design conditions, Heat loss calculation as per ASTM C680 h. **Report on Design & selection of Rails** inside Autoclave chamber for Job Trolley (40T SWL) movement.		
1.	**5.**	**2.**	Following drawings shall be submitted to the purchaser a. **General Arrangement Drawing:** General Arrangement drawing of Autoclave Vessel with Dished ends. b. **Sectional view** of the Autoclave indicating all assembly details of the Autoclave Vessel. c. **Foundation load distribution drawings** indicating load distribution (in KN) for Autoclave Vessel pit, fixed & sliding saddle supports. **d. Design & Assembly drawings for the following** i. All Ports on Autoclave Vessel ii. Individual Ports on Autoclave iii. Handling Trunnions iv. Vessel & Door saddle supports along with assembly details v. Rails inside Autoclave along with assembly details vi. Insulation of Autoclave Vessel with details of retainer studs, ring etc., along with layup scheme. vii. Door & Shell flange rings viii. Blower flanges ix. Door & Blower flange seals x. Door operating & locking mechanism xi. Assembly details of Door operating & locking mechanism on the Autoclave xii. Access Platform for Autoclave xiii. Assembly of Access Platform on Autoclave e. **Fabrication drawings** for all equipment along with detailed weld maps for all assemblies for all configuration drawings specifying the selection of electrodes. f. **Detailed P&ID** for Autoclave Vessel system g. **Detailed Power & Control drawing** for Autoclave Vessel system h. **As built drawings** for Autoclave Vessel with dished ends of Hot Air Autoclave Plant indicating revisions/amendments.		
1.	**6.**	**0.**	**Material of Construction**		
1.	**6.**	**1.**	Plates for Autoclave Vessel with dished ends, blinds for ports	SA-516 Gr.70 as per ASTM A 285	

					Bidder's Compliance (Yes/No)
1.	**6.**	**2.**	Door & Rear dished ends	SA-516 Gr.70 as per ASTM A 285	
1.	**6.**	**3.**	Shell & Door Ring/Flange	SA-266 Gr. 2 as per ASTM A788	
1.	**6.**	**4.**	Rear dished end Rings/Flanges for blower mounting	SA-266 Gr. 2 as per ASTM A788	
1.	**6.**	**5.**	Nozzles/Ports for Autoclave Vessel	Seamless pipes as per ASTM A 106 Gr. B	
1.	**6.**	**6.**	Nozzle Flanges or Blind flanges	Forged ASTM A 105 Class 150 or above as per approved design	
1.	**6.**	**7.**	All reinforcement pads/ pressure pads/support pads	SA-516 Gr.70 as per ASTM A 285	
1.	**6.**	**8.**	Fittings	As per ASTM A 234-WPB	
1.	**6.**	**9.**	Bolting	As per ASTM A 193 Gr B7 bolts with ASTM A194 of minimum class 8.8	
1.	**6.**	**10.**	Vessel Support Saddles	IS2062 Gr B	
1.	**6.**	**11.**	Rails inside Autoclave	IS2062 Gr B	
1.	**6.**	**12.**	Insulation retainer	AISI 316 as per ASTM 240	
1.	**6.**	**13.**	Nozzle gaskets	EPDM/ Viton withstanding 300^0C & 11.05 bar pressure	
1.	**6.**	**14.**	Autoclave Vessel seal gaskets	EPDM/ Viton withstanding 300^0C & 11.05 bar pressure	
1.	**6.**	**15.**	Gears & Shafts for Door operating mechanism	As per ASTM A 291	
1.	**7.**	**0.**	**Preferred makes** In case the supplier is planning to use different make other than as per the list below, prior approval for the same shall be obtained from the purchaser. However, purchaser reserves the right to reject such proposal.		
1.	**7.**	**1.**	Plates, Sheets, Rails	M/sSAIL/TATA/JINDAL/VIZAGSTEEL/ESSAR	
1.	**7.**	**2.**	Nozzle forged Flanges	M/s Rajmani /Bhavya forged/ United Forge Industries/Metal Forge India/Hindustan Forgings	

					Bidder's Compliance (Yes/No)
1.	**7.**	**3.**	Fittings	M/s Metal Forge India/ Rajmani/ Vaibhav/ United Forge Industries/ Bharat forge & fittings/ Metline	
1.	**7.**	**4.**	Pipes	M/s Tubetec/Shree Impex Alloys/Metline/ Amtex/ Maharashtra seamless/ MA international	
1.	**7.**	**5.**	Fasteners	TVS/MA Trade Syndicate/Hussainy/Sakthie/Maarg/ITA fasteners	
1.	**7.**	**6.**	Paint	Berger/ Asian Paint/Flosil-Bet coatings/Grand polycoats	
1.	**8.**	**0.**	**Fabrication methodology**		
1.	**8.**	**1.**	Fabrication shall be done as per the approved fabrication methodology		
1.	**8.**	**2.**	**Raw material Selection:** a. Raw material selection for Autoclave vessel shall be as per ASTM and ASME Sec VIII Div. 1 standards. b. All the plates used for Autoclave vessel shall be rolled, normalized and free from laminar defects. c. All the plates shall be laminar flow defect free and UT tested irrespective of sheet thickness. UT shall be as per ASTM A388 and acceptance level as per ASME SA 578 acceptance level C procedure as per ASME Sec V with 2-2T sensitivity. d. Nozzles shall be from seamless pipes. e. Nozzle flanges shall be forged type, SORF (Slip on raised flanges) with concentric serrations. f. Blinds for the nozzles or ports on vessel shall be forged A 105 flanges of class 150 or above as per design. g. Reinforcement pads shall be form UT tested SA 516 Gr 70 plates. h. Rails for Job Trolley shall be installed with Rail Clamps following Gant rail installation standard		
1.	**8.**	**3.**	**Fabrication** a. UT tested rolled and normalized plates shall be marked and cut as per approved drawing & procedure. Identification shall be transferred on to the marked plates before cutting. b. Dimensions of plates shall be selected such that shell & dished ends of the vessel shall be with least possible no. of plates and joints. c. Vessel dished ends shall be stress relieved following standard code of practice, ASME Sec VIII Div.1 (PWHT as per UCS-56). d. Door & Shell Rings/Flanges and Rear end dish flanges shall be forged & machined as per ASME A266. These rings shall be		

				Bidder's Compliance (Yes/No)
			stress relieved following standard code of practice, ASME Sec VIII Div.1 (PWHT as per UCS-56). e. Door & Shell, Blower assembly forged flanges shall be UT tested as per ASTM A388 standard code of practice. f. All nozzles & ports on the vessel shall be supported with reinforcement pads. g. Nozzle openings not to pierce any weld seam. h. Marking of nozzles/ports shall be done such that no nozzle or port is within 100mm of the heat affected zone i. Plates, nozzles and fittings shall be prepared as per approved fabrication drawings. j. Rails for Job Trolley shall be installed with Rail Clamps following Gant rail installation standard	
1.	**8.**	**4.**	**Welding:** a. Welding procedure (WPS, WPQ, PQR) should comply ASME Sec IX and approved weld map. b. GTAW for root welding and SAW/SMAW for subsequent passes shall be employed ensuring full penetration. c. All butt weld shall be full penetration weld. d. Double V shall be used for shell joints. J-Joint should be avoided. e. All the joints shall be back chipped and DP Tested. Where-ever back chipping is not possible, root weld to be done by GTAW to have full penetration joint. Any other advanced welding methodology can be adopted with prior approval from the purchaser. f. All joints shall be stress relieved as per ASME Sec VIII Division I (UCS-56). g. 100% radiography shall be carried out for all butt-weld (longitudinal & circumferential seam i.e., A, B and C type). Acceptance criteria for Radiography shall be as per ASME Sec V with 2-2T sensitivity (UW51-Full Radiography). h. Root passes for welds including reverse back gouging and grinding shall be inspected and cleared by DP test where ever applicable. i. All weld joints shall be DP tested at root pass and final pass. j. Nozzles shall be welded by full root weld by GTAW &final welding by SMAW or SAW and shall be examined by DP test.	
1.	**8.**	**5.**	Nameplate shall be tag welded on bracket; Brackets shall be welded on RF plates on vessel.	
1.	**8.**	**6.**	Vessel shall be hydro tested at Vendor's site. After hydro-test, no hot work shall be carried out on vessel.	
1.	**9.**	**0.**	**Surface Preparation & Painting Scheme** Refer Section-C/Clause-18 for Surface Preparation & Painting in addition to the below	

<table>
<tr><th></th><th></th><th></th><th></th><th>Bidder's Compliance (Yes/No)</th></tr>
<tr><td>1.</td><td>9.</td><td>1.</td><td>Painting scheme
<table>
<tr><th rowspan="2">Equipment</th><th rowspan="2">Surface Preparation</th><th colspan="3">Painting</th></tr>
<tr><th>Primer Coat</th><th>Intermediate Coat</th><th>Finish Coat</th></tr>
<tr><td>Autoclave Internal</td><td>Blast cleaning to Sa 2 ½ grade</td><td>Inorganic Zinc ethyl-silicate: Two coats with min. 65 µs DFT per coat</td><td>-</td><td>Ferrotol HR Aluminum Paint: Two coats with min. 15 µs DFT per coat</td></tr>
<tr><td>Autoclave External</td><td>Blast cleaning to Sa 2 ½ grade</td><td>Inorganic Zinc ethyl-silicate: Min. 75 µs DFT</td><td>Polyurethane epoxy paint: Min. 80 µs DFT</td><td>Berger thane finish or equivalent: Min. 40 µs DFT</td></tr>
<tr><td>Access Platform/ Structure</td><td>Mechanical Wire Brushing</td><td>BP ROZC IS2074 or equivalent: Min. 30 µs DFT</td><td>-</td><td>Berger thane finish/ epoxy paint or equivalent: Min. 30µs DFT</td></tr>
</table></td><td></td></tr>
<tr><td>1.</td><td>10.</td><td>0.</td><td>Erection & Commissioning Erection & Commissioning of Autoclave Vessel with dished ends shall be as per the scheme of erection & commissioning approved by the Purchaser. Refer Section-C/Clause-17.</td><td></td></tr>
<tr><td>1.</td><td>11.</td><td>0.</td><td>Inspection & Testing – QAP contd..</td><td></td></tr>
</table>

AUTOCLAVE VESSEL WITH DOOR &DISHED ENDS QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
	Raw Material Inspection									
1	Plates-Rolled & Normalized for Autoclave Vessel with dished ends	Mill Test Certificate & Heat Treatment, Marking Check	100%	ASTM A 285, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts	√	AS	-	I, C	
2	Blinds for ports of the Vessel Reinforcement pads for Nozzles & Ports	UT for Laminar flow & Surface Defects	100%	UT as per ATM A 388 & Acceptance level as per ASME SA 578 Level C, Specifications document/Approved drawings.	Test Reports	√	AS	I	C	
3		Dimensional measurement	100%	Specifications document/Approved drawings.	Inspection Reports	√	AS	-	I, C	
4	Shell & Door Ring/Flange & Rear dished end Rings/Flanges for blower mounting	Mill Test Certificate & Heat Treatment, Marking Check, Grain size, Residual elements, Alternate Tension Test Orientation, Micro structure test, UT, LPT, Macro etch test, Product Analysis, Hardness, Impact Test	100%	ASTM A 266 & ASTM A788, ASME Sec V with 2-2T sensitivity Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts, Inspection reports	√	AS	I	C	
5	Seamless pipes for Nozzles/Ports for Autoclave Vessel	Mill certificates, Hardness, Product analysis Heat treatment, Hydro static tests,	100%	ASTM A 106, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts, Inspection reports	√	AS	-	I, C	

AUTOCLAVE VESSEL WITH DOOR &DISHED ENDS QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
		Metal structure & etching test, Dimensional measurement								
6	Nozzle Flanges	Mill certificates, Hardness, Hydro static tests, Dimensional measurement	100%	ASTM A 105, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Inspection reports	√	AS	-	I, C	
7	Fittings, Gaskets	Mill certificates, Dimensional measurement	100%	ASTM A 234 ASME B16.5, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts, Inspection reports	√	AS	-	I, C	
8	Bolting	Mill certificates, Dimensional measurement	100%	ASTM A 193 & A194, Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	AS	-	I, C	
9	Rolled plates of IS2062 Gr B for Vessel Support Saddles	Mill certificates, UT test irrespective of plate thickness, Dimensional measurement	100%	IS2062, Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	AS	I	C	
10	Rails of IS2062 Gr B for Job feeding Trolley	Mill certificates, Dimensional measurement	100%	IS2062, Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	AS	-	I, C	
11	AISI 316 sheet for Insulation retainer	Mill certificates, Dimensional measurement	100%	ASTM A240, Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	AS	-	I, C	
12	Gears & Shafts for Door operating mechanism	Mill certificates, UT test & LPT, Dimensional measurement	100%	ASTM A291, A388 with SA 578 acceptance level C, Specifications	Material Test Certificates, Test reports, Inspection reports	√	AS	I	C	

AUTOCLAVE VESSEL WITH DOOR &DISHED ENDS QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
				document/Approved drawings.						
	Material Stamp transfer									
13	Material Stamp transfer after marking, before cutting.	Stamp transfer.	100%	Approved Drawing	-	√	AS	-	I, C	
	Bought -Out Items /Inward Items Inspection									
14	Details of all bought out items, shall be submitted for Purchaser's approval.	Visual Inspection, Suitability as per Specifications, Approved drawings, & Design reports	100%	Specifications Document, Approved drawings & design report	Visual Inspection report, technical specifications, operation & maintenance manuals, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	-	AS, C	
15	Autoclave Gasket, Flange Gaskets	Visual Inspection, Test Certificates in addition to Suitability as per Specifications, Approved drawings & Design reports	100%	Specifications Document, Approved drawings & design report, Relevant Standards for testing	Visual Inspection report, technical specifications, operation & maintenance manuals, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	-	AS, C	
16	Industrial Lamps for Inside Autoclave	Visual Inspection, Test Certificates in addition to Suitability as per Specifications, Approved drawings & Design reports	100%	Approved design report, Drawing and Technical specifications	Visual Inspection report, technical specifications, operation & maintenance manuals, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	-	AS, C	
17	Insulation materials	Material Test Certificate- Bulk Density,% Incombustibility loss, Heat	100%	ASTM C1696, Approved design & analysis report,	Test & Inspection Reports	√	V	-	AS, C	

AUTOCLAVE VESSEL WITH DOOR &DISHED ENDS QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
		resistance, Moisture content, Recovery after compression, Thermal conductivity @ 200^0C, Linear Shrinkage & Other relevant tests as per standards, Insulation Class, Thickness & Dimensional Check, Visual Inspection		Drawing and Technical specifications						
	In Process Inspection									
	AUTOCLAVE VESSEL									
	Dished ends fabrication									
18	Weld edge preparation	Root face, angle, Cleanliness & Visual	100%	ASME Sec VIII Div. 1, ASME Sec V with 2-2T sensitivity& codes of practice, Specifications Document, Approved Procedure, drawings & design report	Fabrication checklist.	√	AS	-	I, C	
19	Set up	Offset, root gap, profile & Dimensions	100%		Fabrication Check list & SIR	√	AS	I	C	
20	Root pass, Back chip, Final pass	Visual, LPT acceptance criteria	100%		PT Report, Fabrication checklist.	√	AS	I	C	
21	Weld Visual Inspection before RT	Visual, bead height	100%		Fabrication checklist.	√	AS	I	C	
22	Radiography after forming	RT film Review.	FULL		RT Report	√	AS	-	I, C	
23	Inspection after forming	Visual, Profile, Over & Under crowning, Ovality, Dimensions, LPT of long seams, Weld edge, Knuckle minimum thickness	100%		Inspection Reports	√	AS	I	C	

AUTOCLAVE VESSEL WITH DOOR &DISHED ENDS QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
	Ground Long seam, Shell Fabrication									
24	Weld edge preparation	Root face, angle, cleanliness & Visual	100%	ASME Sec VIII Div. 1 & Relevant code of practice, ASME Sec V with 2-2T sensitivity, Specifications Document, Approved Procedure, drawings & design report	Fabrication checklist.	√	AS	-	I, C	
25	Set up of long seam after rolling	Offset, root gap, profile & Dimensions	100%		Fabrication Check list & SIR	√	AS	-	I, C	
26	Root pass, Back chip, Final pass	Visual, LPT	100%		PT Report, Fabrication checklist.	√	AS	I	C	
27	Weld Visual Inspection before RT	Visual, bead height	100%		Fabrication checklist.	√	AS	I	C	
28	Radiography	RT film Review.	FULL		RT Report	√	AS	-	I, C	
	Welding of Nozzle flanges to Nozzle Pipe, Nozzle pipe to fittings, Nozzles with Reinforcement pads to Vessel									
29	Weld edge preparation	Root face, angle, cleanliness. & Visual	100%	ASME Sec VIII Div. 1 &ASME Sec V with 2-2T sensitivity, Relevant code of practice, Specifications Document, Approved Procedure, drawings & design report	Fabrication checklist.	√	AS	-	I, C	
30	Set up	Verticality, Offset, root gap, profile & Dimensions	100%		Fabrication Check list & SIR	√	AS	-	I, C	
31	Root pass, Back chip, Final pass	Visual, LPT	100%		PT Report, Fabrication checklist.	√	AS	I	C	
32	Weld Visual Inspection before RT	Visual, bead height	100%		Fabrication checklist.	√	AS	-	I, C	
33	Radiography (above DN250)	RT film Review.	FULL		RT Report	√	AS	-	I, C	-
	Shell & Door Flange Machining									
34	Proof machining	Visual, Dimension & Layout	100%	ASTM A266, Relevant code of practice, Specifications Document, Approved Procedure & drawings	SIR	√	AS	-	I, C	
35	Final Inspection	Visual, Ovality, Dimensions	100%		SIR	√	AS	I	C	

AUTOCLAVE VESSEL WITH DOOR &DISHED ENDS QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
36	Machined flanges inspection	UT inspection	100%	UT as per ATM A 388 & Acceptance level as per ASME SA 578 Level C, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts, Inspection reports	√	AS	I	C	
	Cir-seam set-up of Shell to Shell, Dished end to Shell, Door dish to Door flange, Shell to Shell flange, Nozzle on Shell, Blind flange, Rear/Door dished ends									
37	Weld edge preparation	Root face, angle, cleanliness. & Visual	100%	ASME Sec VIII Div. 1, ASME Sec V with 2-2T sensitivity& Relevant code of practice, Specifications Document, Approved Procedure, drawings & design report	Fabrication checklist.	√	AS	-	I, C	
38	Set up	Verticality, Offset, root gap, profile & Dimensions	100%		Fabrication Check list & SIR	√	AS	-	I, C	
39	Root pass, Back chip, Final pass	Visual, LPT	100%		PT Report, Fabrication checklist.	√	AS	I	C	
40	Weld Visual Inspection before RT	Visual, bead height	100%		Fabrication checklist.	√	AS	I	C	
41	Radiography	RT film Review.	FULL		RT Report	√	AS	-	I, C	
42	Inspection of Machined Components (Pad type Nozzles etc.)	Visual, Dimension, UT & LPT	100%		Inspection report	√	AS	I	C	
	All nozzle ports, Thermocouple port, Vacuum port, Heater element ports									
43	Marking Inspection before drilling	Visual, Dimensional	100%	ASME Sec VIII Div. 1 & Relevant code of practice, Specifications Document, Approved Procedure, drawings & design report	SIR	√	AS	-	I, C	
44	Inspection after drilling	Visual, Dimensional	100%		Inspection Reports	√	AS	I	C	
	Fixed & Sliding saddles									
45	Fixed & Sliding saddles Inspection	Visual, Dimensional, Base plate flatness	100%	ASME Sec VIII Div. 1 & Relevant code of practice,	Inspection Reports	√	AS	-	I, C	

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S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
				Specifications Document, Approved Procedure, drawings & design report						
46	Saddles setup inspection to shell pad plate	Alignment, Orientation, Visual & Dimensional	100%	ASME Sec VIII Div. 1 & Relevant code of practice, Specifications Document, Approved Procedure, drawings & design report	Inspection Reports	√	AS	I	C	
47	Rails fit up inside Vessel	Dimensional Inspection, Parallelism, Straightness etc.	100%	ASME Sec VIII Div. 1 & Relevant code of practice, Specifications Document, Approved Procedure, drawings & design report	Inspection Reports	√	AS	-	I, C	
	Saddle reinforcement pads welding & Welding of Saddles to pads									
48	Weld edge preparation	Root face, angle, cleanliness. & Visual	100%	ASME Sec VIII Div. 1, ASME Sec V with 2-2T sensitivity& Relevant code of practice, Specifications Document, Approved Procedure, drawings & design report	Fabrication checklist.	√	AS	-	I, C	
49	Set up	Verticality, Offset, root gap, profile & Dimensions	100%		Fabrication Check list & SIR	√	AS	-	I, C	
50	Root pass, Back chip, Final pass	Visual, LPT	100%		PT Report, Fabrication checklist.	√	AS	I	C	
51	Weld Visual Inspection	Visual, bead height	100%		Fabrication checklist.	√	AS	I	C	
	Fabrication of Door operating & Locking Mechanism									
52	Inspection of Forged, Formed & Machined components (Links, Shafts, Screws, Gears, Pinions, Wheels, Cams, Eye bolt, Pins, Rollers, Bearing housing etc)	Visual, Dimensional, Profile, Heat treatment, Hardness, UT & LPT		ASTM A291, A388 with SA 578 acceptance level C, ASME Sec V with 2-2T sensitivity Specifications document/Approved drawings, Procedure	Stage Inspection Report, Test reports	√	AS	I	C	

AUTOCLAVE VESSEL WITH DOOR &DISHED ENDS QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
	Man-in-Clave Arrangement									
53	Final Inspection after Installation of Man-in-Clave Arrangement	Visual, Dimension	100%	Relevant code of practice, Specifications Document, Approved Procedure, drawings	Stage Inspection Report	√	AS	I	C	
	Rails Installation Inside Autoclave									
54	Final Inspection after Installation of Rails inside Autoclave	Visual, Dimension, check for marking of critical locations for strain measurement & deflection	100%	Gant rail installation standard, Specifications Document, Approved Procedure, drawings	Stage Inspection Report	√	AS	I	C	
	INSTALLATION OF INSULATION									
55	Insulation Material testing in baking oven before use	Baking of insulation material in oven @200° C & duration 4 Hr. and Visual inspection,	100%	ASTM C1696, C450 & Approved Procedure	Stage Inspection Report	√	AS	-	I, C	
56	Visual inspection of Autoclave internal surface before filling of Insulation	Visual Inspection for internal painting & foreign material.	100%	Approved Drawing	Stage Inspection Report	√	AS	-	I, C	Insulation filling to be done only after internal painting
57	Insulation Flat Plate for Insulation support on shell side & dished ends	Visual, Dimension, Waviness, Profile, circularity	100%	ASTM C1696, C450 Approved Drawing	Stage Inspection Report	√	AS	-	I, C	
58	Trial Insulation layup & marking for openings & projections	Overlapping direction & length, Waviness, Gaps in between, cut out size, Circularity of insulation & Visual. Flat plates are perfect circular without local bends or out of shape.	10% Random	ASTM C1696, C450 Approved Drawing	None	√	AS	I, C	-	

AUTOCLAVE VESSEL WITH DOOR &DISHED ENDS QUALITY ASSURANCE PLAN										
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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
59	After removing of trial insulation layup, visual inspection before filling of insulation.	Visual	100%	ASTM C1696, C450 Approved Drawing	None	√	AS	-	I, C	
60	Laying of Insulation blankets. @ Shell Rear dished end & door side	No. of layers, final Thickness as per drawing, Visual, Layup scheme	100%	ASTM C1696, C450 Approved Drawing, Layup procedure & scheme	Stage Inspection Report, Layup drawings.	√	AS	I, C	-	
61	Insulation Shell Setup [Bolting & Riveting of Insulation Shell to support flat plate]	Overlapping direction, Waviness, gaps in between overlapping, circularity of insulation & Visual. Proper riveting/bolt nut tightening, Patches	100%	ASTM C1696, C450 Approved Drawing, Rivet installation manual for correct method of drilling hole, correct grip length and proper riveting.	Stage Inspection Report	√	AS	I, C	-	
62	Insulation petal setup on Rear dish & Door Dish side	Waviness, gaps in between overlapping, Profile of insulation & Visual inspection for loose and improper fixed rivets, patches	100%	ASTM C1696, C450 Approved Drawing	Stage Inspection Report, Layup drawings.	√	AS	I, C	-	
63	Final Visual inspection of Retainer plates of insulation on shell & Retainer Petal on dish after Riveting	Visual inspection for loose and improper fixed rivets, patches, ensuring concentricity with the port and full rivets are rivetted. Wherever there is no access for drill gun/ rivet gun, split the washer in to two halves and tack weld the washer.	100%	ASTM C1696, C450 Approved Drawing	Stage Inspection Report, layup reports, Inspection	√	AS	I	C	
	Surface Preparation & Painting									
64	Surface Preparation & Painting	Visual Inspection & Dry Film thickness measurement	100%	As per approved scheme for surface preparation & painting	Inspection Reports	√	AS	I	C	

AUTOCLAVE VESSEL WITH DOOR &DISHED ENDS QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
65	Painting Inspection	Shade conformance	100%	As per approved shade	Inspection Reports	√	AS	I	C	
	Final Certification									
66	Design Data Stamping			As per Approved drawing, ASME code & Design reports		√	AS	I	C	
	Pre-Delivery Inspection (FAT)									
	AUTOCLAVE									
67	Final Dimensional Inspection before Hydro-Test before insulation layup.	Dimensional Inspection of Vessel & its components	100%	As per Approved drawing	Inspection Reports	√	AS	I, C	-	
68	Final weld inspection before and after Hydro Test before insulation layup.	Fillet weld size measurement, Visual Inspection of Weld	100%	As per Approved drawing	Inspection Reports	√	AS	I, C	-	
69	Hydro-Test of Vessel at 11.05 bar g before insulation layup.	Leakages, Strain measurement at critical locations, Pressure measurement at the top of the vessel	100%	As per ASME code & Specification document, Approved design & analysis report	Test Reports	√	AS	I, C	-	
70	Autoclave insulation and other internals	Visual Inspection	100%	Specifications document & Approved drawings	Inspection Reports	√	AS	I, C	-	
71	Pneumatic Test with Reinforcement pads at 9.35 bar g after insulation layup.	Leakage	100%	As per ASME code	Inspection Reports	√	AS	I, C	-	
72	Inspection & Functional testing of Motorized Door operating & locking mechanism	Visual Inspection, Function Test-Inspection, Operation of Door operating & Locking mechanism	100%	Specifications document & Approved drawings	Inspection Reports	√	AS	I, C	-	

AUTOCLAVE VESSEL WITH DOOR &DISHED ENDS QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
73	Vessel Saddle Supports	Visual Inspection	100%	Specifications document & Approved drawings	Inspection Reports	√	AS	I, C	-	
74	Assembled Autoclave with Door & Dished ends with all components	Visual Inspection	100%	Specifications document & Approved drawings	Inspection Reports	√	AS	I, C	-	
75	Inspection after all internal attachments	Visual Inspection	100%	Specifications document & Approved drawings	Inspection Reports	√	AS	I, C	-	
76	Performance test of Rails inside Autoclave	Load test of rails at 1.25 times SWL i.e., 50 Ton Strain measurement & Deflection measurement	100%	As per specifications document, Approved procedure & reports	Inspection report	√	AS	C	-	
	INSULATION									
77	Insulation retainer	Distortion after pneumatic test	100%	As per specifications document & procedure	Inspection reports	√	AS	I, C	-	
78	Insulation	Skin temperature of Autoclave in operation, Heat loss calculation	100%	As per specifications document & procedure	Inspection reports & Heat loss calculation report	√	AS	I, C	-	
	Final Acceptance (Site Acceptance Test)									
	AUTOCLAVE									
80	Pneumatic Test at Design Pressure (after insulation & duct installation)	Pneumatic test at 9.35 bar, 1.1 times of design pressure. Pressure measurement at the top of the vessel	100%	ASME Sec VIII Div.1, ASME Sec V with 2-2T sensitivity& specifications document	Inspection report	√	AS	C	-	
81	Weld inspection after pneumatic test	LPT	100%	ASME Sec V with 2-2T sensitivity, Relevant code of practice, specifications document	Inspection report					
82	Functional Test for all equipment of Autoclave	Each equipment performance as per specifications individually and in assembly	100%	As per specifications document	Inspection report	√	AS	C	-	

AUTOCLAVE VESSEL WITH DOOR &DISHED ENDS QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
83	Functional Test to meet the user requirement	Trial runs of Vulcanization & Pre-heating Cycles	100%	As per specifications document	Inspection report	√	AS	C	-	
84	Performance test of Rails inside Autoclave	Load test of rails at 1.25 times SWL i.e., 50 Ton	100%	As per specifications document	Inspection report	√	AS	C	-	
	INSULATION									
85	Performance Test of Vessel Insulation	Skin temperature	100%	As per specifications document & procedure	Inspection reports & Heat loss calculation report	√	AS	C	-	
86	Hot Air Autoclave Plant assembled with all sub-systems	Trial Runs & Functional Requirement tests of entire plant for all operations	100%	As per specifications document	Inspection report	√	AS	C	-	
	D* - Records identified with tick [√] shall be essentially included by supplier in QA documentation.	**MTC – Material Test Certificate, SIR-Stage Inspection Reports IR – Inspection Report, LPT-Liquid Penetrant Test, P-Perform, W-Witness, R-Review/Clearance**		**MPT-Magnetic Particle Test, UT-Ultrasonic Test, RT-Radiography**	**AS – Autoclave Supplier, V-Manufacturer / Vendor, I– Third Party Inspector C– Purchaser/Customer (SDSC-SHAR, ISRO),**					

Note:	
1	Testing by suitable method shall be done at NABL certified laboratories only. The NDT Reports shall be certified and approved by minimum ASNT/ ISNT Level-II qualified personnel.
2	Equipment / material shall not be dispatched / shipped to site until written dispatch clearance is given by Purchaser.
3	Authorized inspection engineers shall sign off the approved QAP on completion of inspection from each agency.
4	In the absence of specified standards and where ever there is a conflict between the specification given & the standard code, sound engineering practice shall be followed with the approval of the Purchaser.

				Bidder's Compliance (Yes/No)
2.	**0.**	**0.**	**JOB FEEDING SYSTEM FOR HOT AIR AUTOCLAVE PLANT**	
			Job Feeding Mechanism for SWL 40T constitutes **i.** Rails **ii.** Job Feeding Trolley with Saddle supports for Job **iii.** Rail Bridge **iv.** Trolley Moving Mechanism	
2.	**1.**	**0.**	**Functional Requirement**	
2.	**1.**	**1.**	Trolley with saddles is used for moving the Job in and out of the Autoclave chamber. For this, rails are to be laid on Fined Floor Level of High bay and inside the chamber. Along with that, a connecting bridge with rails that connects the Autoclave chamber rails with rails on Fined Floor Level of High bay shall be provided. Connecting rail bridge shall have rotary joint to aid lifting of rail bridge over a hinge to enable closure of Autoclave side articulated door. Lifting of Rail bridge shall be powered by pneumatic cylinder.	
2.	**1.**	**2.**	Refer Section-D Annexure-VI, Figure-2&3 for general arrangement of jobs on job feeding trolley & inside Autoclave.	
2.	**2.**	**0.**	**Specifications**	
2.	**2.**	**1.**	**Rails:** a. Rails (SWL 40T) shall be laid for Trolley movement from High Bay area to Autoclave chamber as per standard Gant rail installation. b. Rails shall be clamped to the base plates. c. Rails shall be designed for a Trolley with 40 Tons of Safe Working Load (SWL). d. Foundations drawings for Rails shall be provided for civil construction for installation of rails.	
2.	**2.**	**2.**	**Rail Bogie/Job Feeding Trolley:** a. Length of the bogie shall be 11m, width and height of rail bogie, rails size, rail track, rail span and weight of rail bogie shall be provided during design stage for approval. b. Autoclave rail bogie shall be designed to move and position jobs inside the Autoclave vessel, which has to undergo process cycles at design temperature and pressure. Rail bogie shall be designed with uniform top sheet/plate for SWL 40 T such that the trolley takes the intended load at any location along the length of the Trolley supported by two saddles as shown in Section-D Annexure-VI Figure-3. c. Oil/grease, which is temperature sensitive, shall not be used for lubrication of the rail bogie wheel bearings. Rail bogie wheel	

				Bidder's Compliance (Yes/No)
			shall be provided with life time self-lubricated bearings for this purpose. d. Motorized system shall be provided to move the rail bogie in and out of the autoclave. Rack and Pinion mechanism working in two strokes or any other mechanism with the approval of the purchaser be designed for moving the Trolley. No separate counter weight technique shall be used for ensuring stability of the Trolley. Trolley operating motor mechanism shall be mounted in between the rails. e. Job loading schematic diagram with saddles on Trolley is given in Figure2&3 of Section-D Annexure-VI. Two-point loading pattern shall be considered for design. Trolley shall be stable for any loading condition of job (i.e. for job of any length, positioned at any location on the trolley). f. Stability analysis of the Job loading Trolley with all possible load combinations shall be submitted to the purchaser. r. Suitable locking shall be provided for the trolley in parking position inside and outside the autoclave body. s. Necessary drawing, design & analysis shall be sent during detailed design for review and clearance from purchaser. Design of the Trolley shall be such that there shall be no requirement of counter weight for stabilizing the Trolley in any loading conditions. t. Proximity sensors (Min. 4 No.) to be provided at both ends and to be interlocked with rail bogie motor as per details provided under Section C/ Clause 10 & 11. These sensors are to be interfaced with Data Acquisition System to indicate the position of job in the user interface/mimic. u. Rail bogie operation shall be possible only from local HMI panel. Refer Section C/ Clause 10 & 11 for details.	
2.	**2.**	**3.**	**Saddle Supports for Job:** a. A set of 2 No. of common saddles are to be supplied for positioning Job on the rail bogie as shown in Section-D Annexure-VI Figure-3. b. Each saddle (dismountable and movable type) shall have lifting hooks for handling or re-positioning. Suitable locking mechanism for saddles shall be provided. c. Supplier shall furnish the saddle dimensions and drawings to the purchaser before fabrication for approval and utility assessment.	
2.	**2.**	**4.**	**Rail Bridge (SWL 40T):** a. In-order to facilitate autoclave door operation, certain length of the rails for rail bogie are to be laid on a rotary link, hereafter called as 'Rail Bridge'.	

				Bidder's Compliance (Yes/No)
			b. This rail bridge shall be able to rotate about its end located away from the autoclave, with the help of a pneumatic actuator (preferably double acting pneumatic cylinder), such that at fully actuated position, rail bridge shall attain the vertical orientation (> 90^0 with FFL) leaving back sufficient space for door swing during door operation. The Rail bridge shall be provided with positive safety locking system to prevent inadvertent fall from lifted orientation. c. Width of the rail bridge shall be such that Rail Bridge also acts as walk over from Trolley parking bay to Autoclave floor covering. d. Rail Bridge shall be designed with least possible weight for a Trolley of SWL 40T. e. Length of the rail bridge shall facilitate door opening/closing with reasonably good space margin. This rail bridge shall connect the rail laid inside the autoclave to the rail laid outside in the rail bogie pit for movement of rail bogie in and out of Autoclave. f. Rail Bridge Up/Down operations shall be carried out from Local HMI panel. g. Bridge status (Up/Down) shall be interfaced with PLC through proximity sensors and interlocked with autoclave door and rail bogie systems. h. Design details and technical brochure of pneumatic actuator shall be furnished for purchaser's clearance.	
2.	**2.**	**5.**	**Compressor for Instrument Air:** a. An air-cooled compressor mounted on a vertical air receiver of suitable size shall be provided to cater the needs of Rail bridge operation, Instrumentation process control, Valve actuation etc. b. Instrument airline shall be with Stainless steel tubing and respective fittings c. All details of compressor and air receiver selection shall be provided to the purchaser for acceptance. d. Inter connection shall be provided between instrument air compressor line and process air compressor line as redundancy. e. Compressor shall have Profinet/Profibus interface compatibility and critical parameters for monitoring shall be interfaced with main SCADA. f. Refer Section-C/Clause-4 for QAP & installation of instrument air circuit & compressor with receiver. g. Refer Section-C/Clause-9,10,11 for more details h. Refer QAP of Section-C/Clause-4 for QAP of instrument air compressor & circuit in combination with the QAP for Job feeding mechanism	

					Bidder's Compliance (Yes/No)
2.	**3.**	**0.**	**Documentation – Job feeding mechanism** Refer Section-C Clause 15 in conjunction with the below		
2.	**3.**	**1.**	Following reports shall be submitted to the purchaser a. **Design Report along with CAD model** for all design drawings of Job feeding mechanism of Hot Air Autoclave Plant. b. **Report on selection criteria, detailed specifications** of each and every bought-out item, supported with detailed calculations as per relevant codes of practice & compliance with PO specifications document. c. **Report on** Centre of Gravity & adequacy of locking mechanism for both Rail bridge & Trolley in all load combinations & Weight of Job feeding Trolley & Rail bridge as per the code. d. **Report on design** of Trolley on Rails, Rail Bridge in all load combinations.		
2.	**3.**	**2.**	Following drawings shall be submitted to the purchaser a. **General Arrangement Drawing:** General Arrangement drawing for Autoclave with Job feeding mechanism. b. **Foundation load distribution drawings** indicating load distribution (in KN) for Trolley rails, Rail bridge, Pneumatic cylinder for Rail bridge. **c. Design & Fabrication drawings for the following** i. Job feeding mechanism with Rails, Trolley & Rail Bridge with pneumatic actuator indicating details of each individual structure. ii. Assembly of Job feeding mechanism of Autoclave. d. **Detailed Power & Control drawing** for Job feeding mechanism system e. **Detailed P&ID** for Job feeding mechanism system f. **As built drawings of** Job feeding mechanism of Hot Air Autoclave Plant indicating details of revisions/amendments.		
2.	**4.**	**0.**	**Material of Construction**		
			Description	**Material**	
2.	**4.**	**1.**	Plates	IS2062 Gr B	
2.	**4.**	**2.**	Structural members	IS2062 Gr B	
2.	**4.**	**3.**	Rails, Rail Clamps	IS2062 Gr B	
2.	**4.**	**4.**	Wheels	C55Mn75	
2.	**4.**	**5.**	Shafts, Gears	ASTM EN grade material	
2.	**4.**	**6.**	Pneumatic cylinder	Stainless steel	
2.	**4.**	**7.**	Job Support Saddles	IS2062 Gr B	

					Bidder's Compliance (Yes/No)
2.	**5.**	**0.**	**Preferred makes:** In case the supplier is planning to use different make other than as per the list below, prior approval for the same shall be obtained from the purchaser. However, purchaser reserves the right to reject such proposal.		
2.	**5.**	**1.**	Plates, Structural members	M/s.SAIL/TATA/JINDAL/VIZAGSTEEL/ESSAR	
2.	**5.**	**2.**	Rails& Rail Clamps	M/s. SAIL/JINDAL/TATA/ ESSAR/ VIZAG-RINL/ Mahindra Ugine Steel (MUSCO)/ Hindustan Forgings	
2.	**5.**	**3.**	Bearings	SKF, FAG, NTN	
2.	**5.**	**4.**	Compressor for Instrument air	Atlas Capco, Chicago pneumatic, Ingersoll rand with Profinet/Profibus interface compatibility	
2.	**5.**	**5.**	Paint	Berger/ Asian Paint/Flosil-Bet coatings/Grand polycoats	
2.	**6.**	**0.**	**Indicative Fabrication methodology:** Fabrication shall be done as per the approved fabrication methodology		
2.	**6.**	**1.**	**Raw material Selection:** a. Raw material selection for Job feeding mechanism shall be as per ASTM and ASME Sec VIII Div. 1 standards. b. All the plates used for Job feeding mechanism shall be rolled and normalized. c. All the plates shall be laminar flow defect free and UT tested irrespective of sheet thickness. UT shall be as per ASTM A388 and acceptance level as per ASME SA 578 acceptance level C procedure as per ASME Sec V with 2-2T sensitivity. Bearings shall be oil free life time bearings.		
2.	**6.**	**2.**	**Fabrication** a. UT tested rolled and normalized plates shall be marked and cut as per approved drawing & procedure. Identification shall be transferred on to the marked plates before cutting. b. Plates/ Structural members shall be selected such that all load bearing members shall be with least possible or no weld joints. All equipment of Job feeding mechanism shall be stress relieved following standard code of practice, ASME Sec VIII Div.1 (PWHT as per UCS-56). c. Shafts, Gears etc. per ASME A291. These shall be stress relieved following standard code of practice, ASME Sec VIII Div.1 (PWHT as per UCS-56) and tested by Magnetic Particle		

<table>
<tr><td></td><td></td><td></td><td></td><td>Bidder's Compliance (Yes/No)</td></tr>
<tr><td></td><td></td><td></td><td>test (ASTM A 275) or UT (A388 with SA 578 level C acceptance).
d. Fabrication shall be as per approved fabrication drawings.</td><td></td></tr>
<tr><td>2.</td><td>6.</td><td>3.</td><td>Welding:
a. Structural steel Welding procedure (WPS, WPQ, PQR) should comply AWS D1.1 and approved weld map.
b. GTAW for root welding and SAW/SMAW for subsequent passes shall be employed ensuring full penetration.
c. All butt weld shall be full penetration weld.
d. Double V shall be used for shell joints.
e. All the joints shall be back chipped and DP Tested. Where-ever back chipping is not possible, root weld to be done by GTAW to have full penetration joint. Any other advanced welding methodology can be adopted with prior approval from the purchaser.
f. All joints shall be stress relieved as per ASME Sec VIII Division-I (UCS-56).
g. 100% radiography shall be carried out for all butt-welds for plates > 20 mm thick as per ASME Sec V with 2-2T sensitivity (UW51-Full Radiography).
h. Root passes for welds including reverse back gouging and grinding shall be inspected and cleared by DP test where ever applicable.
d. All weld joints shall be DP tested at root pass and final pass.</td><td></td></tr>
<tr><td>2.</td><td>7.</td><td>0.</td><td>Surface Preparation & Painting Scheme
Refer Section-C/Clause-18 for Surface Preparation & Painting in addition to the below</td><td></td></tr>
<tr><td>2.</td><td>7.</td><td>1.</td><td>Painting scheme
<table>
<tr><th></th><th>Surface Preparation</th><th colspan="3">Painting</th></tr>
<tr><th></th><th></th><th>Primer Coat</th><th>Intermediate Coat</th><th>Finish Coat</th></tr>
<tr><td>Trolley</td><td>Blast cleaning to Sa 2 ½ grade</td><td>Inorganic Zinc ethyl-silicate: Two coats with min. 75µs DFT per coat</td><td>-</td><td>Ferrotol HR Aluminum Paint: Two coats with min. 15 µs DFT per coat</td></tr>
<tr><td>Job support saddles</td><td>Blast cleaning to Sa 2 ½ grade</td><td>Inorganic Zinc ethyl-silicate: Two coats with min. 75µs DFT per coat</td><td>-</td><td>Ferrotol HR Aluminum Paint: Two coats with min. 15 µs DFT per coat</td></tr>
<tr><td>Rail Bridge</td><td>Mechanical Wire Brushing</td><td>BP ROZC IS2074 or equivalent: Min. 70 µs DFT</td><td>-</td><td>Berger thane finish/ epoxy paint or equivalent: Min. 40µs DFT</td></tr>
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				Bidder's Compliance (Yes/No)
2.	**8.**	**0.**	**Erection & Commissioning** Erection & Commissioning of Job feeding mechanism shall be as per the scheme of erection & commissioning approved by the Purchaser. Refer Section-C/Clause-17.	
2.	**9.**	**0.**	**Inspection & Testing – Indicative QAP contd.**	

JOB FEEDING SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
	Raw Material Inspection									
1	Plates for Trolley, Rail base plate & Job support saddles	Mill Test Certificate & Heat Treatment as applicable, Marking Check, Surface Defects by visual inspection & UT, Dimensional measurement	100%	IS2062 standard code, Specifications document /Approved drawings.	Material Test Certificates, Lab reports, Inspection reports	√	AS	I	C	
2	Structural members, Rails, Rail Clamps	Mill Test Certificate & Heat Treatment, Marking Check, Surface Defects by visual inspection, Dimensional measurement	100%	IS2062 standard code, Specifications document /Approved drawings.	Material Test Certificates, Lab reports, Inspection reports	√	AS	-	I, C	
3	Wheels	Mill Test Certificate & Heat Treatment, Marking Check, Surface Defects by visual inspection, Heat Treatment Dimensional measurement	100%	ASTM standard code, Specifications document /Approved drawings.	Material Test Certificates, Lab reports, Inspection reports, Heat Treatment charts	√	AS	-	I, C	
4	Shafts, Gears	Mill Test Certificate & Heat Treatment, Marking Check, Surface Defects by visual inspection, Heat Treatment Dimensional measurement, UT & LPT	100%	ASTM A291, A388 with acceptance level of SA578 level C, LPT standard code, Specifications document /Approved drawings.	Material Test Certificates, Lab reports, Inspection reports, Heat Treatment charts	√	AS	I	C	
	Material Stamp transfer									

JOB FEEDING SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
5	Material Stamp transfer after marking, before cutting.	Stamp transfer.	100%	Approved Drawing	-	√	AS	-	I,C	
	Bought -Out Items /Inward Items Inspection									
6	Details of all bought out items, shall be submitted for Purchaser's approval.	Visual Inspection, Suitability as per Specifications, Approved drawings, & Design reports	100%	Specifications Document, Approved drawings & design & analysis report	Visual Inspection report, technical specifications, Operation & maintenance manuals, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	AS	-	I,C	
7	Compressor for Instrument Air with Receiver & respective tubing circuit	Refer QAP of Compressed Air system for indicative QAP for Compressor for Instrument Air with Receiver & respective tubing								
	In Process Inspection									
	JOB FEEDING MECHANISM									
	Trolley, Rail Bridge, Rail bridge operating unit									
8	Marking and cutting Dimensions and bevel preparation	Dimensions, Visual Inspection	100%	Approved Drawing/ Procedure	Inspection Reports	√	AS	-	I, C	
9	Fit-up inspection - Dimensions bevel details mismatch	Dimensions, Visual Inspection	100%	Approved Drawing/ Procedure	Inspection Reports	√	AS	-	I, C	
10	LPT on root and final pass	Visual Inspection &LPT	100%	Approved Drawing/ Procedure, AWS D1.1	Inspection Reports	√	AS	-	I, C	

JOB FEEDING SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
11	LPT on back grinding	Weld soundness & Check for full penetration, Visual Inspection & Penetrant Test	100%	Approved Drawing/ Procedure, AWS D1.1	Inspection Reports	√	AS	-	I, C	
12	Heat treatment for Gears, Shafts– review of SR charts	Heat Treatment Chart	100%	Relevant Standard	H.T. chart	√	AS	-	I, C	
	Assembly of Trolley, Rail Bridge, Rail bridge operating unit									
13	Fit up inspection for Trolley	Dimensions, Visual Inspection	100%	Approved Drawing/ Procedure	Inspection Reports	√	AS	-	I, C	
14	Fit up inspection for Rail bridge & Rail bridge operating unit	Dimensions, Visual Inspection	100%	Approved Drawing/ Procedure	Inspection Reports	√	AS	-	I, C	
15	Inspection of all components of Job feeding mechanism	Visual Inspection	100%	Approved Drawings & Specifications Document	Inspection Reports	√	AS	-	I,C	
	Surface Preparation & Painting									
16	Surface Preparation & Painting	Visual Inspection & Dry Film thickness measurement	100%	As per approved scheme for surface preparation & painting	Inspection Reports	√	AS	I	C	
17	Painting Inspection	Shade conformance	100%	As per approved shade	Inspection Reports	√	AS	I	C	
	Final Certification									
18	Design Data Stamping			As per Approved drawing, & Design reports		√	AS	I	C	
	Pre-Delivery Inspection (FAT)									
	JOB FEEDING MECHANISM									
19	Final weld inspection before load test	Fillet weld size measurement, Visual Inspection of Weld, LPT	100%	As per Approved drawing, AWS D1.1	Inspection Reports	√	AS	-	I,C	

JOB FEEDING SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
20	Machined components Inspection	Visual & Dimensional	100%	As per Approved drawing	Inspection Reports	√	AS	-	I,C	
21	Inspection of Motorized Job feeding mechanism in full assembly	Visual Inspection, Dimensional Inspection- Flatness, Squareness, FunctionalTest- Trolley movement, Rail bridge operation	100%	Specifications document & Approved drawings	Inspection Reports	√	AS	-	I,C	
22	Speed Test of Trolley mounted with 1.25 times SWL load in forward & reverse motion	Speed of the movement, Current & Voltage reading during operation	100%	As per specifications document & Approved design & analysis report	Inspection report	√	AS	I, C	-	
23	Load Test of Trolley mounted with 1.25 times SWL load in forward & reverse motion	Deflection of load bearing members at critical locations, Strain measurement at critical locations	100%	As per specifications document & Approved design & analysis report	Inspection report	√	AS	I, C	-	
24	Final weld inspection after load test	Fillet weld size measurement, Visual Inspection of Weld, LPT	100%	As per Approved drawing, AWS D1.1	Inspection Reports	√	AS	-	I, C	
	Final Acceptance (Site Acceptance Test)									
	JOB FEEDING MECHANISM									
25	Functional Test of Job feeding mechanism in full assembly and its individual components	Trial Run as per user requirement	100%	As per specifications document	Inspection report	√	AS	C	-	
26	Speed Test of Trolley mounted with 1.25 times SWL load in forward & reverse motion	Speed of the movement, Current & Voltage reading during operation	100%	As per specifications document & Approved design & analysis report	Inspection report	√	AS	C	-	

JOB FEEDING SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
27	Load Test of Trolley mounted with 1.25 times SWL load in forward & reverse motion	Deflection of load bearing members at critical locations, Strain measurement at critical locations	100%	As per specifications document & Approved design & analysis report	Inspection report	√	AS	C	-	
28	Final weld inspection after load test	Fillet weld size measurement, Visual Inspection of Weld, LPT	100%	As per Approved drawing, AWS D1.1	Inspection Reports	√	AS	C	-	
29	Hot Air Autoclave Plant assembled with all sub-systems	Trial Runs & Functional Requirement tests of entire plant for all operations	100%	As per specifications document	Inspection report	√	AS	C	-	
	D* - Records identified with tick [√] shall be essentially included by supplier in QA documentation.	**MTC – Material Test Certificate, SIR-Stage Inspection Reports IR – Inspection Report, LPT-Liquid Penetrant Test, P-Perform, W-Witness, R-Review/Clearance**		**MPT-Magnetic Particle Test, UT-Ultrasonic Test, RT-Radiography**	**AS – Autoclave Supplier, V-Manufacturer / Vendor, I– Third Party Inspector C– Purchaser/Customer (SDSC-SHAR, ISRO),**					
Note:										
1	Testing by suitable method shall be done at NABL certified laboratories only. The NDT Reports shall be certified and approved by minimum ASNT/ ISNT Level-II qualified personnel.									
2	Equipment / material shall not be dispatched / shipped to site until written dispatch clearance is given by Purchaser.									
3	Authorized inspection engineers shall sign off the approved QAP on completion of inspection from each agency.									
4	In the absence of specified standards and where ever there is a conflict between the specification given & the standard code, sound engineering practice shall be followed with the approval of the Purchaser.									

				Bidder's Compliance (Yes/No)
3.	**0.**	**0.**	**AIR CIRCULATION SYSTEM FOR HOT AIR AUTOCLAVE PLANT**	
			Air Circulation system works in conjugation with Pressurization & De-pressurization system, Heating system & Cooling system. Air Circulation system constitutes **i.** Blower/Fan with electric motor **ii.** Air Circulation Duct	
3.	**1.**	**0.**	**Functional Requirement:**	
			a. **Air circulation system** shall be designed to maintain uniform temperature distribution throughout the vessel during Autoclave Operation i.e., during heating & cooling process with or without pressure. b. **Blower/Fan** is mounted on the rear dished end of the Vessel at the center. Air circulated from fan/ blower is heated with heaters or cooled with heat exchanger based on the process requirement. This hot or cold air is then circulated into the Autoclave chamber vide **annular air duct** built throughout the Autoclave chamber& deflected by autoclave door dome. This enables uniform air circulation and ensures minimum spatial variation throughout the vessel.	
3.	**2.**	**0.**	**Specifications**	
3.	**2.**	**1.**	**Blower/Fan with Drive:** a. Blower/Fan capacity shall be designed based on the air & velocity requirement. During non-pressurized process of Autoclave, blower itself shall develop air circulation to achieve spatial variation as stated in Section-C/ Clause No.: 1. b. Blower motor shall have pressurized motor with cooling water jacket for cooling down the drive temperature. c. Current drawn by the pressurized motor shall be within 80% of the rated value during operation of Autoclave within its design parameters, with or without pressurization. d. Speed (Rpm) of the blower shall be constant till the pressure within the chamber is 5.0 bar g and then can be reduced in proportion to maintain the current drawn within 80% of the rated value. e. The material of construction of fan wheel shall be AISI 316 or equivalent. f. The capacity of the fan in m^3/hour and the power rating of its drive shall be furnished during design stage. The party shall also provide design calculations for fixing the capacity of the fan and power rating of the drive.	

				Bidder's Compliance (Yes/No)
			g. **Cooling arrangement of the fan drive/ fan motor winding** and the requirements for the same including inlet and out let water temperature shall be clearly furnished during design stage. h. Centrifugal pump shall be used in cooling water circuit of the blower. Inlet water to the pump shall be from the common water storage tank and outlet shall be into common hot water tank. All wetted parts of the cooling water circuit of the blower shall be of stainless steel with filters indicating clog status to ensure that no entry of contamination into blower jacket as well as pump during operation. i. Blower/Fan bearing shall be selected for life time to with stand axial load as well as radial loads during Autoclave operation. j. A heavy-duty fan, drawing rated power at 8.0 bar (g) & coincident temperature of 150^0C shall be provided. Refer Section-C/Clause 9,10,11 for details. Glandless fan drive complete with statically & dynamically balanced fan wheel shall be mounted at the rear end of the autoclave to ensure uniform circulation of air inside the autoclave chamber to achieve specified temperature spatial variation. k. Fan shall be powered through VFD system for smooth functioning. Fan motor shall be inverter duty suitable for operation with 2 No. VFDs – one active and other as stand by with simple change over selector switch. l. Fan winding temperature monitor (temperature transmitter), over temperature trip shall be incorporated and status shall be interfaced with PLC. The fan capacity shall be suitably selected to achieve temperature spatial variation (Max. Value – Min. Value of all monitors) of ± 2^0C with working pressure and also with atmospheric pressure. m. The fan motor shall be provided with thermistor protection for rise in winding temperature with indication of motor winding temperature. n. The make for VFD drive is SIEMENS or ABB. Refer Section C/Clause-11 for details. o. ON/OFF/TRIP status, RPM, current etc. of the fan shall be sensed and interfaced with the PLC via profinet communication. p. Individual status of interconnected interlock of fan circuit (i.e., man in vessel, door closed, activation of emergency stop button etc.) shall be interfaced to PLC. q. Dis-mountable type of FAN shall be provided.	
3.	**2.**	**2.**	**Air Circulation Duct:**	
			An annular air guide/duct with minimum 3 mm thick sheet of AISI 316-grade of stainless-steel sheet shall be installed to guide the air flow	

					Bidder's Compliance (Yes/No)
			through a conical duct from blower/fan, enclosing heat exchanger to annular duct in Autoclave shell, designed to withstand the rated air flow at pressure & non-pressure operational conditions.		
3.	**3.**	**0.**	**Documentation – Air Circulation System** Refer Section-C Clause 15 in conjunction with the below		
3.	**3.**	**1.**	Following reports shall be submitted to the purchaser a. **Design Report along with CAD model** for Air circulation system of Hot Air Autoclave Plant. Each detail of design drawing shall be supported by respective Design report. b. **Report on selection criteria, detailed specifications** of all bought-out items viz., Blower, Blower motor etc. supported with detailed calculations as per relevant codes of practice. c. **Report on design air circulation duct** of Air circulation system as per the standard code. d. **Report on** performance of Air circulation system in combination with pressurization system, heating system & cooling system of Hot Air Autoclave.		
3.	**3.**	**2.**	Following drawings shall be submitted to the purchaser a. **General Arrangement Drawing:** General Arrangement drawing of Air circulation system of Hot Air Autoclave with dimensions of all the equipment, brief specifications of bought-out items, bill of material & material of construction. b. **Design & Assembly drawings for the following** i. Fan/Blower with motor & cooling water jacket of Autoclave. ii. Air circulation duct of Autoclave showing all details of joints, studs' locations etc. c. **Detailed P&ID** for Job feeding mechanism system d. **Detailed Power & Control drawing** for Job feeding mechanism system. e. **As built drawings** for Air circulation system of Hot Air Autoclave Plant indicating details of revisions/amendments.		
3.	**4.**	**0.**	**Material of Construction**		
			Description	**Material**	
3.	**4.**	**1.**	Sheet for Duct & Rivets	AISI 316 as per ASTM 240	
3.	**4.**	**2.**	Blower impeller	AISI 316 as per ASTM 240/ Aluminium alloy	
3.	**4.**	**3.**	Blower Gaskets	Viton to withstand 300^0C temperature	
3.	**4.**	**4.**	Blower shaft	EN grade material	

					Bidder's Compliance (Yes/No)
3.	**4.**	**5.**	Blower motor insulation	Class H to withstand design parameters (NEMA standards)	
3.	**5.**	**0.**	**Preferred makes** In case the supplier is planning to use different make other than as per the list below, prior approval for the same shall be obtained from the purchaser. However, purchaser reserves the right to reject such proposal.		
			Description	**Preferred Makes**	
3.	**5.**	**1.**	Sheet for Duct & Rivets	M/s.SAIL/TATA/JINDAL/VIZAGSTEEL/ESSAR	
3.	**5.**	**2.**	Paint	Berger/ Asian Paint/Flosil-Bet coatings/Grand polycoats	
3.	**6.**	**0.**	**Indicative Fabrication methodology**		
3.	**6.**	**1.**	Fabrication shall be done as per the approved fabrication methodology		
3.	**6.**	**2.**	**Raw material Selection:** a. Raw material selection for Air circulation system shall be as per ASTM and ASME Sec VIII Div. 1 standards. b. Bearing for shall be oil free/ maintenance free life time bearings.		
3.	**6.**	**3.**	**Fabrication** a. Qualified Sheets shall be marked and cut as per approved drawing & procedure. Identification shall be transferred on to the marked plates before cutting. b. Sheets shall be bent without any waviness or gap between joints. c. Fabrication shall be as per approved procedure & fabrication drawings. d. Assembly of Blower with motor to the Autoclave and cooling system for blower motor winding shall be as per the approved procedure & assembly drawings.		
3.	**6.**	**3.**	Performance test of individual components and in full assembly of Air circulation system shall carried out at Vendor's site as well as Purchaser's site.		
3.	**7.**	**0.**	**Surface Preparation & Painting Scheme:** Refer Section-C/Clause-18 for Surface Preparation & Painting.		
3.	**8.**	**0.**	**Erection & Commissioning** Erection & Commissioning of Air Circulation System shall be as per the scheme approved by the Purchaser. Refer Section-C/Clause-17.		
3.	**9.**	**0.**	**Inspection &Testing – Indicative QAP contd.**		

AIR CIRCULATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
	Raw Material Inspection									
1	AISI 316 sheet for Air Duct, Studs etc	Mill certificates, Dimensional measurement	100%	ASTM A240, Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	AS	-	I, C	
2	Blower Fan Hosing	Mill certificates, Dimensional measurement	100%	Relevant ASTM standard, Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	AS	-	I, C	
	Blower Fan:									
3	Casing (Front plate Back Plate and Scroll), Belt guard and base frame, Fan Cabinet, Coil casing, Header pipe, Copper Tube, U-bends, Filters	Visual Inspection, Physical & Chemical Analysis	100%	Relevant Codes of Practice, Approved drawing & Procedure	Material Test Certificates, Test Reports, Inspection reports	√	V	-	AS, C	
4	Fan Shaft, Impeller (Back Plate, Front Shroud and Blades)	Physical & Chemical Analysis, Surface Defects by UT &LPT, Visual & Dimensional Inspection	100%	ASTM A240, A388 with acceptance level SA 578 level C, Other relevant standards, Specification's document/Approved drawings.	Material Test Certificates, Test Reports, Inspection reports	√	V	-	AS, C	
	Material Stamp transfer									
5	Material Stamp transfer after marking, before cutting.	Stamp transfer.	100%	Approved Drawing	-	√	AS	-	I, C	
	Bought -Out Items /Inward Items Inspection									
6	Details of all bought out items, shall be submitted for Purchaser's approval.	Visual Inspection, Suitability as per Specifications, Approved drawings, & Design reports	100%	Specifications Document, Approved drawings & design report	Visual Inspection report, technical specifications, Operation & maintenance manuals, data sheets, OEM	√	AS	-	I, C	

AIR CIRCULATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
					certification, Warranty certificates, Performance reports along with supplier's address					
	Blower Fan with Motor									
7	Welding procedure, Inspection of machined components (Hub, Bush, lock plate etc. as per suppliers QAP)	Review, Visual inspection & Dimension measurement	100%	AWS D1.1, Manufacturing Drawings	WPS, PQR, Inspection report	√	V	-	AS, C	
8	Blower fan inspection after machining	Visual inspection & Dimension measurement, Inspection of Blade profile, Pitch, Direction of blade, Surface finish	100%	Manufacturing Drawings, Relevant Approved Design-Analysis report & Drawings	Inspection report	√	V	I	AS, C	
9	Hydrostatic and pneumatic pressure test for cooling coils	Leak test	100%	ASME Sec VIII Div. 1 and specification	Inspection Report	√	V	-	AS, C	
10	Dynamic balancing of Impeller	Visual	100%	As per ISO 1940 Gr. 6.4	Test Certificate	√	V	AS, I	C	
11	Pressurized Electric Motor	Performance Test	100%	Relevant code of Practice	Test Certificate	√	V	AS	C	
12	Cooling water Pump for cooling of blower motor winging	**Mill certificates** for Pump Casing, Impeller, Pump Shaft, Shaft Sleeve. **Hydro-static test** of Casing. **Dynamic balancing & Run-out**< 0.06mm of Impeller & Shaft.	100%	As per ISO 1940-dynamic balancing, ASME Sec VIII Div.1 for hydro test, API-610-Performance of pump, NPSH, Mechanical run & Vibration test	MTC, Test reports, Inspection reports, technical specifications, Characteristic curves, operation & maintenance manuals, data sheets, OEM certification,	√	V	I, AS	C	

AIR CIRCULATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
		Visual & Dimensional inspection of Pump Assembly. **Pump Performance Test-** differential head, power consumption and efficiency. **NPSH test, Mechanical run test**for 4 hrs., **Vibration test**			Warranty certificates, Performance reports along with supplier's address					
	In Process Inspection									
	Blower/Fan Assembly to Autoclave									
13	Fixing of Insulation box on the blower port cover	Fix the pre-fabricated and well packed with insulation material to the blower port flange. Ensure that it is concentric and properly fixed.	100%	Approved Drawing & Procedure/ Relevant code of practice	Stage Inspection Report	√	AS	-	I, C	
14	Assembly of blower motor with fan on the autoclave	Check for concentricity & proper assembly	100%	Approved Drawing & Procedure/ Relevant code of practice	Stage Inspection Report	√	AS	I, C	-	
15	Performance testing of Assembled fan with motor	Fan run test for 4hrs at rated values, Air Delivery pressure, Static Pressure, Air Velocity, Pressure difference, Efficiency, Noise < 85bB, Vibration	100%	ASME PTC-13, Relevant code of Practice, Technical specification, Performance Data sheets	Inspection Report	√	V	AS	C	

AIR CIRCULATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
	Air Circulation Duct Installation									
16	Inspection & Installation of ducting inside Autoclave	Visual, Profile &dimension Inspection, Gaps in between insulation shell & duct shell, No-gap between Heat exchanger & Autoclave Platform, Gap between Heat exchanger & Closing Plates, Air leakage, Waviness, Duct ID measurement after assembly	100%	Approved Drawing & Procedure, Specifications document/ Relevant code of practice	Stage Inspection Report	√	AS	I, C	-	
	Surface Preparation & Painting									
17	Surface Preparation & Painting	Visual Inspection & Dry Film thickness measurement	100%	As per approved scheme for surface preparation & painting	Inspection Reports	√	AS	I	C	
18	Painting Inspection	Shade conformance	100%	As per approved shade	Inspection Reports	√	AS	I	C	
	Final Certification									
19	Design Data Stamping			As per Approved drawing, ASME code & Design reports		√	AS	I	C	
	Pre-Delivery Inspection (FAT)									
20	Performance testing of Assembled fan with motor	Air Delivery, Static Pressure, Air Velocity, Pressure difference, Efficiency, Noise, Vibration	100%	Relevant code of Practice, Technical specification, Performance Data sheets	Inspection Report	√	AS	I, C	-	

AIR CIRCULATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
21	Performance Test of Air circulation system in full assembly	Visual Inspection, Air Velocity at various locations especially at indicated critical zones, Function Test-Inspection of performance of air circulation system	100%	Specifications document & Approved drawings, Design & Analysis report	Inspection Reports	√	AS	I, C	-	
	Final Acceptance (Site Acceptance Test)									
22	Performance Test of Air circulation system in full assembly	Spatial Variation of Temperature after 10 min of stabilization in pressurized and non-pressurized condition inside autoclave along with functional tests	100%	As per specifications document	Inspection report	√	AS	C	-	
23	Hot Air Autoclave Plant assembled with all sub-systems	Trial Runs & Functional Requirement tests of entire plant for all operations	100%	As per specifications document	Inspection report	√	AS	C	-	
	D* - Records identified with tick [√] shall be essentially included by supplier in QA documentation.	**MTC – Material Test Certificate, SIR-Stage Inspection Reports IR – Inspection Report, LPT-Liquid Penetrant Test, P-Perform, W-Witness, R-Review/Clearance**		**MPT-Magnetic Particle Test, UT-Ultrasonic Test, RT-Radiography**	**AS – Autoclave Supplier, V-Manufacturer / Vendor, I– Third Party Inspector C– Purchaser/Customer (SDSC-SHAR, ISRO)**					
Note:										

AIR CIRCULATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
1	Testing by suitable method shall be done at NABL certified laboratories only. The NDT Reports shall be certified and approved by minimum ASNT/ ISNT Level-II qualified personnel.									
2	Equipment / material shall not be dispatched / shipped to site until written dispatch clearance is given by Purchaser.									
3	Authorized inspection engineers shall sign off the approved QAP on completion of inspection from each agency.									
4	In the absence of specified standards and where ever there is a conflict between the specification given & the standard code, sound engineering practice shall be followed with the approval of the Purchaser.									

				Bidder's Compliance (Yes/No)
4.	**0.**	**0.**	**PRESSURIZATION & DE-PRESSURIZATION SYSTEM FOR HOT AIR AUTOCLAVE PLANT**	
			The medium of pressurization for Hot Air Autoclave Plant is dry compressed air free from traces of oil and moisture. Pressurization & De-pressurization system constitutes **i.** 2Nos. of Oil Free Reciprocating Air Compressors with centrifugal cooling water pumps **ii.** 1 No. of Air Dryer **iii.** 1 No. of stainless steel Air Receiver **iv.** Process air pipeline with flanges & fittings **v.** Flow Control Valves, Isolation Valves, Manual by-pass Valves **vi.** Related Instrumentation & Control system	
4.	**1.**	**0.**	**Functional Requirement:**	
4.	**1.**	**1.**	2 Nos. of Reciprocating Compressors working at 10.0 bar, each with capacity to pressurize Autoclave at 3.0 bar/hr. shall be connected to a single air dryer unit. Dried air free from traces of oil and moisture shall be accumulated in Air receiver. Based on demand during Autoclave operation, Air is fed into Autoclave through control valves from the air receiver.	
4.	**1.**	**2.**	Each Reciprocating compressor shall be water cooled with individual centrifugal water pumps connected to common cooling tower unit for compressors. Cooling water circuit of one of the compressors shall act as redundant for the other compressor's cooling water circuit in case of need. To serve the purpose, cooling water circuits of each compressor shall be connected with a pipeline with a valve for change over. Entire cooling water line for compressor units shall be of Stainless Steel. Also, cooling water circuit shall have filters with clog status indicators ensuring no contamination reaches the service equipment.	
4.	**1.**	**3.**	Parameters of all the equipment in the pressurization & de-pressurization systems shall be interfaced with Autoclave PLC for logging, control & monitoring purpose.	
4.	**1.**	**4.**	These two compressor units along with cooling water circuits, Air Dryer & Air Receiver shall also operate individually without link with Autoclave control unit. However, during Autoclave operation, critical parameters based on user requirement shall be displayed in Autoclave SCADA screen and logged.	
4.	**1.**	**5.**	Refer Section- C Clause No.: 9,10,11 along with P&I Diagram in Annexure-VII for Operation, Control & Monitoring.	

				Bidder's Compliance (Yes/No)
4.	**2.**	**0.**	**Specifications**	
4.	**2.**	**1.**	**Compressors:** a. Suitable 2 Nos. of Oil Free Reciprocating Air compressors for meeting the Autoclave process requirement of 3 bar/h pressurization rate shall be selected with Profibus/ Profinet interface capability. b. Each reciprocating compressor shall ~ 1500 m^3/h with working pressure 10.0 bar g c. Refer Schematic of Compressor P&I Diagram in Annexure-VII for the configuration of the compressors. d. Cooling water lines for each compressor shall be connected such that both the cooling water pumps act as redundant to each other. Capacity of the cooling water pumps shall be selected to cater this redundancy. e. Cooling water pumps for each compressor shall be centrifugal pumps connected to cooling tower for compressor units as shown in P&I diagrams in Section-D/Annexure-VII All joints shall be Stainless steel flanged type joints.	
4.	**2.**	**2.**	**Air Dryer:** a. 1 No. of Air Dryer of capacity ~ 1500 m^3/h with working pressure 10.0 bar g and dew point 4^0C or better shall be selected connected in common to both the compressors. All joints shall be Stainless steel flanged type joints.	
4.	**2.**	**3.**	**Air Receiver:** a. 1 No. of stainless steel Air Receiver of capacity 6 m^3 with design pressure 11.0 bar g with accessories like safety relief valve, pressure transmitter, pressure gauge & drain valve suitable for Autoclave volume shall be designed as per ASME Sec VIII Div1. b. Air receiver shall have man hole, 3 Nos. of blinded spare ports for inlet & outlet for compressed air. c. Plates used for Air receiver shall be UT tested irrespective of thickness d. Nozzles shall be from seamless pipes. e. Flanges shall be forged. f. Dished ends shall have no joints. g. All butt welds shall be 100% radiographed as per ASME Sec V with 2-2T sensitivity h. All joints shall be flanged type. i. Flanges shall be forged SORF with concentric serrations. j. No nozzles shall be within 100mm of heat affected /weld zone.	

				Bidder's Compliance (Yes/No)
4.	**2.**	**4.**	**Compressed Air pipeline:** a. Compressed Air circuit connecting 2 Nos. of Compressors, Air Dryer & Air receiver along with all necessary accessories with suitable tapping points shall be with seamless stainless steel, 304L as per A312 supplied by the supplier. Supplier has to extend the air supply from this point with necessary controls. b. Pneumatic line (pressurization and de-pressurization) of autoclave connected with control valves and fittings, from compressed air supply point to autoclave inlets and from autoclave outlets to external vent lines to meet the operational requirement. c. All the measuring parameters of the compressors, air dryer & air receiver shall be interfaced with main Programmable Logic Controller (PLC) in addition to the display in local displays of each equipment. d. Flanges shall be forged SORF with concentric serrations. e. Pipeline fittings shall be seamless buttweld type. f. Details of the compressed air supply line shall be finalized on mutual agreement between purchaser and vendor.	
4.	**2.**	**5.**	**Air Venting pipeline:** a. Air exhaust from autoclave process shall vent out to a safe place outside the building through stainless steel vent pipe during pressurization maintenance and de-pressurization cycles. b. Venting shall be controlled by electrically/electro-pneumatically operated proportional control valves. c. Vent pipes with suitable anchor/support structures and thrust plates shall be designed, supplied and installed to meet the requirements as per the code. d. Generated thrust reactions during venting shall be nullified. e. Design shall take into account, limiting the back pressure during venting operation within the acceptable limit and making the system fool proof against accumulation of liquids/ rainwater, foreign matter, corrosion etc. f. Material of construction of the vent pipes associated with SRV and Burst disc shall be of stainless steel. g. **Air Muffler:** Venting shall be through silencer to limit the sound level to maximum of 85 dB A measured from a distance of 1m. h. Details of the venting scheme shall be furnished during detailed engineering. i. All joints shall be flanged type. j. Flanges shall be forged SORF with concentric serrations.	

				Bidder's Compliance (Yes/No)
			k. All the Venting pipeline shall be of stainless steel. l. Flanges shall be forged, fittings shall be seamless stainless steel & valves shall be flanged type. Flanges shall be forged SORF with concentric serrations.	
4.	**2.**	**6.**	**Valves for Pressurization and De-pressurization system:** a. Pressurization and de-pressurization of autoclave is to be done via electro-pneumatically operated proportional flow control valves (FCV) with smart positioner. Each FCV shall have manually operated isolation valves at both the ends in series and a common manual by-pass valve in parallel to both the FCVs. b. There shall be main and redundant lines for pressurization which merges into a common line at inlet of the autoclave. Both the lines are to be fitted with FCVs, isolation and bypass valves. c. There shall be a manually operated valve with position/status indicator at the common compressed air inlet line of the autoclave. There shall be a pressure transmitter with display indicating the inlet compressed air pressure available for autoclave process. d. There shall be vent line from the autoclave, which bifurcates into three separate line and then merges together to form a single vent line – One line for main de-pressurization line with main FCV and series isolation valves, second line with redundant FCV and series isolation valves and third with manual bypass valves. Both the FCVs shall be electro-pneumatically operated. e. Position feedback of all FCV/manual valves shall be interfaced with the PLC. All valves shall be at an accessible height from the ground level for ease of the operation. f. Instrument air requirement for valves operation shall be met from the supply of compressor for instrument air. g. **Filters:** Compressed air shall be passed through a system of filters of adequate air flow capacity for removal of particles of up to 25-micron size and oil. Filtration area shall be 10 times more than the pipe cross-section. Charging filters shall allow flow with 50% clogged condition. Overall size of filters shall be optimum. Filter clog status shall be interfaced with PLC. h. All valves & filters shall be flanged type	
4.	**2.**	**7.**	**Pressurization control system:** a. The entire pressurization system shall be designed and built with appropriate instrumentation and control system to facilitate in three modes of operation namely AUTO,	

				Bidder's Compliance (Yes/No)
			DISCRETE and MAINTENANCE MODE as detailed out under instrumentation and control system in Section-C/Clause 9,10 & 11. b. The default pressurization path is to be preset in the user interface. If the default path fails, pressurization is to be done via the redundant path giving a Pop-Up intimation in the SCADA with acknowledgement to the user. c. The control system shall be designed to limit the difference between set point and process variable to 0.1bar maximum. d. FCVs shall be PID controlled for achieving accurate and smooth pressure control as per defined cure cycle. There shall be two pressure transmitters to monitor and control autoclave pressure in AUTO MODE and one pressure transmitter to monitor and control autoclave pressure in MAINTENANCE MODE. e. In case of power failure, the air outlet shall be closed to maintain controller set pressure inside the autoclave.	
4.	**2.**	**8.**	**Compressor for Instrument Air & Instrument air circuit:** a. An air-cooled compressor mounted on a vertical air receiver of suitable size shall be provided to cater the needs of Rail bridge operation, Instrumentation process control, Valve actuation etc. b. Instrument airline shall be with seamless Stainless-steel tubing and respective seamless stainless-steel fittings as per standard codes, ASME B1.1 Stainless steel double ferrule compression tube fitting, ASTM 276, ASME SA 479 -Straight fittings and tube adapter and ASTM A 182, ASME SA 182 for elbow, cross and tee fittings) c. All details of compressor and air receiver selection shall be provided to the purchaser for acceptance. d. Inter connection shall be provided between instrument air compressor line and process air compressor line as redundancy. e. Compressor shall have Profinet/Profibus interface compatibility and critical parameters for monitoring shall be interfaced with main SCADA. Refer Section-C/Clause-9 & 11 for more details	
4.	**3.**	**0.**	**Documentation – Compressed Air System** Refer Section-C Clause 15 in conjunction with the below	
4.	**3.**	**1.**	Following reports shall be submitted to the purchaser a. **Design Report** for Compressed Air system & Instrument Air system of Hot Air Autoclave Plant. b. **Report on selection criteria, detailed specifications** of all bought-out items viz., Process Air compressors,	

					Bidder's Compliance (Yes/No)
			Instrument air compressor, centrifugal pump, Air receiver, Air dryer & Chiller units, supported with detailed calculations as per relevant codes of practice & compliance with PO specifications document of Compressed Air system & Instrument Air system of Hot Air Autoclave Plant. c. **Report on selection of Piping size, Safety Relief Valves, Flow Control Valves, Flanges & Fittings selection** Plant as per the standard code.		
4.	**3.**	**2.**	Following drawings shall be submitted to the purchaser a. **General Arrangement Drawing:** General Arrangement drawing for Compressed Air & Instrument Air System of Hot Air Autoclave plant. b. **Foundation load distribution drawings of the following** indicating load distribution (in KN)for Compressed Air & Instrument Air System equipment viz., Process Air compressors, Instrument air compressor, centrifugal pump, Air receiver, Air dryer & Chiller units of Hot Air Autoclave plant. c. **Process & Instrument Air Piping layout and Venting line layout** of Hot Air Autoclave Plant as per the standard code. d. **Fabrication drawings** for Air receiver along with detailed weld maps. e. **Detailed P&ID** for Compressed Air system & Instrument Air system of Hot Air Autoclave Plant f. **Detailed Power & Control drawing** for Compressed Air system & Instrument Air system of Hot Air Autoclave Plant g. **As built drawings** Process & Instrument Air piping layout and Venting line layout of Hot Air Autoclave Plant with clear indication of revisions/amendments.		
4.	**4.**	**0.**	**Material of Construction**		
			Description	**Material**	
			Air Receiver		
4.	**4.**	**1.**	Plates for Air Receiver, blinds for ports	Stainless Steel as per ASTM A 240	
4.	**4.**	**2.**	Nozzles/Ports for Air Receiver	Seamless SS pipes as per ASTM A 312	
4.	**4.**	**3.**	Nozzle Flanges	Forged ASTM A 182	
4.	**4.**	**4.**	All reinforcement pads/ pressure pads/support pads	Stainless Steel as per ASTM A 240	
4.	**4.**	**5.**	Pipes for Nozzles/ports	Seamless SS pipes as per ASTM A 312	

					Bidder's Compliance (Yes/No)
4.	**4.**	**6.**	Fittings	As per ASTM A403	
4.	**4.**	**7.**	Supports	Stainless steel ASTM A 240	
4.	**4.**	**8.**	Gaskets for joints	EPDM/ Viton withstanding 100^0C & 11.05 bar pressure	
4.	**4.**	**9.**	Bolting	As per ASTM A193 bolts with ASTM A 194 nuts	
			Compressed Air Pipeline		
4.	**4.**	**10.**	Pipes	Seamless Stainless steel, ASTM A312	
4.	**4.**	**11.**	Fittings	Seamless butt weld fittings, ASTM A403	
4.	**4.**	**12.**	Flanges	Forged flanges of SORF type with concentric serrations, ASTM A 182	
4.	**4.**	**13.**	Valves	Stainless steel as per ASTM A 182 as per ASME 16.34	
4.	**4.**	**14.**	Bolting	As per ASTM A193 bolts with ASTM A 194 nuts	
4.	**4.**	**15.**	Gaskets for joints	EPDM/ Viton withstanding 100^0C & 11.05 bar pressure	
			Instrument Air Tubing		
4.	**4.**	**16.**	Instrument air tubing	Stainless steel, ASTM A312	
4.	**4.**	**17.**	Stainless steel Tube fittings	ASTM 276-Straight fittings and tube adapter and ASTM A 182 for elbow, cross and tee fittings	
4.	**4.**	**18.**	Stainless steel Valves	ASTM A217	
4.	**5.**	**0.**	**Preferred makes** In case the supplier is planning to use different make other than as per the list below, prior approval for the same shall be obtained from the purchaser. However, purchaser reserves the right to reject such proposal.		
4.	**5.**	**1.**	Plates	M/s.SAIL/TATA/JINDAL/VIZAGSTEEL/ESSAR	
4.	**5.**	**2.**	Forged Flanges	M/s Rajmani/Bhavya forged/United Forge Industries/Metal Forge India/HindustanForgings	
4.	**5.**	**3.**	Fittings	M/s Metal Forge India/Rajmani/Vaibhav/United Forge Industries/Bharat forge & fittings/Metline	
4.	**5.**	**4.**	Pipes	M/s Tubetec/Shree Impex Alloys/Metline/ Amtex/ Maharashtra seamless/ MA international	
4.	**5.**	**5.**	Instrument Air Tubing fittings	M/s Parker/ Swagelok/Insap	

					Bidder's Compliance (Yes/No)
4.	**5.**	**6.**	Fasteners	TVS/MA Trade Syndicate/ Hussainy/ Sakthie / Maarg /ITA fasteners	
4.	**5.**	**7.**	Manual Valves	BDK/Leader/Marck/Audco/L&T/Virgo/Micro finish/Velan/ Flowserve	
4.	**5.**	**8.**	Filters	Placka/Shavo	
4.	**5.**	**9.**	Reciprocating compressor	Atlas Capco, Chicago Pneumatic, Ingersoll rand with Profinet/Profibus interface compatibility	
4.	**5.**	**10.**	Air Dryer	GeM, Chicago Pneumatic, Ingersoll rand with Profinet/Profibus interface compatibility	
4.	**5.**	**11.**	Cooling water pumps for compressors	Shakthi, Kirloskar, Havells, Grundfos, CRI	
4.	**5.**	**12.**	Safety Relief Valves	Crosby, Tyco SanMar, Lesser	
4.	**5.**	**13.**	Cooling tower for compressor units	Paharpur/Artech	
4.	**5.**	**14.**	Paint	Berger/ Asian Paint/Flosil-Bet coatings/Grand polycoats	
4.	**6.**	**0.**	**Indicative Fabrication methodology:** Fabrication shall be done as per the approved fabrication methodology		
4.	**6.**	**1.**	**Raw material Selection:** a. Raw material selection for Air Receiver shall be as per ASTM and ASME Sec VIII Div. 1 standards. b. All the plates used for Air Receiver shall be rolled and normalized. c. All the plates shall be laminar flow defect free and UT tested irrespective of sheet thickness. UT shall be as per ASTM A388 and acceptance level as per ASME SA 578 acceptance level C procedure as per ASME Sec V with 2-2T sensitivity. d. Nozzles shall be from seamless pipes. e. All flanges shall be forged type, SORF (Slip on raised flanges) with concentric serrations. f. Blinds for the nozzles or ports on vessel shall be forged as per ASTM A105 as per design. g. Reinforcement pads shall be form UT tested SA 516 Gr 70 plates. h. All wetted parts of the Instrument Air & Compressed process air circuit shall be of stainless steel i. Flanges for pipe joints shall be forged type SORF with concentric serrations.		
4.	**6.**	**2.**	**Fabrication** a. **Process Compressed Air circuit:** Pipe joints shall be flanged. No threaded joints are acceptable. Where ever,		

				Bidder's Compliance (Yes/No)
			threaded joints are required, companion flange shall be provided. b. All the pneumatic pipelines, flanges, fittings & valves shall be flanged type of seamless Stainless-Steel pipes. c. Flanges shall be forged SORF with concentric serrations. d. Pipeline fittings shall be seamless buttweld type. e. **Instrument airline:** Instrument airline shall be seamless stainless-steel tubing as per ASTM A 269 and fittings shall be Stainless steel double ferrule compression tube fitting as per ASME B1.1 and ASTM A 403 WP. All instrument air tubing and fittings shall be imperial sizes, expressed in nominal outside diameter (OD) and all threads shall be NPT Tubing and fittings shall be of 316 SS conforming to ASTM A269.The minimum size shall be ¼ inch OD. Tubing runs shall be supported and protected. Tube fittings shall be of double ferrule, pressure seat, no torque type and shall be of reputable makes (such as Swagelok or Parker). Ferrule and nut shall be of the same material as the fittings. Flare type fitting shall not be used. f. **Threaded of Instrument Air line connections** shall be NPT for all components and piping and tubing systems for process and utilities connections. TFE threads sealant shall be used on all threaded connections. Tape shall not be used. Tubing shall be supported and protected by stainless steel angle / channel or ladder / tray along the complete length of each run and shall be fastened with stainless steel saddles at a maximum of 1 m intervals on straight runs. Channel or tray support for tubing runs shall be sized for a minimum capacity of 30% greater than that required. All pneumatic exhaust ports and breathers shall be fitted with bug screens, installed facing downwards. Hardness for tubes shall not exceed RB 70 –79 and hardness for fittings (ferrules) shall be such that, there is a minimum hardness difference of 5 to 10 between tube and fittings for better sealing. g. **Air Receiver:** Plates shall be selected such that shell of the vessel shall be with least possible no. of plates and joints. Dished ends with no joints. Shell & Dished ends shall be stress relieved following standard code of practice, ASME Sec VIII Div.1 (PWHT as per UCS-56). h. UT tested rolled and normalized plates shall be marked and cut as per approved drawing & procedure. Identification shall be transferred on to the marked plates before cutting.	

				Bidder's Compliance (Yes/No)
			i. Manhole flange & cover flange shall be forged type. Forged flanges shall be UT tested as per ASTM A388 standard code of practice. j. All nozzles & ports on the vessel shall be supported with reinforcement pads. k. Nozzle openings not to pierce any weld seam. l. Nozzle flanges shall be forged type SORF with concentric serrations. m. Marking of nozzles/ports shall be done such that no nozzle or port is within 100mm of the heat affected zone Plates, nozzles and fittings shall be prepared as per approved fabrication drawings.	
4.	**6.**	**3.**	**Process Air Pipeline Welding:** a. Welding procedure (WPS, WPQ, PQR) should comply ASME Sec IX and ASME 31.3, API 1104 and approved weld map. b. GTAW for root welding and SAW/SMAW for subsequent passes shall be employed ensuring full penetration for all weld joints of Compressed air & Instrument air system. c. All butt weld shall be full penetration weld. d. All weld joints in pipeline circuit shall be DP tested at root pass and final pass. e. Flange faces shall be kept free from weld spatter and arcstrike. f. Backing rings shall not be used. g. PWHT of pipelines shall be in accordance with ASME 31.3. h. Where welds are to be produced between differing grades of stainless steels, the weld procedures, electrodes, filler wires, welding techniques, etc., shall be those required by the higher grade of material. i. All electrode and filler wires shall comply with AWS A5.4 and AWS A5.9. Electrodes to be used for general butt welding of austenitic stainless steel will be rutile type EXXX-16. j. **Grinding Wheels:** For Austenitic Stainless-Steel Pipes, Grinding shall be carried out using resin bonded alumina or silicon carbide grinding wheels. Rubber bonded wheels or wheels containing Sulphur shall not be used. Wheels previously used on ferritic steels shall not be used on the carbon steels. k. **Wire Brushes:** All wire brushes used on austenitic stainless-steel pipes shall be of stainless steel.	

<table>
<tr><td></td><td></td><td></td><td></td><td>Bidder’s Compliance (Yes/No)</td></tr>
<tr><td></td><td></td><td></td><td>Air Receiver Welding:
l. Welding procedure (WPS, WPQ, PQR) should comply ASME Sec-IX and approved weld map.
m. GTAW for root welding and SAW/SMAW for subsequent passes shall be employed ensuring full penetration for air receiver.
n. All butt weld shall be full penetration weld.
o. All weld joints in pipeline circuit shall be DP tested at root pass and final pass.
p. Double V shall be used for shell joints and J-Joint should be avoided.
q. All the joints shall be back chipped and DP Tested. Where-ever back chipping is not possible, root weld to be done by GTAW to have full penetration joint. Any other advanced welding methodology can be adopted with prior approval from the purchaser.
r. All joints of Air receiver shall be stress relieved as per ASME Sec VIII Div.1 (UCS-56).
s. 100% radiography shall be carried out for all butt-weld (longitudinal & circumferential seam i.e., A, B and C type). Acceptance criteria for Radiography shall be as per ASME Sec V with 2-2T sensitivity (UW51-Full Radiography).
t. Root passes for welds including reverse back gouging and grinding shall be inspected and cleared by DP test where ever applicable.
u. Nozzles shall be welded by full root weld by GTAW &final welding by SMAW or SAW and shall be examined by DP test.</td><td></td></tr>
<tr><td>4.</td><td>6.</td><td>4.</td><td>All fittings, Valves & flanges shall have identification marks punched and easy be visible after assembly</td><td></td></tr>
<tr><td>4.</td><td>6.</td><td>5.</td><td>Pipeline circuit shall be hydro tested at Purchaser's site after assembly as per ASME Sec VIII Div.1. After hydro-test, no hot work shall be carried out on vessel.</td><td></td></tr>
<tr><td>4.</td><td>6.</td><td>6.</td><td>Instrument air tubing circuit shall be pneumatic tested at Purchaser’s site as per ASME Sec VIII Div.1 after assembly.</td><td></td></tr>
<tr><td>4.</td><td>7.</td><td>0.</td><td>Surface Preparation & Painting Scheme: Refer Section-C/Clause-18 for Surface Preparation & Painting in addition to the below</td><td></td></tr>
<tr><td>4.</td><td>7.</td><td>1.</td><td>Painting scheme
<table>
<tr><td></td><td>Surface Preparation</td><td colspan="3">Painting</td></tr>
<tr><td></td><td></td><td>Primer Coat</td><td>Intermediate Coat</td><td>Finish Coat</td></tr>
<tr><td>Air Receiver</td><td>Blast cleaning</td><td>Inorganic Zinc</td><td>-</td><td>Berger thane</td></tr>
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<tr><th></th><th></th><th></th><th></th><th>Bidder's Compliance (Yes/No)</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td></td><td>to Sa 2 ½ grade</td><td>ethyl-silicate: Two coats with min. 65µs DFT per coat</td><td></td><td>finish or equivalent: Min. 30 µs DFT</td></tr>
<tr><td>Piping</td><td>Mechanical wire Brushing</td><td>BP ROZC IS2074 or equivalent: Min. 30 µs DFT</td><td></td><td>Berger thane finish/ epoxy paint or equivalent: Min. 30 µs DFT</td></tr>
</table>
</td><td></td></tr>
<tr><td>4.</td><td>8.</td><td>0.</td><td>Erection & Commissioning</td><td></td></tr>
<tr><td>4.</td><td>8.</td><td>1.</td><td>Refer Section-C/Clause-17 for erection & commissioning in addition to the below</td><td></td></tr>
<tr><td>4.</td><td>8.</td><td>2.</td><td>Erection of Pipeline/Tubing involves
a. Installation of in-line instrument items like manual valves, control valves, flow meters/transmitter, measuring gauges, safety valves, line mounted filters, expansion joints etc.
b. Fabrication & erection of pipe supports including both shop and field fabrication include cutting, threading, bending, welding, bolting, etc.
c. Administration of material certificates, welding operations and execution, administration of all destructive & non-destructive examination and all testing operations as required by the applicable procedure and standards.</td><td></td></tr>
<tr><td>4.</td><td>8.</td><td>3.</td><td>Pipeline erection
Specification Standards referred below shall be the latest editions, including all revisions and addenda.
a. Process Piping: ASME B31.3
b. Pipe Flanges: ASME B16.5
c. Stainless-Steel Butt-welding Fittings: ASME B16.9
d. Pipeline Welding design: API 1104
e. Valves: ASME B16.34</td><td></td></tr>
<tr><td>4.</td><td>8.</td><td>4.</td><td>Piping Fabrication and Erection Specification
All attachments to piping i.e., saddles, pads, etc. are to be made of same material to the pipe.</td><td></td></tr>
</table>

				Bidder's Compliance (Yes/No)
4.	**8.**	**5.**	**Tolerances:** a. **Pipe Dimensions:** Tolerances shall be ±1.5mm from flange face to flange face, or center line of pipe to flange face. b. **Flange Face:** Flange faces shall not be concave. Convexity from flange bore to joint face periphery shall not exceed 0.15mm per centimeter width of joint face. c. **Squareness of Flanges:** Flanges shall be square to the axis of the pipe to within an angle of 0° - 18' (0.3°) i.e., 0.05mm per centimeter measured across the face of the flange, with the pipe adequately supported. **Bolt Holes of Flanges:** Flange bolt holes shall straddle the established centerlines (Horizontal or vertical). However, flanged connections on equipment may vary and should be individually checked. When these connections differ, the bolt hole orientation shall be indicated on the isometric piping detail sheet. Holes in double flanged pipes shall be correctly aligned.	
4.	**8.**	**6.**	**Weld Details:** a. **Butt Welds:** The term "Butt-Weld" refers to circumferential butt joints only. Special requirements may be imposed where longitudinal welds are to be made and these welds shall be carried out only with the approval of the purchaser. No Longitudinal and Spiral welds are accepted. b. **Weld Preparation** shall be in accordance with ASME 31.3 and the following: c. Weld ends shall be beveled or square cut for welding as follows: i. Beveled for wall thickness greater than 2.3mm ii. Square cut for wall thickness 2.3 mm and less iii. **Root Gaps:** Spacers shall be used while tack welding pipe and fittings in position to insure proper gap and full penetration in welding. The tack welds complying with the requirements of ASME B31.3 and API 1104 may be allowed to become a part of the finished weld, whereas those not complying are not acceptable and must be chipped out before completing the weld.	
4.	**8.**	**7.**	**Bore Matching and Alignment:** Bore matching and alignment shall be in accordance with ASME B31.3. Where pipe, fittings and flanges are to be joined by circumferential butt-welds, the corresponding parts shall be modelled and matched so that any misalignment at the inside of the piping	

				Bidder's Compliance (Yes/No)
			shall not exceed 1/16 inch at any point of the circumference of the joint. Fit-up work may include pressing, hammering, local heating or grinding as required to reduce any misalignment due to diameter tolerances, out-of-roundness or unequal wall thickness of the parts of less than 1/16 inch. parts having unequal wall thickness and bores shall be prepared in accordance with ASME B31.3.	
4.	**8.**	**8.**	**Cutting:** a. Pipes may be cut mechanically by sawing or grinding machine. b. Cutting method involving heating e.g., Flame or arc cutting for carbon steel are allowed providing the cut edge is machined or ground back sufficiently far to give specified parent material properties at the cut edge with a minimum of 1.5 mm. c. Plasma-jet cutting may be use to cut austenitic stainless-steel pipes and other materials. d. Flame cutting of austenitic stainless-steel pipe is not allowed.Other methods of cutting may be employed only with the approval of the Purchaser.	
4.	**8.**	**9.**	**Welding Position of Longitudinal Seams:** Longitudinal seams in seam welded pipe shall be located so as to clear openings and external attachments possible. Longitudinal seams in adjoining courses shall be preferably at 180°but a minimum between seams is in accordance with construction specification.	
4.	**8.**	**10.**	**Branch Welds:** Branch connections shall be located as indicated on the piping detail sheet or isometric piping drawings. All branch connections shall be designed in accordance with ASME B31.3. Forged or extruded branch connections are preferred.	
4.	**8.**	**11.**	**No Fitting:** Branches shall be of 'Stub-in' design in accordance with Construction ASME B31.3.	
4.	**8.**	**12.**	Forged branch attachments (Branchlets) shall be of the type specified on approved drawings and fitted accurately to the contours of the run pipe.	
4.	**8.**	**13**	**Mitered Bends:** Mitered bends shall be in accordance with piping material specification ASTM A 312. The number of cuts shall be as stated on the drawing. Mitered bends are used only when specified on the drawings and shall be in accordance with ASME B31.3. A joint efficiency not exceeding 70% shall be used in the strength calculations for mitered bends. The welds in mitered bends shall penetrate the full thickness of the pipe and the bead on the inside of the	

				Bidder's Compliance (Yes/No)
			throat shall be smooth and have an even curvature. In order to prevent a notch effect.	
4.	**8.**	**14.**	**Beveled Ends:** Construction Specification as per ASME B31.3.	
4.	**8.**	**15.**	**Fillet Welds:** Construction Specification as per ASME B31.3.	
4.	**8.**	**16.**	**Bending**: Bends shall conform dimensionally to the drawings and relevant clauses of this specification. Hot bend is not permitted.	
4.	**8.**	**17.**	**Valves:** Valves shall be located in accessible areas. Install valves so that the stems are not below a horizontal position. Orient all valves so that the hand wheels do not obstruct passageways.	
4.	**8.**	**18.**	**Flanged Joints**: Protect all flange faces from damage. Take care not to mar the faces of the flanges. Bring all flanged joints up flush so that the entire flange face bears uniformly on the gasket, and then take up with uniform bolt tension. In bolting joints with spiral wound gaskets, the gasket shall be compressed until the raised faces of the flanges uniformly contact the compression gauge ring.	
4.	**8.**	**19.**	**Flanged Equipment Connection**: A flange cover shall be kept on all flanged connections to pumps, compressors, turbines, and similar equipment until ready to connect the piping. Piping connecting to mechanical equipment, such as pumps and compressors shall be fit-up in close parallel and lateral alignment, prior to tightening the bolting the joints. The installation shall be approved by the Purchaser prior to tightening the bolting. Carbon steel piping that has not required post-weld heat treatment may be heated for minor corrections in fit. The temperature shall not exceed 660℃. Cooling of the pipe shall not be accelerated by the application of water. Purchaser shall be notified when heating for fit-up is required.	
4.	**8.**	**20.**	**Restrictions:** All restrictions which would interfere with filling, venting, draining, or flushing shall not be installed until after completion of the pressure test and line flushing operations. This includes flow nozzles, meters and similar in-the-line equipment.	
4.	**8.**	**21.**	**Temporary Gaskets:** Protect gaskets from damage until final installation is complete. When temporary make up at flanged joints is required in piping systems using special gaskets, make up the joint with a less expensive sheet gasket and save the special gasket for the final installation.	

				Bidder's Compliance (Yes/No)
4.	**8.**	**22.**	**Pipe Supports**: All field supports shall be installed in accordance with the standard drawings. If the field supports are not installed or are unavailable when the piping is erected, use temporary blocking or other adequate means of support until the field supports can be installed. Careful consideration must be given to the support of 2-inch and smaller piping to prevent excessive deflection.	
4.	**8.**	**23.**	**Expansion Joints:** Check the expansion joint specification for special instructions. Corrugated expansion joints shall be installed with length extended or compressed for the ambient temperature condition at erection, depending on anticipated direction and magnitude of movement after the line reaches the operating temperature. Make a final check to see that shipping ties have been removed after line tests and that any pre-set that may be specified has been accounted for.	
4.	**8.**	**24.**	**Temporary Strainers**: Temporary suction strainers shall be installed at the suction nozzles of all pumps, compressors and other equipment, before pipeline flushing. They shall be located between the suction block valve and the equipment.	
4.	**8.**	**25.**	**Threaded Connections**: No threaded connections are accepted.	
4.	**8.**	**26.**	Erection & Commissioning of Compressed Air system & Instrument Air circuit shall be as per the scheme of erection & commissioning approved by the Purchaser.	
4.	**8.**	**27.**	**Tubing erection**	
4.	**8.**	**28.**	a. Instrument lines shall be run in the vertical plane as far as possible and shall be run with the minimum number of changes of directions consistent with good practice and neat appearance. All pipe and tubing shall be run in horizontal and vertical planes only. b. Tubing shall be bent with correct size tubing bender where required to avoid the use of fittings. c. Tubing cutter shall always be used to cut tubing. The use of short lengths of tubing in long runs shall be avoided, to avoid the use of fittings. All tubing shall be run in such a manner as to give the maximum protection against mechanical damage. Tubing runs shall be grouped together and clamped where possible. Tubing shall be arranged so that couplings can be tightened without distorting lines. d. Instrument tubing shall not run-on trays intended for cables and shall not share the same transit with cables. Tubing run in permanent enclosures shall not have joints, except at special junction boxes provided for this purpose. Where tubing is run in permanent	

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enclosures, it shall be ensured that entry and exit of such enclosures is clean and smooth.
e. Tubes installed but not connected, shall have the ends closed in approved fashion to prevent the entry of foreign material by suitable caps or plugs. All reasonable precautions shall be taken to prevent foreign material entering tubing / pipelines before and during erection.
f. No pipe or tube shall be left with mechanical strain on it. Where the length of transmission tubing exceeds 60 m, Purchaser shall be consulted as to the necessity of installing signal booster relays.
g. Where permanent enclosures are left with space for instrument tubing to be pulled in at some future date, a galvanized pull wire of adequate size shall be left in the tray.
h. Piping Supports: Piping and tubing shall be adequately supported and fixed at distances not exceeding those in the following table:
<table>
<tr><td></td><td>Tubing size</td><td>Max. Distance Between Supports</td></tr>
<tr><td rowspan="3">Single Tubing</td><td>3/8″ O.D. and less</td><td>Continuous</td></tr>
<tr><td>½” to ¾” Nom. Size</td><td>2.0 m (6 ft.)</td></tr>
<tr><td>¾” to 1″ Nom. Size</td><td>3.0 m (9ft.)</td></tr>
<tr><td colspan="2">Multi tube Bundles</td><td>3.0 m (9ft.)</td></tr>
</table>
i. All field-mounted instrument air tubing shall be supported with galvanized steel angles or channels of minimum 1/8inch thickness fabricated to present a neat appearance.
All instrument tubing supports shall be galvanized prior to installation.
j. Pipe bushing shall not be used. Plugs shall be of bar-stock with hex heads.
k. If extended lengths of multiple tubing are to be run, multiple bundles and junction boxes with weatherproof entries may be used to the best advantage.
l. Manufacturer or fabricator supplying skid mounted equipment ‘s or vessels with instrumentation, which provides, or utilizes pneumatic, offside alarms, shutdowns, or control functions shall tube signals to a
</td><td></td></tr>
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				Bidder's Compliance (Yes/No)
			central bulkhead, near skid boundary, available for hook up by the contractor for connection to offside equipment. m. Location of the bulkhead shall be noted on vendor drawings. n. Differential or static pressure sensing lines shall not exceed 6.0m (20 Feet) for direct connected or locally mounted instruments.	
4.	**9.**	**0.**	**Inspection & Testing – Indicative QAP contd..**	

PRESSURIZATION & DE-PRESSURIZATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
	Raw Material Inspection									
1	Plates-Rolled & Normalized for Air Receiver with dished ends and Reinforcement pads for Nozzles & Ports, Manhole & Cover Flange	Mill Test Certificate & Heat Treatment, Marking Check	100%	ASTM A 285, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts	√	A S	-	I, C	
2		UT for Laminar flow & Surface Defects and macro etch test for forged components	100%	UT as per ATM A 388 & Acceptance level as per ASME SA 578 Level C, Specifications document/Approved drawings.	Test Reports	√	A S	I	C	
3		Dimensional measurement	100%	Specifications document/Approved drawings.	Inspection Reports	√	A S	-	I, C	
4	Seamless pipes for Nozzles/Ports for Air Receiver	Mill certificates, Hardness, Product analysis Heat treatment, Hydro static tests, Metal structure &Macro etch test, Dimensional measurement	100%	ASTM A 106, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts, Inspection reports	√	A S	-	I, C	
5	Nozzle Flanges- forged type	Mill certificates, Hardness, Heat treatment, Hydro static tests, Dimensional measurement	100%	ASTM A 105, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts, Inspection reports	√	A S	-	I, C	
6	Fittings, Gaskets	Mill certificates, Dimensional measurement	100%	ASTM A 234 ASME B16.5, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat	√	A S	-	I, C	

PRESSURIZATION & DE-PRESSURIZATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
					Treatment Charts, Inspection reports					
7	Bolting	Mill certificates, Dimensional measurement	100%	ASTM A 193 & A194, Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	A S	-	I, C	
8	Rolled plates of IS2062 Gr B for Vessel Support Saddles	Mill certificates, UT test irrespective of plate thickness, Dimensional measurement	100%	IS2062, Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	A S	I	C	
9	Pipes & Fittings for Compressed Air pipeline	MTC, Heat Treatment Charts, Pickling & Passivation-Visual inspection, Product analysis, Mechanical Test, Intergranular Corrosion Test, Macro Etch Test, UT-for thickness measurement	100%	ASTM A312,A 403Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	A S	-	I, C	
10	Tubing & Fitting for Instrument Air pipeline	MTC, Heat Treatment Charts, Product analysis, Mechanical Test, UT-for thickness measurement, Intergranular Corrosion Test, Proof Pressure test	100%	ASTM A269, A 403, A262-IGC,A450-PPT, Specifications document/Approved drawings.	Material Test Certificates, Test Reports Inspection reports	√	A S	-	I, C	
	Material Stamp transfer									
11	Material Stamp transfer after marking, before cutting.	Stamp transfer.	100%	Approved Drawing	-	√	A S	-	I, C	
	Bought -Out Items /Inward Items Inspection									
12	Details of all bought out items, shall be submitted for Purchaser's approval.	Visual Inspection, Suitability as per	100%	Specifications Document, Approved drawings & design report	Visual Inspection report, technical specifications,	√	V	-	AS, C	

PRESSURIZATION & DE-PRESSURIZATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
		Specifications, Approved drawings, & Design reports			operation & maintenance manuals, installation & assembly guide, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address					
13	Flange Gaskets	Visual Inspection, Test Certificates in addition to Suitability as per Specifications, Approved drawings & Design reports	100%	Specifications Document, Approved drawings & design report, Relevant Standards for testing	Visual Inspection report, technical specifications, operation & maintenance manuals, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	-	AS, C	
14	Compressor	Compressor Casings- **Foundry test certificates and thicknesses**measurement. **Hydro-static test** on reciprocating compressor cylinder, cooling jackets, piping, pressure vessels, filters and coolers,	100%	Manufacturer drawings, design specifications, ASME PTC 10-Performance test, BS EN ISO 5167-2-flow measurement, API 618-Vibration limits and other codes of practice	MTC, Inspection reports, Test reports, technical specifications, operation & maintenance manuals, data sheets, OEM certification, Warranty	√	V	I,AS	C	

PRESSURIZATION & DE-PRESSURIZATION SYSTEM QUALITY ASSURANCE PLAN										
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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
		Inspection of assembly of piston end clearance, crankshaft deflection, run-out check, proper match marking and protection of machined surfaces. **Mechanical running test, Strip down test, Final visual and dimensional inspection** MTC of all components, **Compressor performance test**-FAD (Flow), Working pressure, Specific Power, Noise & Vibration			certificates, Performance reports along with supplier's address					
15	Air Dryer	**Visual & Dimensional** Inspection, **Performance test**- pressure dew point, flow rate, pressure drop, compressed-air loss, power consumption and noise emission	100%	Manufacturer drawings, design specifications, Test codes of practice- ISO 7183:2007.	MTC, Performance test reports, Inspection reports, technical specifications, operation & maintenance manuals, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	I,AS	C	
16	Cooling water pump-Centrifugal	**Mill certificates** for Pump Casing, Impeller, Pump Shaft, Shaft Sleeve.	100%	As per ISO 1940-dynamic balancing, ASME Sec VIII Div.1 for hydro test, API-610-	MTC, Test reports, Inspection reports, technical	√	V	I,AS	C	

PRESSURIZATION & DE-PRESSURIZATION SYSTEM QUALITY ASSURANCE PLAN										
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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
		Hydro-static test of Casing. **Dynamic balancing & Run-out**< 0.06mm of Impeller & Shaft. **Visual & Dimensional inspection** of Pump Assembly. **Pump Performance Test-** differential head, power consumption and efficiency. **NPSH test,** **Mechanical run test** for 4 hrs., **Vibration test**		Performance of pump, NPSH, Mechanical run & Vibration test	specifications, Characteristic curves, operation & maintenance manuals, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address					
17	Cooling tower for Compressor units	**Original Material Certificates,** **Performance Test**- Water Flow Rate, Hot Water Temp., Cold Water Temp., Wet Bulb Temp., Cooling Range, Approach, Heat Load, Capacity **Dynamic balancing** of fan	100%	CTI ATC-105-Acceptance code for cooling tower, ISO 1940 -Dynamic balancing, Approved design document, drawings & specifications	Performance evaluation data sheet, Test reports, Inspection reports, technical specifications, Characteristic curves, operation & maintenance manuals, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	I,AS	C	
18	Flow regulators & Lubricator, Air Muffler, Strainers	Visual Inspection, Test Certificates in addition to	100%	Approved design calculations, report and	Visual Inspection report,	√	V	I,AS	C	

PRESSURIZATION & DE-PRESSURIZATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
		Suitability as per Specifications, Approved drawings & Design reports		Technical specifications	technicalspecifications, data sheets, operation & maintenance manuals, installation & assembly manuals, OEM certification,Warranty certificates, Performance reports along with supplier's address					
19	Pressure &Temperature gauges	Mill test reports, checking of characteristics including the following items as minimum: - type, dial, enclosure material, damper and separator, Pressure test, Calibration check test, Performance test including hysteresis, Final visual / Dimension Inspection	100%	Approved design report and Technical specifications	All inspection reports, Visual Inspection report, technical specifications, data sheets, OEM certification,Warranty certificates, Performance reports along with supplier's address	√	V	I,AS	C	
20	Safety Relief Valves for compressed air system	**Original MaterialCertificates**, Body **Hydrostatic and Leak Test**, **Visual & Dimension** Inspection of all Parts before & after assembly, **Seat Leak Test**, **Pop test**, Valve Name Plate marking, Pre-shipment Inspection (Check for end-closures for Valves)	100%	API 526-Design & Construction, API 520-sizing & selection, API 521-guideline for pressure relieving, API 527-Inspection code, Approved Drawing, Calculations and Technical specifications	MTC, Test reports, All inspection reports, Visual Inspection report, operation & maintenance manual, installation & assembly manual, technical specifications,	√	V	I,AS	C	

PRESSURIZATION & DE-PRESSURIZATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
					data sheets, OEM certification,Warranty certificates, Performance reports along with supplier's address					
21	Valves (Globe, Check, Ball, Gate, Butterfly), Flow control Valves	**Original Material Certificates**, Body **Hydrostatic and Leak Test**, Visual & Dimension Inspection of all Parts before & after assembly, **Seat Leak Test**, Valve Name Plate marking, Pre-shipment Inspection (Check for end-closures for Valves)	100%	Design: ASME B 16.34, ASTM A-217: Material inspection, API 598-Inspection & Testing, Approved Drawing, Calculations and Technical specifications	MTC, Test reports, All inspection reports, Visual Inspection report, operation & maintenance manual, installation & assembly manual, technical specifications, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	I, AS	C	
	In Process Inspection									
	AIR RECEIVER TANK									
	Shell Fabrication									
	Long seam									
22	Weld edge preparation	Root face, angle, cleanliness.	100%	ASME Sec VIII Div. 1, ASME Sec IX, ASME Sec V with 2-2T sensitivity& codes of	Fabrication checklist.	√	A S	-	I,C	

PRESSURIZATION & DE-PRESSURIZATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
23	Set up of long seam of shell course.	Offset, root gap, profile & Dimensions	100%	practice, Specifications Document, Approved Procedure, drawings & design report	Fabrication checklist., SIR	√	AS	-	I,C	
24	Back chip	Visual, LPT acceptance criteria	100%		LPT Report	√	AS	I	C	
25	Weld Visual Inspection before RT	Visual, bead height	100%		Fabrication checklist.	√	AS	-	I,C	
26	Radiography on weld	RT film Review.	FULL		RT Report	√	AS	-	I,C	
	Cir-Seam Shell to shell setup									
27	Weld edge preparation	Root face, angle, cleanliness & Visual	100%	ASME Sec VIII Div. 1, ASME Sec IX, ASME Sec V with 2-2T sensitivity& codes of practice, Specifications Document, Approved Procedure, drawings & design report	Fabrication checklist.	√	AS	-	I, C	
28	Set up of Cir-seam of shell course (As applicable)	Offset, root gap, profile & Dimensions	100%		Fabrication checklist, SIR	√	AS	-	I, C	
29	Back chip	Visual, LPT acceptance criteria	100%		LPT Report	√	AS	I	C	
30	Weld Visual Inspection before RT	Visual, bead height	100%		Fabrication checklist.	√	AS	-	I, C	
31	Radiography on weld	RT film Review.	FULL		RT Report	√	AS	-	I, C	
	Dished ends fabrication									
	Long seam									

PRESSURIZATION & DE-PRESSURIZATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	COMPONENT/ OPERATION /ACTIVITY	TO BE CHECKED	QUANTUM OF CHECK	REFERENCE DOCUMENTS	RECORDS FORMAT		AGENCY			REMARK
							P	W	R	
1	2	3	4	5	6	D*	7			8
32	Weld edge preparation	Root face, angle, cleanliness. & Visual	100%	ASME Sec VIII Div. 1, ASME Sec IX, ASME Sec V with 2-2T sensitivity& codes of practice, Specifications Document, Approved Procedure, drawings & design report	Fabrication checklist.	√	AS	-	I, C	
33	Set up	Offset, root gap, profile & Dimensions	100%		Fabrication checklist, SIR	√	AS	-	I, C	
34	Back chip	Visual, LPT acceptance criteria	100%		LPT Report	√	AS	I	C	
35	Weld Visual Inspection before RT	Visual, bead height	100%		Fabrication checklist.	√	AS	-	I, C	
36	Radiography	RT film Review.	FULL		RT Report	√	AS	-	I, C	
37	**Dished end Inspection after forming (Final inspection)**	Visual, Profile, Over/Under crowning, Dimensions &LPT acceptance criteria	100%		Dish End Inspection Report.	√	AS	I	C	
38	**Heat Treatment**	Temp. Time, Support Arrangement, Calibration TC of Recorders, Thermocouples	100%		Heat treatment Requisition, Heat Treatment Chart	√	AS	-	I, C	
	Set up and welding of Flange to Manhole Neck / Nozzle Pipe, Cir. Seam Set up of Dished End to Shell, Long seam set up of Manhole Neck									
39	Weld edge preparation	Root face, angle, cleanliness & Visual	100%	ASME Sec VIII Div. 1, ASME Sec IX, ASME Sec V with 2-2T sensitivity& codes of practice, Specifications Document, Approved Procedure, drawings & design report	Fabrication checklist.	√	AS	-	I, C	
40	Set up	Offset, root gap, profile & Dimensions	100%		Fabrication Check list & Nozzle Setup Report	√	AS	-	I, C	
41	Back chip	Visual, LPT acceptance criteria	100%		PT Report, Fabrication checklist.	√	AS	I	C	
42	Weld Visual Inspection before RT	Visual, bead height	100%		Fabrication checklist.	√	AS	-	I, C	

PRESSURIZATION & DE-PRESSURIZATION SYSTEM QUALITY ASSURANCE PLAN										
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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
43	Radiography	RT film Review.	FULL		RT Report,	√	A S	-	I, C	
	Set up and Welding of Nozzles on shell and Dished Ends									
44	Weld edge preparation	Root face, angle, cleanliness & Visual	100%	ASME Sec VIII Div. 1, ASME Sec IX, ASME Sec V with 2-2T sensitivity& codes of practice, Specifications Document, Approved Procedure, drawings & design report	Fabrication checklist.	√	A S	-	I, C	
45	Set up	Root gap & Dimensions	100%		Fabrication Check list & SIR	√	A S	-	I, C	
46	Back chip	Visual, LPT acceptance criteria	100%		PT Report Fabrication Check List	√	A S	I	C	
47	Final Inspection Weld Visual	Visual, bead height,	100%		Fabrication checklist.	√	A S	-	I, C	
48	**Inside Visual Inspection Before Closing Seam**	Visual, Dimensions	100%	Approved Drawing/Procedure/ Relevant standard	Stage Inspection Report	√	A S	-	I,C	
49	**Setup & welding of non-pressure part and attachments.**	Visual & Dimensions	100%	Approved Drawing/Procedure/ Relevant standard	Fabrication checklist, Stage inspection Report	√	A S	-	I,C	
	COMPRESSED AIR CIRCUIT									
50	Pipes/Tubes Marking and cutting Dimensions and bevel preparation	Dimensions, Visual Inspection	100%	Approved Drawings, Layout & Specifications Document	---	√	A S	-	I, C	
51	Fit-up inspection - Dimensions bevel details mismatch for pipes/tubes	Dimensions, Visual Inspection	100%	Approved Drawings, Layout & Specifications Document	Dimensional inspection report	√	A S	-	I, C	

PRESSURIZATION & DE-PRESSURIZATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
52	DPT on root and final pass of pipes	Visual Inspection &LPT acceptance criteria	100%	API 1104	DPT report & Visual Inspection report	√	AS	-	I, C	
53	Dimensional Inspection after assembly of all components	Visual Inspection & Dimensional	100%	Approved Drawings, Layout & Specifications Document	Inspection Reports	√	AS	C	-	
	Pre-Delivery Inspection (FAT)									
	Air Receiver									
54	Final inspection Before hydro test	Visual	100%	Approved Drawing/Procedure/ Relevant standard	Stage Inspection Report. Final Dimension Report RT Summary	√	AS	I	C	
		Dimensional Inspection				√	AS	I	C	
		Verification of examination & NDE records				√	AS	I	C	
55	Design Data Punching on Equipment	Verification of Details	100%	Approved Drawing/Procedure/ Relevant standard	Photo Copy	√	AS	I	C	
56	Hydrostatic Test at 1.3 times the design pressure	Leak Proof ness & Deformation, Strain measurement on critical locations	100%	Approved Drawing/Procedure/ ASME Sec VIII Div.1	Pressure test Report.	√	AS	I	C	
57	Draining & drying of equipment after hydro test	Visual inspection	100%	Approved Procedure	Stage Inspection Report.	√	AS	I	C	
58	Final inspection After Successful hydro test	Visual	100%	Approved Drawing/Procedure/ ASME Sec V with 2-2T sensitivity, Relevant standard	Stage Inspection Report. Final Dimension Report RT Summary	√	AS	I	C	
		Dimensional Inspection				√	AS	I	C	
		LPT test on all welds				√	AS	I	C	
	Surface Preparation & Painting									

PRESSURIZATION & DE-PRESSURIZATION SYSTEM QUALITY ASSURANCE PLAN										
S. No.	COMPONENT/ OPERATION /ACTIVITY	TO BE CHECKED	QUANTUM OF CHECK	REFERENCE DOCUMENTS	RECORDS FORMAT		AGENCY			REMARK
							P	W	R	
1	2	3	4	5	6	D*	7			8
59	Surface Preparation & Painting	Visual Inspection & Dry Film thickness measurement	100%	As per approved scheme for surface preparation & painting	Inspection Reports	√	A S	I	C	
60	Painting Inspection	Shade conformance	100%	As per approved shade	Inspection Reports	√	A S	I	C	
	Final Certification									
61	Design Data Stamping			As per Approved drawing, ASME code & Design reports		√	A S	I	C	
	Final Acceptance (Site Acceptance Test)									
	Air Receiver									
62	Pneumatic Test	Pneumatic test at 1.1 times of design pressure. Pressure measurement at the top of the vessel	100%	ASME Sec VIII Div.1 & specifications document	Inspection report	√	A S	C	-	
63	Weld inspection after pneumatic test	LPT acceptance criteria	100%	Relevant code of practice, specifications document	Inspection report					
64	Functional Test for all equipment of Compressed Air system & Instrument Air system	Each equipment performance as per specifications individually and in assembly	100%	As per specifications document	Inspection report	√	A S	C	-	
65	Functional Test to meet the user requirement	Trial runs of Vulcanization & Pre-heating Cycles	100%	As per specifications document	Inspection report	√	A S	C	-	
	COMPRESSED AIR CIRCUIT									
66	Inspection of weld joints before hydro test	Visual, Dimension & LPT	100%	Approved Drawing, Specifications, API 1104, Relevant standards, Approved procedure	Stage Inspection Report	√	A S	C	-	
67	Hydro test at 1.5 times design pressure	Check for leaks	100%	Approved Drawing, Specifications, API 1104,	Test Report	√	A S	C	-	

PRESSURIZATION & DE-PRESSURIZATION SYSTEM QUALITY ASSURANCE PLAN										
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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
				ASME 31.3, Approved procedure						
68	Inspection of weld joints after hydro test	Visual, Dimension & LPT	100%	Approved Drawing, Specifications, API 1104, Relevant standards, Approved procedure	Stage Inspection Report	√	A S	C	-	
69	Inspection of All Pipe Lines fabricated at the factory as part of valve junctions.	Visual, Dimension, Location of Valves / Fittings, Direction of Piping & Check Valves, Tolerance on Linear Dimensions (Intermediate or Overall), Hydro / leak test Correct class (150/300) of the flanges to be used with the correct bolts and nuts.	100%	Approved Drawing, Specifications, Relevant standards, Approved procedure	Stage Inspection Report	√	A S	C	-	
70	Performance & Functional test for Compressed Air system	Performance & functional Test of individual components, Performance of assembled systems, Trail run for user requirement	100%	Approved Drawing, Specifications, Relevant standards, Approved procedure	Inspection Report	√	A S	C	-	
	INSTRUMENT AIR CIRCUIT									
71	**Proof Pressure Test before Dismantling & re-assembly test:** Tubes and fittings selected at random shall be subjected to a pressure of 1.5 times the maximum working pressure without leak.	Check for leaks	100%	ASTM A450, as per specifications document	Inspection & Test report	√	A S	C	-	

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
72	**Dismantling and Re-assembly Test:** A minimum of three test assemblies that have successfully completed `Proof Pressure Test' as above shall be disassembled and assembled ten times after which they must pass the Proof Pressure Test' again	Check for leaks	100%	As per specifications document	Inspection & Test report	√	AS	C	-	
73	**Proof Pressure Test after Dismantling & re-assembly test:** Tubes and fittings selected at random shall be subjected to a pressure of 1.5 times the maximum working pressure without leak.	Check for leaks	100%	Standard practice code, as per specifications document	Inspection & Test report	√	AS	C	-	
	Surface Preparation & Painting for Piping									
74	Surface Preparation & Painting	Visual Inspection & Dry Film thickness measurement	100%	As per approved scheme for surface preparation & painting	Inspection Reports	√	AS	I	C	
75	Painting Inspection	Shade conformance	100%	As per approved shade	Inspection Reports	√	AS	I	C	
76	Hot Air Autoclave Plant assembled with all sub-systems	Trial Runs & Functional Requirement tests of entire plant for all operations	100%	As per specifications document	Inspection report	√	AS	C	-	
	D* - Records identified with tick [√] shall be essentially included by supplier in QA documentation.	**MTC – Material Test Certificate, SIR-Stage Inspection Reports IR – Inspection Report, LPT-Liquid Penetrant Test,**		**MPT-Magnetic Particle Test, UT-Ultrasonic Test, RT-Radiography P-Perform, W-Witness, R-Review/Clearance**	**AS – Autoclave Supplier, V-Manufacturer / Vendor, I– Third Party Inspector C– Purchaser/Customer (SDSC-SHAR, ISRO),**					

PRESSURIZATION & DE-PRESSURIZATION SYSTEM QUALITY ASSURANCE PLAN										
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							P	W	R	
1	2	3	4	5	6	D*	7			8
Note:										
1	Testing by suitable method shall be done at NABL certified laboratories only. The NDT Reports shall be certified and approved by minimum ASNT/ ISNT Level-II qualified personnel.									
2	Equipment / material shall not be dispatched / shipped to site until written dispatch clearance is given by Purchaser.									
3	Authorized inspection engineers shall sign off the approved QAP on completion of inspection from each agency.									
4	In the absence of specified standards and where ever there is a conflict between the specification given & the standard code, sound engineering practice shall be followed with the approval of the Purchaser.									

				Bidder's Compliance (Yes/No)
5.	**0.**	**0.**	**HEATING SYSTEM FOR HOT AIR AUTOCLAVE PLANT**	
			Heating System works in combination with Air-Circulation system of the Autoclave to ensure uniform temperature distribution throughout the Autoclave usable area. Heating system comprises of Heater Banks, Temperature controls & monitors.	
5.	**1.**	**0.**	**Functional Requirement:**	
5.	**1.**	**1.**	Heating system of the Autoclave shall be envisaged to achieve heating rate of 1.5^0C/minute (continuously variable) for a range of 30^0 C to 150^0 C at design parameters of the vessel- MAWP 8.0 bar g at coincident temperature of 150^0C with maximum charge of 36,000 kg of steel and 4,000 kg of NBR rubber. Control accuracy shall be ± 0.1^0C.	
5.	**1.**	**2.**	There shall be temperature monitors throughout the vessel to ensure uniform temperature distribution throughout the vessel	
5.	**1.**	**3.**	Allowable spatial variation (Max. value - Min. value of all the temperature monitors) after stabilization of temperature at any set point is ± 2^0C within 10 minutes after reaching set point with atmospheric pressure with the aid of fan/blower.	
5.	**1.**	**4.**	**Heater Banks arrangement & operation:** Individual heating elements shall be grouped suitably to form heater banks. Whenever there is heating requirement, all the heater banks shall share the heat load equally and come into operation. In case of fault in any of the heater banks, rest of the heater banks shall share the load and meet the process demand with automatic switch over. To meet these situations, heater banks shall be arranged such that, no zone of autoclave is affected in case of any heater bank fault condition during operation.	
5.	**1.**	**5.**	Refer Section- C/Clause No.:9, 10 & 11 along with P&I Diagram in Section-D/Annexure-VII for Operation, Control & Monitoring.	
5.	**2.**	**0.**	**Specifications**	
5.	**2.**	**1.**	**Heater Banks:** a. The details such as maximum heating capacity of the heaters provided in autoclave, heating capacity calculations, no. of heater banks, individual heater capacity, construction details of the heaters and the sheaths including material specification etc. shall be furnished during design stage along with thermal analysis considering all operational conditions. 4 Nos. of heater banks shall be provided preferably.	

				Bidder's Compliance (Yes/No)
			b. Mounting of the heaters inside the autoclave shall ensure uniform heating throughout the autoclave. c. All the banks shall be independently operable and redundancy shall be provided such that peak heating load should be met by 75% capacity of the heater elements. d. The joint interfaces between the heaters and the autoclave body shall be leak proof. e. Wear pads for heaters shall be of same material as shell/rear dish end f. Heating shall be through thyristor-controlled logic. Refer Section-C/Clause No.:9, 10 & 11 for details. g. The current drawn by the individual heater banks and percentage output to heating load shall be monitored via PLC using profinet. h. Interlock of heater circuit (i.e., fan/blower running status, respective heater incomer is switched on/off status, activation of emergency stop button etc.) to be brought separately as a status to the PLC. i. Heater's capacity and no. of banks shall be arrived by the manufacturer considering heat load and heating cycle with the approval of purchaser. j. Tubular material housing the heating element shall be Inconel/ Nickel-iron-Chromium alloy for usage at high temperature and oxidation resistance.	
5.	**2.**	**2.**	**Temperature Sensors:** a. Minimum 22 No. of temperature sensors with Class AA accuracy mounted through suitable ports on the body of the autoclave shall be provided for accurate and reliable measurement. b. The sensors shall be uniformly distributed on both the sides along the length of the autoclave. c. Job temperature measurement is to be done via K-type thermocouple sensors, minimum 12 No. and mounting locations to be finalized during detailed engineering.	
5.	**3.**	**0.**	**Documentation – Heating System:** Refer Section-C Clause 15 in conjunction with the below	
5.	**3.**	**1.**	**Following reports** shall be submitted to the purchaser a. Design Report for Heating System of Hot Air Autoclave Plant detailing the selection of heaters/heater banks capacity, heater banks arrangement, arrangement of temperature sensors for control and monitoring. b. Report on thermal load at various conditions and performance of Heating system in combination with air circulation system	

					Bidder's Compliance (Yes/No)
			i.e., during pressurization & de-pressurization and cooling system during each type of load condition. c. Report on design & assembly of heaters at the rear dished end of the Autoclave. d. Report on selection criteria, detailed specifications of each and every bought-out item, supported with detailed calculations as per relevant codes of practice & compliance with PO specifications document. e. Report on thermal analysis of Hot Air Autoclave Plant with & with pressure, and during pressurization & de-pressurization at rated capacities as well as operating conditions.		
5.	**3.**	**2.**	Following drawings shall be submitted to the purchaser a. **General Arrangement Drawing:** General Arrangement drawing for Heating system of Hot Air Autoclave plant. b. **Design & Assembly drawings for the following** i. Arrangement of Heaters & Heater banks of Heating system ii. Design & Assembly of Heater ports on Autoclave dished end indicating insulation and reinforcement. iii. Design & Assembly of individual heater on Autoclave dished end, indicating the detailed sealing arrangement. iv. Arrangement of Temperature sensors v. Design & Assembly of Temperature sensor ports indicating insulation and reinforcement. vi. Design & Assembly of individual Temperature sensor port, indicating the detailed sealing arrangement. vii. Design drawing showing the interface of Heating system with air circulation system and other sub-systems of Hot Air Autoclave. c. **Fabrication drawings** for all equipment of Heating system. d. **Surface Preparation & Painting scheme** for the system shall be submitted. e. **Detailed P&ID** for Heating system f. **Detailed Power & Control drawing** for Heating system g. **As built drawings** after testing, erection & commissioning shall be submitted for Heating System of Hot Air Autoclave Plant with clear indication of revisions/amendments.		
5.	**4.**	**0.**	**Material of Construction**		
			Description	**Material**	
5.	**4.**	**1.**	Heating elements	Refer Section-C/Clause-9,10,11	
5.	**4.**	**2.**	Seals	Viton to withstand 300^0C	
5.	**5**	**0.**	**Preferred makes:** Refer Section-C/Clause-9,10,11		
5.	**6.**	**0.**	**Indicative Fabrication methodology:** Fabrication shall be done as per the approved fabrication methodology		

				Bidder's Compliance (Yes/No)
5.	**6.**	**1.**	**Raw material Selection:** a. Raw material selection for heater elements shall be as per ASTM and ASME Sec VIII Div. 1 standards. b. Ports shall be seamless tubes of same material as that of dished end & Shell Pads if any shall be form UT tested SA 516 Gr 70 plates.	
5.	**6.**	**2.**	**Fabrication:** Fabrication shall be as per approved fabrication & assembly drawings. Ports for heaters & sensors shall be as per approved ASME Sec VIII Div.1 procedure.	
5.	**6.**	**3.**	**Welding:** a. Welding procedure (WPS, WPQ, PQR) should comply ASME Sec IX and approved weld map. b. GTAW for root welding and SAW/SMAW for subsequent passes shall be employed ensuring full penetration. c. All joints shall be stress relieved as per ASME Sec VIII Division I (UCS-56). All weld joints shall be DP tested at root pass and final pass.	
5.	**6.**	**4.**	Vessel shall be hydro tested at Vendor's site. After hydro-test, no hot work shall be carried out on vessel.	
5.	**7.**	**0.**	**Erection & Commissioning:** Erection & Commissioning shall be as per approved scheme. Refer Section-C/Clause-17 for erection & commissioning	
5.	**8.**	**0.**	**Inspection &Testing – Indicative QAP contd.**	

HEATING SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
	Raw Material Inspection									
1	Raw Materials for Heating System	Mill Test Certificate & Heat Treatment, Marking Check	100%	ASTM standards, Specifications document /Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts	√	AS	-	I,C	
2		Surface Defects-Visual	100%		No rust, No surface defects	√	AS	-	I,C	
3		Dimensional measurement	100%		Inspection Reports	√	AS	-	I,C	
4	Plates for wear pads/reinforcement pads	Surface Defects by UT & Visual Inspection	100%	No rust & No surface defects for Visual Inspection, ASME Sec VII Div.1 & ASME Sec V with 2-2T sensitivity	MTC, Lab Reports, Inspection Reports	√	AS	I	C	
5	Seamless Pipes/Tubes for ports	Surface Defects by UT & Visual Inspection	100%	No rust & No surface defects for Visual Inspection, ASME Sec VII Div.1 &ASME Sec V with 2-2T sensitivity	MTC, Lab Reports, Inspection Reports	√	AS	-	I,C	
	Material Stamp transfer									
6	Material Stamp transfer after marking, before cutting.	Stamp transfer.	100%	Approved Drawing	-	√	AS	-	I,C	
	Bought -Out Items /Inward Items Inspection									
7	Details of all bought out items, shall be submitted for Purchaser's approval.	Visual Inspection, Suitability as per Specifications, Approved drawings, & Design reports	100%	Specifications Document, Approved drawings & design report	Visual Inspection report,Technical specifications, Operation & Maintenance manuals, Installation & Assembly	√	AS	-	I,C	

HEATING SYSTEM QUALITY ASSURANCE PLAN										
S. No.	COMPONENT/ OPERATION /ACTIVITY	TO BE CHECKED	QUANTUM OF CHECK	REFERENCE DOCUMENTS	RECORDS FORMAT		AGENCY			REMARK
							P	W	R	
1	2	3	4	5	6	D*	7			8
					manual,data sheets, OEM certification,Warranty certificates, Performance reports along with supplier's address					
8	Thermocouple Wire	Visual Inspection, Test Certificates in addition to Suitability as per Specifications, Approved drawings & Design reports	100%	ASTM standards, Approved Drawing and Technical specifications	MTC, Inspection Reports	√	V	I,AS	C	
9	Electrical heater functional test	High voltage test for Grounding, Visual inspection after functional test, Dimensions, physical damage particularly for end terminals, Continuity Test	100%	ASME relevant code of practice, Specifications Document, Approved drawings & design report	Test & Inspection Reports	√	V	I,AS	C	At Factory without Electric Support/Panel Installation
	In Process Inspection									
	HEATER COILS INSTALLATION									
10	Installation of Electrical Heater Coil	Gap between Heater Coil to Insulation Shell, Tightness of the heater assembly, Grounding test of coils after installation	100%	Approved Drawing& Procedure	Stage Inspection Report	√	AS	I	C	
	Thermocouple Feed throughs									

HEATING SYSTEM QUALITY ASSURANCE PLAN										
S. No.	COMPONENT/ OPERATION /ACTIVITY	TO BE CHECKED	QUANTUM OF CHECK	REFERENCE DOCUMENTS	RECORDS FORMAT		AGENCY			REMARK
							P	W	R	
1	2	3	4	5	6	D*	7			8
11	Final Machining of thermocouple feed throughs along with Teflon bush	Visual, Dimension	100%	Approved Drawing	Stage Inspection Report	√	AS	-	I,C	
12	Installation of thermocouple feed throughs on equipment & routing inside Autoclave	Visual, Dimension	100%	Approved Drawing	Stage Inspection Report	√	AS	I	C	
	Surface Preparation & Painting									
13	Surface Preparation & Painting	Visual Inspection & Dry Film thickness measurement	100%	As per approved scheme for surface preparation & painting	Inspection Reports	√	AS	I	C	
	Final Certification									
14	Design Data Stamping			As per Approved drawing, ASME code & Design reports		√	AS	I	C	
	Pre-Delivery Inspection (FAT)									
	HEATING SYSTEM									
15	Performance Test of Individual components of Heating system and also in full assembly to meet the functional requirement	Heating rate with specified control accuracy in combination with & without pressurization as well as cooling, endurance test	100%	As per specifications document	Inspection report	√	AS	I	C	
	Final Acceptance (Site Acceptance Test)									
	HEATING SYSTEM									

HEATING SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
16	Performance Test of Individual components of Heating system and also in full assembly to meet the functional requirement	Heating rate with specified control accuracy in combination with & without pressurization as well as cooling, endurance test	100%	As per specifications document	Inspection report	√	AS	C	-	
17	Hot Air Autoclave Plant assembled with all sub-systems	Trial Runs & Functional Requirement tests of entire plant for all operations	100%	As per specifications document	Inspection report	√	AS	C	-	
	D* - Records identified with tick [√] shall be essentially included by supplier in QA documentation.	**MTC – Material Test Certificate, SIR-Stage Inspection Reports IR – Inspection Report, LPT-Liquid Penetrant Test,**		**MPT-Magnetic Particle Test, UT-Ultrasonic Test, RT-Radiography P-Perform, W-Witness, R-Review/Clearance**		**AS – Autoclave Supplier, V-Manufacturer / Vendor, I– Third Party Inspector C– Purchaser/Customer (SDSC-SHAR, ISRO),**				

Note:	
1	Testing by suitable method shall be done at NABL certified laboratories only. The NDT Reports shall be certified and approved by minimum ASNT/ ISNT Level-II qualified personnel.
2	Equipment / material shall not be dispatched / shipped to site until written dispatch clearance is given by Purchaser.
3	Authorized inspection engineers shall sign off the approved QAP on completion of inspection from each agency.
4	In the absence of specified standards and where ever there is a conflict between the specification given & the standard code, sound engineering practice shall be followed with the approval of the Purchaser.

				Bidder's Compliance (Yes/No)
6.	**0.**	**0.**	**COOLING SYSTEM FOR HOT AIR AUTOCLAVE PLANT**	
			Cooling system of Autoclave works in conjunction with Air circulation system of the Autoclave. Cooling system of Hot Air Autoclave Plant includes i. Pre-cooling and main cooling systems for fine and coarse cooling. ii. Heat exchanger mounted at the rear end of the autoclave. iii. Drain tank iv. Cooling tower v. Associated pumps, pipelines with necessary instrumentation and control systems.	
6.	**1.**	**0.**	**Functional requirement:**	
6.	**1.**	**1.**	Autoclave cooling system shall be designed to achieve the maximum cooling rate (continuously varying) of 1.5 ^{0}C/min for autoclave medium and charge with control accuracy of ± 0.1^{0}C.	
6.	**1.**	**2.**	In order to achieve the required cooling rate, a heat exchanger mounted on a trolley shall be positioned before the blower/fan. Cooling water enters the heat exchanger and cools the hot air thus cooling down the temperature in the vessel.	
6.	**1.**	**3.**	To ensure specified control accuracy during operation for cooling two kinds of cooling shall be designed. One for coarse cooling and the other for fine cooling of the process temperature.	
6.	**1.**	**4.**	All wetted parts of the cooling water system for Autoclave & service equipment shall be of stainless steel.	
6.	**1.**	**5.**	Refer Section- C/Clause No.: 9,10 & 11 along with P&I Diagram in Section-D/ Annexure-VII for Operation, Control & Monitoring.	
6.	**2.**	**0.**	**Specifications**	
6.	**2.**	**1.**	**Pre-Cooling & Main Cooling:** a. Hot Air Autoclave Plant cooling system shall be capable of controlled rapid and slow cooling during its operation. To achieve this, Pre-Cooling & Main Cooling mechanism with fine and coarse cooling capabilities shall be employed. b. Cooling system shall be designed to achieve continuously variable cooling rate of 1.5 ^{0}C/min for autoclave medium and charge with control accuracy of ± 0.1^{0}C.	
6.	**2.**	**2.**	**Heat Exchanger:** a. Heat exchanger shall be designed as per ASME Sec VIII Div.1 and TEMA standards to withstand pressure higher than maximum allowable pressure of autoclave at a coincident	

				Bidder's Compliance (Yes/No)
			temperature of 150^0C, with leak proof and easily maintainable glands at inlet & outlet points. b. Heat exchanger configuration shall be such that no water remains inside the exchanger at the end of the process. c. Hot water outlet from the Heat exchanger shall be such that Hot water with vapor generated during high temperature cooling phases shall be suitably vent out during both fine & coarse cooling. d. Suitable Safety Relief Valve shall be mounted for Heat exchanger. e. Cooling water lines shall be fit with filters with clog status to ensure no contamination entry into the Heat exchanger. f. Cooling water pump capacity shall be commensurate with internal pressure rating of heat exchanger to meet the required cooling rate. g. Heat exchanger shall be mounted on a trolley and positioned inside Autoclave for modular construction. h. Inlet & Outlet shall be fit with companion flanges for assembly with other components	
6.	**2.**	**3.**	**Drain Tank:** a. A drain tank shall be provided for collection of hot water/steam from heat exchanger possibly during pre-cooling phase as well as from blower/fan cooling jacket. b. Water level monitor and control with provision to pump hot water to the hot water basin of storage tank in cooling tower shall be provided. c. Inlet & Outlet shall be fit with companion flanges for assembly with other components	
6.	**2.**	**4.**	**Cooling Tower:** a. Cooling tower of suitable capacity along with necessary accessories shall be provided for cooling the hot water from the autoclave heat exchanger, drain tank, fan/ blower jacket & vacuum pumps during Autoclave operation. b. Details like – Wet bulb temperature, Capacity, approach and range of cooling tower, assumed temperature difference across the heat exchanger, flow rate through cooling coil, TR rating etc. shall be furnished during detailed engineering. c. Cooling water storage tank of minimum $20m^3$ with partition for hot water and cool water shall be supplied along with the cooling tower. d. Temperature and water level monitor shall be provided for cooling water storage tank to circulate water to cooling tower or replenish the water when required.	

				Bidder's Compliance (Yes/No)
			e. Cooling tower shall be of capacity to cater cooling of water from all service equipment i.e., cooling water from vacuum pumps etc., in addition to hot water from the autoclave heat exchanger and drain tank. f. Inlet & Outlet shall be fit with companion flanges for assembly with other components	
6.	**2.**	**5.**	**Cooling water pumps:** a. Cooling water pump for circulation from cooling tower storage tank through heat exchanger during pre-cooling/fine cooling and main cooling/coarse cooling phase shall be provided. b. Cooling water pumps for circulation through autoclave fan motor winding, compressors & vacuum pumps during Autoclave operation shall be provided. c. Suitable pump for recirculation of hot water from drain tank to hot water basin of cooling tower storage tank. d. Cooling water pump for recirculation of hot water from hot water basin of storage tank to cooling tower shall be provided. e. Details of pumps shall be furnished during detailed engineering. f. Stand by pumps shall be provided as a redundant setup. g. Separate page shall be created in SCADA of the hot air autoclave cooling system indicating its schematic, critical process parameters, alarms, generated trip status if any during the operation, event log etc. h. Inlet & Outlet shall be fit with companion flanges for assembly with other components	
6.	**2.**	**6.**	**Cooling water pipeline for Autoclave process:** a. All the cooling pipelines shall be of Stainless Steel. Any alternative material of better quality shall be with the approval of purchaser. b. There shall be main and redundant lines for all Autoclave cooling water inlets which merges into a common line at inlet of the autoclave. Both the lines are to be fitted with FCVs, isolation and bypass valves. c. All associated pipeline for cooling water circuit shall be fit with necessary instrumentation and control systems. d. Interconnection between cooling pipelines shall be provided for 100 % redundancy. (Refer indicative P&I Diagram in Annexure-VII) e. Pipelines shall have gradient to avoid water clogging in the lines.	

				Bidder's Compliance (Yes/No)
			f. Erection of cooling bellows, pipe supports, thrust frames and anchors to the foundation & walls wherever necessary based on equipment location plan. **g. Filters:** Cooling water shall be passed through a system of filters of adequate air flow capacity for removal of particles of up to 25-micron size and oil. Filtration area shall be 10 times more than the pipe cross-section. Charging filters shall allow flow with 50% clogged condition. Overall size of filters shall be optimum. Filter clog status shall be interfaced with PLC	
6.	**2.**	**7.**	**Flow control valves for cooling system:** a. There shall be main and redundant lines for fine and coarse cooling which merges into an individual common line at respective inlets of the autoclave. Both the main & redundant lines of the fine & coarse cooling lines are to be fitted with FCVs, isolation and bypass valves. b. There shall be a manually operated valve with position/status indicator at the common inlet line of the autoclave. There shall be a flow transmitter with display indicating the inlet flow available for autoclave process for both fine cooling and main cooling. c. There shall be hot water outlet line from the autoclave for fine cooling as well as coarse cooling. d. Position feedback of all FCV/manual valves shall be interfaced with the PLC. All valves shall be at an accessible height from the ground level for ease of the operation. e. Instrument air requirement for valves operation shall be met from the supply of compressor for instrument air. f. Drain valves shall be provided to avoid water log in pipelines after the operation, with a provision to control remotely. Main and pre-cooling line should be fitted with redundant line with FCVs (with smart positioner) and manual isolation valves. g. Position feedback of all valves shall be interfaced with the PLC. h. All cooling water inlet & return lines from Autoclave equipment as well as service equipment shall have flow transmitters to indicate healthiness of respective cooling water circuits.	
6.	**2.**	**8.**	**Control system for Cooling:** a. Control system for cooling shall be linked with same PID loop which controls the autoclave temperature. b. The cooling water flow control shall be such the spatial variation of temperature of autoclave medium is within ± 2^0C of the set point.	

				Bidder's Compliance (Yes/No)
			c. Cooling systems for service equipment like blower, vacuum pumps, compressor, re-circulation pump for cooling tower, drain tank pump etc., shall be interfaced with PLC and incorporated in the SCADA page intended for Hot Air Autoclave cooling system.	
6.	**2.**	**9.**	Refer Section-C/ Clause-9, 10 & 11 in line with the above specifications for Cooling water system specification.	
6.	**3.**	**0.**	**Documentation – Cooling Water System:** Refer Section-C Clause 15 in conjunction with the below	
6.	**3.**	**1.**	Following reports shall be submitted to the purchaser a. **Design Report** for Cooling Water System of Hot Air Autoclave Plant. b. **Report on selection criteria, detailed specifications** of all bought-out items viz., Heat exchanger, Cooling Tower and Cooling water pumps supported with detailed calculations as per relevant codes of practice & compliance with PO specifications document of Cooling Water System of Hot Air Autoclave Plant. c. **Report on selection of** Piping size, Safety Relief Valves, Flow Control Valves, Flanges & Fittings selection, piping layout of Cooling water system of Hot Air Autoclave Plant as per the standard code.	
6.	**3.**	**2.**	Following drawings shall be submitted to the purchaser a. **General Arrangement Drawing:** General Arrangement drawing for Cooling water system of Hot Air Autoclave plant. b. **Foundation load distribution drawings of the following** indicating load distribution (in KN) for Cooling Water System of Hot Air Autoclave plant. i. Cooling Water Pumps ii. Cooling Tower iii. Drain tank **c. Design drawings for the following** i. Heat Exchanger ii. Heat exchanger assembly inside Autoclave over a Trolley iii. Cooling water piping layout iv. Cooling water inlet and outlet ports of Autoclave v. Cooling Tower vi. Drain Tank vii. Interface details of Cooling water system with Air Circulation system & Heating system of Autoclave. d. **Detailed P&ID** for Cooling water system of Hot Air Autoclave Plant	

					Bidder's Compliance (Yes/No)
			e. **Detailed Power & Control drawing** for Cooling water system of Hot Air Autoclave Plant f. **As built drawings** Cooling water piping layout of Hot Air Autoclave Plant with clear indication of revisions/amendments.		
6.	**4.**	**0.**	**Material of Construction**		
			Description	**Material**	
			Cooling water Pipeline		
6.	**4.**	**1.**	Pipes	Seamless Stainless steel, ASTM A312	
6.	**4.**	**2.**	Fittings	Seamless butt weld fittings, ASTM A403	
6.	**4.**	**3.**	Flanges	Forged flanges of SORF type with concentric serrations, ASTM A 182	
6.	**4.**	**4.**	Valves	Stainless steel as per ASTM A 182 as per ASME 16.34	
6.	**4.**	**5.**	Bolting	As per ASTM A193 bolts with ASTM A 194 nuts	
6.	**4.**	**6.**	Gaskets for joints	EPDM/ Viton withstanding 100^0C & 11.05 bar pressure	
6.	**4.**	**7.**	20 cu.m Cooling Water Tank with partition - for Cooling Tower	Fibre Reinforced Plastic	
6.	**5.**	**0.**	**Preferred makes** In case the supplier is planning to use different make other than as per the list below, prior approval for the same shall be obtained from the purchaser. However, purchaser reserves the right to reject such proposal.		
6.	**5.**	**1.**	Plates	M/s.SAIL/TATA/JINDAL/VIZAGSTEEL/ESSAR	
6.	**5.**	**2.**	Forged Flanges	M/s Rajmani/Bhavya forged/United Forge Industries/Metal Forge India/HindustanForgings	
6.	**5.**	**3.**	Fittings	M/s Metal Forge India/Rajmani/Vaibhav/United Forge Industries/Bharat forge & fittings/Metline	

					Bidder's Compliance (Yes/No)
6.	**5.**	**4.**	Pipes	M/s Tubetec/Shree Impex Alloys/Metline/ Amtex/ Maharashtra seamless/ MA international	
6.	**5.**	**5.**	Fasteners	TVS/MA Trade Syndicate/Hussainy/Sakthie/Maarg/ITA fasteners	
6.	**5.**	**6.**	Manual Valves	BDK/Leader/Marck/Audco/L&T/Virgo/ Micro finish/ Velan/Flowserve	
6.	**5.**	**7.**	Filters	Placka/Shavo	
6.	**5.**	**8.**	Cooling water pumps	Shakthi, Kirloskar, Havells, Grundfos, CRI	
6.	**5.**	**9.**	Cooling Tower	Paharpur/Artech	
6.	**5.**	**10.**	Paint	Berger/ Asian Paint/Flosil-Bet coatings/Grand polycoats	
6.	**6.**	**0.**	**Indicative Fabrication methodology:** Fabrication shall be done as per the approved fabrication methodology		
6.	**6.**	**1.**	**Raw material Selection:** a. Raw material selection for Heat Exchanger shall be as per ASTM and ASME Sec VIII Div. 1 standards. b. Nozzles shall be from seamless pipes for Heat exchanger. c. All flanges shall be forged type, SORF (Slip on raised flanges) with concentric serrations. d. Blinds for the nozzles or ports on vessel shall be forged as per ASTM A 105. e. Reinforcement pads shall be form UT tested SA 516 Gr 70 plates. f. Flanges for pipe joints shall be forged type SORF with concentric serrations.		
6.	**6.**	**2.**	**Fabrication** a. **Cooling water circuit:** Pipe joints shall be flanged. No threaded joints are acceptable. Where ever, threaded joints are required, companion flange shall be provided. b. All the pipelines, flanges, fittings & valves shall be flanged type of seamless Stainless-Steel pipes. c. Flanges shall be forged SORF with concentric serrations. d. Pipeline fittings shall be seamless buttweld type. e. **Heat Exchanger:** Fabrication shall be in compliance with ASME Sec VIII Div.1 along with PWHT as per UCS-56. f. Forged flanges shall be used after UT tested as per ASTM A388 standard code of practice.		

				Bidder's Compliance (Yes/No)
			g. All nozzles of heat exchanger shall be supported with reinforcement pads. h. Nozzle openings not to pierce any weld seam. i. Nozzle flanges shall be forged type SORF with concentric serrations. j. Marking of nozzles/ports shall be done such that no nozzle or port is within 100mm of the heat affected zone k. Plates, nozzles and fittings, Trolley for Heat exchanger shall be prepared as per approved fabrication drawings. l. Drain Tank, Cooling Tower shall be as per approved drawings	
6.	**6.**	**3.**	**Cooling water Pipeline Welding:** a. Welding procedure (WPS, WPQ, PQR) should comply ASME Sec IX and ASME 31.3, API 1104 and approved weld map. b. GTAW for root welding and SAW/SMAW for subsequent passes shall be employed ensuring full penetration for all weld joints of Compressed air & Instrument air system. c. All butt weld shall be full penetration weld. d. All weld joints in pipeline circuit shall be DP tested at root pass and final pass. e. Flange faces shall be kept free from weld spatter and arcstrike. f. Backing rings shall not be used. g. PWHT of pipelines shall be in accordance with ASME 31.3. h. Where welds are to be produced between differing grades of stainless steels, the weld procedures, electrodes, filler wires, welding techniques, etc., shall be those required by the higher grade of material. i. All electrode and filler wires shall comply with AWS A5.4 and AWS A5.9. Electrodes to be used for general butt welding of austenitic stainless steel will be rutile type EXXX-16. j. **Grinding Wheels:** For Austenitic Stainless-Steel Pipes, Grinding shall be carried out using resin bonded alumina or silicon carbide grinding wheels. Rubber bonded wheels or wheels containing Sulphur shall not be used. Wheels previously used on ferritic steels shall not be used on the carbon steels. k. **Wire Brushes:** All wire brushes used on austenitic stainless-steel pipes shall be of stainless steel. **Heat Exchanger Welding:** l. Welding procedure (WPS, WPQ, PQR) should comply ASME Sec-IX and approved weld map.	

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<tr><th></th><th></th><th></th><th></th><th>Bidder's Compliance (Yes/No)</th></tr>
<tr><td></td><td></td><td></td><td>m. GTAW for root welding and SAW/SMAW for subsequent passes shall be employed ensuring full penetration.
n. All butt weld shall be full penetration weld.
o. All weld joints in pipeline circuit shall be DP tested at root pass and final pass.
p. Double V shall be used for shell joints and J-Joint should be avoided.
q. All the joints shall be back chipped and DP Tested. Where-ever back chipping is not possible, root weld to be done by GTAW to have full penetration joint. Any other advanced welding methodology can be adopted with prior approval from the purchaser.
r. All joints shall be stress relieved as per ASME Sec VIII Div.1 (UCS-56).
s. 100% radiography shall be carried out for all butt-weld. Acceptance criteria for Radiography shall be as per ASME Sec V with 2-2T sensitivity (UW51-Full Radiography).
t. Root passes for welds including reverse back gouging and grinding shall be inspected and cleared by DP test where ever applicable.
u. Nozzles shall be welded by full root weld by GTAW &final welding by SMAW or SAW and shall be examined by DP test.</td><td></td></tr>
<tr><td>6.</td><td>6.</td><td>4.</td><td>All fittings, Valves & flanges shall have identification marks punched and easy be visible after assembly</td><td></td></tr>
<tr><td>6.</td><td>6.</td><td>5.</td><td>Pipeline circuit shall be hydro tested at Purchaser's site after assembly as per ASME Sec VIII Div.1. After hydro-test, no hot work shall be carried out on vessel.</td><td></td></tr>
<tr><td>6.</td><td>7.</td><td>0.</td><td>Surface Preparation & Painting Scheme: Refer Section-C/Clause-18 for Surface Preparation & Painting in addition to the below</td><td></td></tr>
<tr><td>6.</td><td>7.</td><td>1.</td><td>Painting scheme
<table>
<tr><th></th><th rowspan="2">Surface Preparation</th><th colspan="3">Painting</th></tr>
<tr><th>Primer Coat</th><th>Intermediate Coat</th><th>Finish Coat</th></tr>
<tr><td>Heat Exchanger</td><td>Blast cleaning to Sa 2 ½ grade</td><td>Inorganic Zinc ethyl-silicate: Two coats with min. 65µs DFT per coat</td><td>-</td><td>Ferrotol HR Aluminum Paint:Two coats with min. 15 µs DFT per coat</td></tr>
<tr><td>Structure</td><td>Mechanical Wire Brushing</td><td>BP ROZC IS2074 or equivalent:</td><td>-</td><td>Berger thane finish/</td></tr>
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<tr><td></td><td></td><td></td><td></td><td>Bidder’s Compliance (Yes/No)</td></tr>
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<table>
<tr><td></td><td></td><td>Min. 30 µs DFT</td><td></td><td>epoxy paint or equivalent: Min. 30 µs DFT</td></tr>
<tr><td>Piping</td><td>Mechanical Wire Brushing</td><td>BP ROZC IS2074 or equivalent: Min. 30 µs DFT</td><td>-</td><td>Berger thane finish/ epoxy paint or equivalent: Min. 30 µs DFT</td></tr>
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</td><td></td></tr>
<tr><td>6.</td><td>8.</td><td>0.</td><td>Erection & Commissioning: Refer Section-C/Clause 4.8</td><td></td></tr>
<tr><td>6.</td><td>9.</td><td>0.</td><td>Inspection & Testing – Indicative QAP contd..</td><td></td></tr>
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COOLING SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
	Raw Material Inspection									
1	Seamless pipes/tubes for Heat exchanger	Mill certificates, Hardness, Product analysis Heat treatment, Hydro static tests, Metal structure & Macro etch test, Dimensional measurement	100%	ASTM A 106, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts, Inspection reports	√	A S	-	I, C	
2	Nozzle Flanges- forged type	Mill certificates, Hardness, Heat treatment, Hydro static tests, Dimensional measurement	100%	ASTM A 105, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts, Inspection reports	√	A S	-	I, C	
3	Fittings, Gaskets	Mill certificates, Dimensional measurement	100%	ASTM A 234 ASME B16.5, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts, Inspection reports	√	A S	-	I, C	
4	Bolting	Mill certificates, Dimensional measurement	100%	ASTM A 193 & A194, Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	A S	-	I, C	
5	Rolled plates for Trolley of Heat exchanger	Mill certificates, UT test irrespective of plate thickness, Dimensional measurement	100%	Relevant Standard, Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	A S	I	C	
6	Structural steel for Cooling water system	Mill certificates, Dimensional measurement	100%	Relevant Standard, Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	A S	-	I, C	

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
7	Pipes & Fittings for Cooling water pipeline	MTC, Heat Treatment Charts, Pickling & Passivation-Visual inspection, Product analysis, Mechanical Test, Intergranular Corrosion Test, Macro Etch Test, UT-for thickness measurement	100%	ASTM A312, A 403 Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	AS	-	I, C	
	Material Stamp transfer									
8	Material Stamp transfer after marking, before cutting.	Stamp transfer.	100%	Approved Drawing	-	√	AS	-	I, C	
	Bought -Out Items /Inward Items Inspection									
9	Details of all bought out items, shall be submitted for Purchaser's approval.	Visual Inspection, Suitability as per Specifications, Approved drawings, & Design reports	100%	Specifications Document, Approved drawings & design report	Visual Inspection report, technical specifications, operation & maintenance manuals, installation & assembly guide, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	-	AS, C	
10	Flange Gaskets	Visual Inspection, Test Certificates in addition to Suitability as per Specifications, Approved drawings & Design reports	100%	Specifications Document, Approved drawings & design report, Relevant Standards for testing	Visual Inspection report, technical specifications, operation & maintenance manuals, data sheets, OEM certification, Warranty certificates, Performance reports	√	V	-	AS, C	

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
					along with supplier's address					
11	Cooling water pump-Centrifugal	**Mill certificates** for Pump Casing, Impeller, Pump Shaft, Shaft Sleeve. **Hydro-static test** of Casing. **Dynamic balancing & Run-out**< 0.06mm of Impeller & Shaft. **Visual & Dimensional inspection** of Pump Assembly. **Pump Performance Test-** differential head, power consumption and efficiency. **NPSH test, Mechanical run test**for 4 hrs., **Vibration test**	100%	As per ISO 1940-dynamic balancing, ASME Sec VIII Div.1 for hydro test, API-610-Performance of pump, NPSH, Mechanical run & Vibration test	MTC, Test reports, Inspection reports, technical specifications, Characteristic curves, operation & maintenance manuals, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	I, AS	C	
12	Cooling Tower	**Original Material Certificates, Performance Test**- Water Flow Rate, Hot Water Temp., Cold Water Temp., Wet Bulb Temp., Cooling Range, Approach, Heat Load, Capacity **Dynamic balancing** of fan	100%	CTI ATC-105-Acceptance code for cooling tower, ISO 1940 -Dynamic balancing, Approved design document, drawings & specifications	Performance evaluation data sheet, Test reports, Inspection reports, technical specifications, Characteristic curves, operation & maintenance manuals, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	I, AS	C	

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
13	Flow regulators & Lubricator, Air Muffler, Strainers	Visual Inspection, Test Certificates in addition to Suitability as per Specifications, Approved drawings & Design reports	100%	Approved design calculations, report and Technical specifications	Visual Inspection report, technical specifications, data sheets, operation & maintenance manuals, installation & assembly manuals, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	I, AS	C	
14	Pressure & Temperature gauges	Mill test reports, checking of characteristics including the following items as minimum: - type, dial, enclosure material, damper and separator, Pressure test, Calibration check test, Performance test including hysteresis, Final visual / Dimension Inspection	100%	Approved design report and Technical specifications	All inspection reports, Visual Inspection report, technical specifications, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	I, AS	C	
15	Valves (Globe, Check, Ball, Gate, Butterfly), Flow control Valves	**Original Material Certificates**, Body **Hydrostatic and Leak Test**, Visual & Dimension Inspection of all Parts before & after assembly, **Seat Leak Test**, Valve Name Plate marking, Pre-shipment Inspection (Check for end-closures for Valves)	100%	Design: ASME B 16.34, ASTM A-217: Material inspection, API 598-Inspection & Testing, Approved Drawing, Calculations and Technical specifications	MTC, Test reports, All inspection reports, Visual Inspection report, operation & maintenance manual, installation & assembly manual, technical specifications, data sheets, OEM certification, Warranty certificates, Performance reports	√	V	I, AS	C	

COOLING SYSTEM QUALITY ASSURANCE PLAN										
S. No.	COMPONENT/ OPERATION /ACTIVITY	TO BE CHECKED	QUANTUM OF CHECK	REFERENCE DOCUMENTS	RECORDS FORMAT		AGENCY			REMARK
							P	W	R	
1	2	3	4	5	6	D*	7			8
					along with supplier's address					
	In Process Inspection									
	HEAT EXCHANGER									
	Nozzle pipe to pipe/fittings									
16	Weld edge preparation	Root face, angle, cleanliness & Visual	100%	ASME Sec VIII Div.1, ASME Sec IX &ASME Sec V with 2-2T sensitivity, Approved Drawing / Procedure/Relevant code of practice	Fabrication checklist.	√	AS	-	I,C	
17	Set up	Visual, Verticality,Offset, rootgap, profile & Dimensions	100%		Fabrication checklist,SIR	√	AS	-	I,C	
18	Weld Visual Inspection before RT	Visual, LPT on root & final run, bead height	100%		Fabrication checklist.	√	AS	-	I,C	
19	Radiography	RT film Review.	FULL		RT Report	√	AS	-	I,C	
	Setup & Welding of Nozzles on the header									
20	Weld edge preparation	Root face, angle, cleanliness & Visual	100%	ASME Sec VIII Div.1, ASME Sec IX &ASME Sec V with 2-2T sensitivity, Approved Drawing / Procedure/Relevant code of practice	Fabrication checklist.	√	AS	-	I,C	
21	Set up	Offset, rootgap, profile & Dimensions	100%		Fabrication checklist,SIR	√	AS	-	I,C	
22	Weld Visual Inspection before RT	Visual, LPT on root & final run, bead height	100%		Fabrication checklist.	√	AS	-	I,C	
23	Radiography	RT film Review.	FULL		RT Report	√	AS	-	I,C	
24	**Inspection of Tube Sheets after machining & drilling**	Visual Inspection	100%	ASME Sec VIII Div.1, Approved Drawing / Procedure	Inspection Reports	√	AS	I	C	

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
	Closer Plate setup									
25	Weld edge preparation	Root face, angle, cleanliness& Visual	100%	ASME Sec VIII Div.1, ASME Sec IX &ASME Sec V with 2-2T sensitivity, Approved Drawing / Procedure/Relevant code of practice	Fabrication checklist.	√	AS	-	I,C	
26	Set up	Offset, rootgap, profile & Dimensions	100%		Fabrication checklist,SIR	√	AS	-	I,C	
27	Weld Visual Inspection	Visual, bead height	100%		Fabrication checklist.	√	AS	-	I,C	
28	Tube to Tube sheet joint	Set up	100%		SIR	√	AS	-	I,C	
29		Root Run LPT			PT report	√	AS	-	I,C	
30		Visual&LPT after final weld pass			Visual & PT report	√	AS	I	C	
31	Weld Visual Inspection	Weld Visual, bead height	100%		Fabrication checklist.	√	AS	-	I,C	
32	**Tube Sheet & header Inside Visual Inspection before header setup**	Visual, Dimensions	100%		Stage Inspection Report	√	AS	-	I,C	
	Header to tube sheet setup									
33	Weld edge preparation	Root face, Bevel angle & cleanliness.	100%	ASME Sec VIII Div.1, ASME Sec IX &ASME Sec V with 2-2T sensitivity, Approved Drawing / Procedure/Relevant code of practice	Fabrication checklist.	√	AS	I	C	
34	Set up	Root gap, Profile & Dimensions	100%		Fabrication Checklist, SIR	√	AS	I	C	
35	Weld Inspection	Visual, LPT on root & final run, bead height	100%		PT Report	√	AS	I	C	
	Trolley for Heat Exchanger									

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
36	Inspection of Machining Components (Shaft, Wheel, Wheel Cover)	Visual, Dimension	100%	Approved Drawing / Procedure/Relevant code of practice	Stage Inspection Report	√	AS	I	C	
37	Structural Assembly of Trolley	Visual, Dimension, squareness& Flatness measurement using bevel protractor, Wheel Assembly	100%	Approved Drawing / Procedure/Relevant code of practice	SIR	√	AS	I	C	
38	**Setup & welding of non-pressure part attachment**	Visual & Dimensions	100%	ASME Sec VIII Div.1, ASME Sec IX &ASME Sec V with 2-2T sensitivity, Approved Drawing / Procedure/Relevant code of practice	Fabrication checklist	√	AS	-	I,C	
	Heat Exchanger Installation into Autoclave									
39	Cone setup on heat exchanger	Joint at Heat exchanger between cone and Heat exchanger. No gaps should be there.	100%	ASME Sec VIII Div.1, Approved Drawing / Procedure/Relevant code of practice	Stage Inspection Report	√	AS	-	I, C	
40	Installation of heat exchanger With Cone	Gap between blower Pad & cone, Perpendicular & Concentricity with cone and blower fan ID, Heat Exchanger Inlet & Outlet Bolting, Saddle Support Bolting	100%	ASME Sec VIII Div.1, Approved Drawing / Procedure/Relevant code of practice	Stage Inspection Report	√	AS	I	C	
41	Pneumatic test of heat exchanger for bolting joints of flange	Leakage if any, Pressure Gauge Calibration TC.	100%	ASME Sec VIII Div.1, Approved Drawing / Procedure/Relevant code of practice	Pressure Test Report	√	AS	I	C	

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
42	Fixing of closing plate with wire mesh	Visual, dimension & gaps	100%	ASME Sec VIII Div.1, Approved Drawing / Procedure/Relevant code of practice	Stage Inspection Report	√	AS	-	I, C	
	COOLING WATER CIRCUIT									
43	Pipes/Tubes Marking and cutting Dimensions and bevel preparation	Dimensions, Visual Inspection	100%	Approved Drawings, Layout & Specifications Document	---	√	AS	-	I, C	
44	Fit-up inspection - Dimensions bevel details mismatch for pipes/tubes	Dimensions, Visual Inspection	100%	Approved Drawings, Layout & Specifications Document	Dimensional inspection report	√	AS	-	I, C	
45	DPT on root and final pass of pipes	Visual Inspection & LPT acceptance criteria	100%	API 1104	DPT report & Visual Inspection report	√	AS	-	I, C	
46	Dimensional Inspection after assembly of all components	Visual Inspection & Dimensional	100%	Approved Drawings, Layout & Specifications Document	Inspection Reports	√	AS	C	-	
	Pre-Delivery Inspection (FAT)									
	Heat Exchanger									
47	Final inspection Before hydro test	Visual	100%	Approved Drawing/Procedure/ Relevant standard	Stage Inspection Report. Final Dimension Report RT Summary	√	AS	I	C	
		Dimensional Inspection				√	AS	I	C	
		Verification of examination & NDE records				√	AS	I	C	
48	Design Data Punching on Equipment	Verification of Details	100%	Approved Drawing/Procedure/ Relevant standard	Photo Copy	√	AS	I	C	

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
49	Hydrostatic Test at 1.3 times the design pressure	Leak Proof ness & Deformation, Strain measurement on critical locations	100%	Approved Drawing/Procedure/ ASME Sec VIII Div.1	Pressure test Report.	√	A S	I	C	
50	Draining & drying of equipment after hydro test	Visual inspection	100%	Approved Procedure	Stage Inspection Report.	√	A S	I	C	
51	Final inspection After Successful hydro test	Visual	100%	Approved Drawing/Procedure/ ASME Sec V, Relevant standard	Stage Inspection Report.	√	A S	I	C	
		Dimensional Inspection			Final Dimension Report	√	A S	I	C	
		LPT test on all welds			RT Summary	√	A S	I	C	
	Surface Preparation & Painting									
52	Surface Preparation & Painting	Visual Inspection & Dry Film thickness measurement	100%	As per approved scheme for surface preparation & painting	Inspection Reports	√	A S	I	C	
53	Painting Inspection	Shade conformance	100%	As per approved shade	Inspection Reports	√	A S	I	C	
	Final Certification									
54	Design Data Stamping			As per Approved drawing, ASME code & Design reports		√	A S	I	C	
	Final Acceptance (Site Acceptance Test)									
55	Functional Test for all equipment Cooling water system	Each equipment performance as per specifications individually and in assembly	100%	As per specifications document	Inspection report	√	A S	C	-	
56	Functional Test to meet the user requirement	Trial runs of Vulcanization & Pre-heating Cycles	100%	As per specifications document	Inspection report	√	A S	C	-	
	COOLING WATER CIRCUIT									

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
57	Inspection of weld joints before hydro test	Visual, Dimension & LPT	100%	Approved Drawing, Specifications, API 1104, Relevant standards, Approved procedure	Stage Inspection Report	√	AS	C	-	
58	Hydro test at 1.5 times design pressure	Check for leaks	100%	Approved Drawing, Specifications, API 1104, ASME 31.3, Approved procedure	Test Report	√	AS	C	-	
59	Inspection of weld joints after hydro test	Visual, Dimension & LPT	100%	Approved Drawing, Specifications, API 1104, Relevant standards, Approved procedure	Stage Inspection Report	√	AS	C	-	
60	Inspection of All Pipe Lines fabricated at the factory as part of valve junctions.	Visual, Dimension, Location of Valves / Fittings, Direction of Piping & Check Valves, Tolerance on Linear Dimensions (Intermediate or Overall), Hydro / leak test Correct class (150/300) of the flanges to be used with the correct bolts and nuts.	100%	Approved Drawing, Specifications, Relevant standards, Approved procedure	Stage Inspection Report	√	AS	C	-	
61	Performance & Functional test for Cooling water system	Performance & functional Test of individual components, Performance of assembled systems, Trail run for user requirement	100%	Approved Drawing, Specifications, Relevant standards, Approved procedure	Inspection Report	√	AS	C	-	
	Surface Preparation & Painting for Piping									
62	Surface Preparation & Painting	Visual Inspection & Dry Film thickness measurement	100%	As per approved scheme for surface preparation & painting	Inspection Reports	√	AS	I	C	

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
63	Painting Inspection	Shade conformance	100%	As per approved shade	Inspection Reports	√	AS	I	C	
64	Hot Air Autoclave Plant assembled with all sub-systems	Trial Runs & Functional Requirement tests of entire plant for all operations	100%	As per specifications document	Inspection report	√	AS	C	-	
	D* - Records identified with tick [√] shall be essentially included by supplier in QA documentation.	**MTC – Material Test Certificate, SIR-Stage Inspection Reports IR – Inspection Report, LPT-Liquid Penetrant Test,**		**MPT-Magnetic Particle Test, UT-Ultrasonic Test, RT-Radiography P-Perform, W-Witness, R-Review/Clearance**	**AS – Autoclave Supplier, V-Manufacturer / Vendor, I– Third Party Inspector C– Purchaser/Customer (SDSC-SHAR, ISRO),**					
Note:										
1	Testing by suitable method shall be done at NABL certified laboratories only. The NDT Reports shall be certified and approved by minimum ASNT/ ISNT Level-II qualified personnel.									
2	Equipment / material shall not be dispatched / shipped to site until written dispatch clearance is given by Purchaser.									
3	Authorized inspection engineers shall sign off the approved QAP on completion of inspection from each agency.									
4	In the absence of specified standards and where ever there is a conflict between the specification given & the standard code, sound engineering practice shall be followed with the approval of the Purchaser.									

				Bidder's Compliance (Yes/No)
7.	**0.**	**0.**	**VACUUM SYSTEM FOR HOT AIR AUTOCLAVE PLANT**	
			Vacuum system constitutes **i.** 2 Nos. of vacuum pumps with Centrifugal cooling water pump for cooling **ii.** 1 No. of vacuum reservoir & Flow Control Valves **iii.** 4 Nos. of Vacuum ports on Autoclave vessel **iv.** Vacuum suction pipeline from Autoclave vacuum ports to air receiver and from receiver to vacuum pumps.	
7.	**1.**	**0.**	**Functional requirement:**	
7.	**1.**	**1.**	During the Vulcanization of the rubber lined hardware, vacuum bagging technique is employed for good consolidation. In order to maintain vacuum inside the vacuum bag during vulcanization process, vacuum bag shall be connected to vacuum pumps through receiver.	
7.	**1.**	**2.**	Air shall be sucked from the vacuum ports of the vessel and collected in vacuum receiver. Vacuum receiver outlet with FCV (Flow control Valve) is split and connected to vacuum pumps which in turn maintains the vacuum level.	
7.	**1.**	**3.**	Maximum achievable vacuum level at port leading to the vacuum bags provided on the job, placed inside the Autoclave is 1.5 torr. A vacuum level of 1 Torr is to be maintained at vacuum receiver output. Autoclave supplier has to connect the vacuum suction lines of autoclave ports with independent isolation valves, controls and fittings to the manifold connected to vacuum source (vacuum receiver output) available, incorporating proportional FCVs with smart positioner and necessary instrumentation to meet the operational requirement.	
7.	**1.**	**4.**	The vacuum pumps along with receiver & FCVs control and monitoring shall be made possible via PLC with available IOs.	
7.	**1.**	**5.**	All vacuum system lines for autoclave and cooling water lines for vacuum pumps shall be made of stainless steel. Any alternative material of better quality shall be with the approval of purchaser.	
7.	**1.**	**6.**	A vacuum suction port shall be available outside the Autoclave.	
7.	**1.**	**7.**	Refer Section- C/Clause No.: 9,10 & 11 along with P&I Diagram in Section-D/Annexure-VII for Operation, Control & Monitoring.	
7.	**2.**	**0.**	**Specifications**	
7.	**2.**	**1.**	**Vacuum Pumps:**	
7.	**2.**	**2.**	a. 2 Nos. of Vacuum pumps with following specifications shall be connected to common manifold with a Flow Control Valve.	

				Bidder's Compliance (Yes/No)
			b. Vacuum pump capacity: 250 m^3/h c. Vacuum level: 0.5 milli-bar d. Water cooled pumps e. Both the pumps shall be cooled by a common cooling water line split to each pump. Outlet of cooling water from the vacuum pumps shall be connected to common pipeline leading to hot water receiving tank of the cooling tower. f. Both vacuum pumps shall be connected to a common manifold with FCV at the outlet of the Vacuum receiver. g. Instrument air requirement for valves operation shall be met from the supply of compressor for instrument air. h. Vacuum pump lines shall have individual isolation valves. Also, there shall be provision for selecting the vacuum pump that takes over the process from the control panel.	
7.	**2.**	**3.**	**Vacuum Reservoir & Flow Control Valves:** a. 1 No. of Vacuum Receiver with accessories like safety relief valve, transmitter, gauge, flow control valve for vent & drain valve of suitable volume (2 m^3) shall be designed as per ASME Sec VIII Div1. b. Vacuum receiver shall have man hole, 3 Nos. of blinded spare ports for inlet & outlet. c. Details of the vacuum suction line to and from the vacuum reservoir shall be finalized on mutual agreement between purchaser and vendor during detailed engineering. d. Electro-pneumatically controlled proportional valves with smart positioner for vacuum vent (on vacuum reservoir) shall be provided. e. Instrument air requirement for valves operation shall be met from the supply of compressor for instrument air. f. Vacuum transmitter for vacuum receiver shall be provided. g. Vacuum receiver shall be provided with vacuum transmitter and shall be interfaced with PLC. h. Position feedback of all valves shall be interfaced with the PLC.	
7.	**2.**	**4.**	**Vacuum ports & pipeline/tubing:** a. 4 sets of through nozzles/ports of adequate size on the cylindrical body of the autoclave shall be provided inside the Autoclave vessel. Each set of port shall accommodate 2 Nos. of vacuum measurement connection in addition to 3Nos. of vacuum suction line connections that shall be used for evacuation. b. All vacuum transmitters with local display shall be interfaced with PLC.	

				Bidder's Compliance (Yes/No)
			c. The 1st set of vacuum port shall be located on the vessel approximately 2 m away from the door while 4th set shall be 2m away from the rear end. 2nd and 3rd set of ports shall be located in between and evenly spaced. d. Each vacuum line of each port shall have one quick-connect-disconnect coupling/ any better coupling located inside the autoclave body with approval of the purchaser. e. An independent manual isolation and pneumatic on/off valve shall be provided in each vacuum line of each port for evacuation, measurement and control circuitry shall be interfaced with PLC along with associated systems. Provision for logging vacuum bag failure event shall be available and interfaced with SCADA system. f. Autoclave supplier has to establish complete vacuum system to meet the functional requirement. Vacuum pipeline from vacuum ports of autoclave to vacuum suction point (on vacuum reservoir) with necessary controls. Details of the vacuum suction line shall be furnished for purchaser's approval. g. Necessary alarms shall be incorporated on the control system for alerting the operator in the event of bag failure. There has to be a provision for isolating the vacuum pump in case of vacuum bag failure. h. Each vacuum measurement port shall be fit with vacuum transmitter and vacuum gauge with a measuring range of –1 to 10.0 bar (g). i. End fittings size for both vacuum evacuation and vacuum measurement shall be of R3/8" with BSP male thread termination. Projection of these lines shall be least (preferably 100 mm) ensuring clear useful diameter of 5500mm. j. **Filters:** Vacuum suction shall be passed through a system of filters of adequate air flow capacity for removal of particles of up to 25-micron size and oil. Filtration area shall be 10 times more than the pipe cross-section. Charging filters shall allow flow with 50% clogged condition. Overall size of filters shall be optimum. Filter clog status shall be interfaced with PLC. k. Vacuum isolation valves, filters, control valves etc. with necessary manifolds, fittings, pipelines hoses etc. ready to connect to the evacuation system along with necessary instrumentation and controls shall be interfaced with PLC and SCADA system. l. There shall be main and redundant lines for fine and coarse cooling which merges into an individual common line at respective inlets of the autoclave. Both the main & redundant	

				Bidder's Compliance (Yes/No)
			lines of the fine & coarse cooling lines are to be fitted with FCVs, isolation and bypass valves. m. There shall be a manually operated valve with position/status indicator at the common inlet line of the autoclave. There shall be a flow transmitter with display indicating the inlet flow available for autoclave process for both fine cooling and main cooling. n. There shall be hot water outlet line from the autoclave for fine cooling as well as coarse cooling. o. Position feedback of all FCV/manual valves shall be interfaced with the PLC. All valves shall be at an accessible height from the ground level for ease of the operation. p. Instrument air requirement for valves operation shall be met from the supply of compressor for instrument air. q. Weld joints should be minimized in all vacuum lines.	
7.	**2.**	**5.**	**Supply and Installation of Vacuum system:** a. Supply and installation of necessary vacuum piping, bellows, hoses, couplings, fittings, manifolds etc. from the vacuum suction point (on vacuum reservoir) to the autoclave is in the scope of vendor. b. Vacuum system lay out along with its process parameters shall be displayed in SCADA of the hot air autoclave plant.	
7.	**2.**	**6.**	Refer Section- C/Clause No.: 9,10 & 11 along with P&I Diagram in Section-D/Annexure-VII for Operation, Control & Monitoring.	
7.	**3.**	**0.**	**Documentation – Vacuum System** Refer Section-C/Clause 15 in conjunction with the below	
7.	**3.**	**1.**	Following reports shall be submitted to the purchaser a. **Design Report** for Vacuum System of Hot Air Autoclave Plant. b. **Report on selection criteria, detailed specifications** of all bought-out items viz.,Vacuum pumps, cooling water centrifugal pump, Vacuum ports & Vacuum Receiver units etc., supported with detailed calculations as per relevant codes of practice & compliance with PO specifications document of Vacuum System of Hot Air Autoclave Plant. c. **Report on design of** Vacuum pipeline as per API 1104. d. **Report on design of** Vacuum Receiver, Vacuum piping & tubing circuitas per the standard code.	
7.	**3.**	**2.**	Following drawings shall be submitted to the purchaser a. **General Arrangement Drawing:** General Arrangement drawing for Vacuum System of Hot Air Autoclave plant.	

					Bidder's Compliance (Yes/No)
			b. **Sectional views** of the Autoclave indicating all attachments with Vacuum System on Hot Air Autoclave. c. **Foundation load distribution drawings of the following** indicating load distribution (in KN)for Vacuum System of Hot Air Autoclave plant. i. Water cooled Vacuum Pumps ii. Vacuum Receiver tank d. **Design & Assembly drawings for the following** i. Vacuum System Pipeline&Tubing Layout ii. Individual Vacuum ports with quick connect & disconnect couplings iii. Assembly drawings of Vacuum pumps, Cooling water pumps and Flow Control Valves. iv. Vacuum Receiver- Port configuration, Reinforcement pad configuration, Nozzle configuration. e. **Fabrication drawings** for all equipment configuration drawings along with detailed weld maps for all assemblies for all configuration drawings specifying the selection of electrodes. f. **Detailed P&ID** for Vacuum System of Hot Air Autoclave Plant g. **Detailed Power & Control drawing** for Vacuum System of Hot Air Autoclave Plant h. **As built drawings** for Vacuum System of Hot Air Autoclave Plant with clear indication of revisions/amendments.		
7.	**4.**	**0.**	**Material of Construction**		
			Description	**Material**	
			Vacuum Receiver		
7.	**4.**	**1.**	Plates for Vacuum Receiver, blinds for ports	SA-516 Gr.70 as per ASTM A 285	
7.	**4.**	**2.**	Nozzles/Ports for Vacuum Receiver	Seamless pipes as per ASTM A 106 Gr. B	
7.	**4.**	**3.**	Nozzle Flanges	Forged ASTM A 105	
7.	**4.**	**4.**	All reinforcement pads/ pressure pads/support pads	SA-516 Gr.70 as per ASTM A 285	
7.	**4.**	**5.**	Pipes for Nozzles/ports	Seamless pipes as per ASTM A 106 Gr. B	
7.	**4.**	**6.**	Fittings	As per ASTM A 234-WPB	
7.	**4.**	**7.**	Supports	IS2062 Gr B	
7.	**4.**	**8.**	Gaskets for joints	EPDM/ Viton withstanding 100^0C & 11.05 bar pressure	

					Bidder's Compliance (Yes/No)
7.	**4.**	**9.**	Bolting	As per ASTM A193 bolts with ASTM A 194 nuts	
			Vacuum Pipeline		
7.	**4.**	**10**	Pipes	Seamless Stainless steel, ASTM A312	
7.	**4.**	**11.**	Fittings	Seamless butt weld fittings, ASTM A403	
7.	**4.**	**12.**	Flanges	Forged flanges of SORF type with concentric serrations, ASTM A 182	
7.	**4.**	**13.**	Valves	Stainless steel as per ASTM A 182 as per ASME 16.34	
7.	**4.**	**14.**	Bolting	As per ASTM A193 bolts with ASTM A 194 nuts	
7.	**4.**	**15.**	Gaskets for joints	EPDM/ Viton withstanding 100^0C & 11.05 bar pressure	
			Vacuum Tubing		
7.	**4.**	**16.**	Tubing	Stainless steel, ASTM A312	
7.	**4.**	**17.**	Stainless steel Tube fittings, coupling	ASTM 276-Straight fittings and tube adapter and ASTM A 182 for elbow, cross and tee fittings	
7.	**4.**	**18.**	Stainless steel Valves	ASTM A217	
7.	**5.**	**0.**	**Preferred makes** In case the supplier is planning to use different make other than as per the list below, prior approval for the same shall be obtained from the purchaser. However, purchaser reserves the right to reject such proposal.		
7.	**5.**	**1.**	Plates	M/s.SAIL/TATA/JINDAL/VIZAGSTEEL/ESSAR	
7.	**5.**	**2.**	Flanges	M/s Rajmani/ Bhavya forged/ United Forge Industries/Metal Forge India/HindustanForgings	
7.	**5.**	**3.**	Fittings	M/s Metal Forge India/ Rajmani/ Vaibhav/ United Forge Industries/ Bharat forge & fittings/ Metline	

					Bidder's Compliance (Yes/No)
7.	**5.**	**4.**	Vacuum Tubing fittings	M/s Parker/ Swagelok/Insap	
7.	**5.**	**5.**	Pipes	M/s Tubetec/Shree Impex Alloys/Metline/ Amtex/ Maharashtra seamless/ MA international	
7.	**5.**	**6.**	Fasteners	TVS/MA Trade Syndicate/Hussainy/Sakthie/Maarg/ITA fasteners	
7.	**5.**	**7.**	Manual Valves	BDK/Leader/Marck/Audco/L&T/ Virgo/Micro finish/ Velan/Flowserve	
7.	**5.**	**8.**	Filters	Placka/Shavo	
7.	**5.**	**9.**	Vacuum Pumps	Edwards, Busch, Rotovac with Profinet/Profibus interface compatibility	
7.	**5.**	**10.**	Cooling water pumps for Vacuum pumps	Shakthi, Kirloskar, Havells, Grundfos, CRI	
7.	**5.**	**11.**	Safety Relief Valves	Crosby, Tyco SanMar, Lesser	
7.	**5.**	**12.**	Paint	Berger/ Asian Paint/Flosil-Bet coatings/Grand polycoats	
7.	**6.**	**0.**	**Indicative Fabrication methodology:** Fabrication shall be done as per the approved fabrication methodology		
7.	**6.**	**1.**	**Raw material Selection:** a. Raw material selection for Vacuum Receiver shall be as per ASTM and ASME Sec VIII Div. 1 standards. b. All the plates used for Vacuum Receiver shall be rolled and normalized free from laminar defects. c. All the plates shall be laminar flow defect free and UT tested irrespective of sheet thickness. UT shall be as per ASTM A388 and acceptance level as per ASME SA 578 acceptance level C procedure as per ASME Sec V with 2-2T sensitivity. d. Nozzles shall be from seamless pipes. e. All flanges shall be forged type, SORF (Slip on raised flanges) with concentric serrations. f. Blinds for the nozzles or ports on vessel shall be forged as per ASTM A105. g. Reinforcement pads shall be form UT tested SA 516 Gr 70 plates.		

				Bidder's Compliance (Yes/No)
			h. All wetted parts of the Instrument Air & Compressed process air circuit shall be of stainless steel i. Flanges for pipe joints shall be forged type SORF with concentric serrations.	
7.	**6.**	**2.**	**Fabrication** **a. Vacuum pipeline circuit:** Pipe joints shall be flanged. No threaded joints are acceptable. Where ever, threaded joints are required, companion flange shall be provided. b. All the pneumatic pipelines, flanges, fittings & valves shall be flanged type of seamless Stainless-Steel pipes. c. Flanges shall be forged SORF with concentric serrations. d. Pipeline fittings shall be seamless buttweld type. e. **Vacuum tubing** shall be seamless stainless-steel tubing as per ASTM A 269 and fittings shall be Stainless steel double ferrule compression tube fitting as per ASME B1.1 and ASTM A 403 WP. All instrument air tubing and fittings shall be imperial sizes, expressed in nominal outside diameter (OD) and all threads shall be NPT Tubing and fittings shall be of 316 SS conforming to ASTM A269.The minimum size shall be ¼inch OD. Tubing runs shall be supported and protected. Tube fittings shall be of double ferrule, pressure seat, no torque type and shall be of reputable makes (such as Swagelok or Parker). Ferrule and nut shall be of the same material as the fittings. Flare type fitting shall not be used. f. **Threaded connections of Vacuum line** shall be NPT for all components and piping and tubing systems for process and utilities connections. TFE threads sealant shall be used on all threaded connections. Tape shall not be used. Tubing shall be supported and protected by stainless steel angle / channel or ladder / tray along the complete length of each run and shall be fastened with stainless steel saddles at a maximum of 1 m intervals on straight runs. Channel or tray support for tubing runs shall be sized for a minimum capacity of 30% greater than that required. All pneumatic exhaust ports and breathers shall be fitted with bug screens, installed facing downwards. Hardness for tubes shall not exceed RB 70 –79 and hardness for fittings (ferrules) shall be such that, there is a minimum hardness difference of 5 to 10 between tube and fittings for better sealing. g. **Vacuum Receiver:** Plates shall be selected such that shell of the vessel shall be with least possible no. of plates and joints. Dished ends with no joints. Shell & Dished ends shall be stress relieved following standard code of practice, ASME Sec VIII Div.1 (PWHT as per UCS-56).	

				Bidder's Compliance (Yes/No)
			h. UT tested rolled and normalized plates shall be marked and cut as per approved drawing & procedure. Identification shall be transferred on to the marked plates before cutting. i. Manhole flange & cover flange shall be forged type. Forged flanges shall be UT tested as per ASTM A388 standard code of practice. j. All nozzles & ports on the vessel shall be supported with reinforcement pads. k. Nozzle openings not to pierce any weld seam. l. Nozzle flanges shall be forged type SORF with concentric serrations. m. Marking of nozzles/ports shall be done such that no nozzle or port is within 100mm of the heat affected zone n. Plates, nozzles and fittings shall be prepared as per approved fabrication drawings.	
7.	**6.**	**3.**	**Vacuum Pipeline Welding:** a. Welding procedure (WPS, WPQ, PQR) should comply ASME Sec IX and ASME 31.3, API 1104 and approved weld map. Vacuum lines shall be with least possible weld joints. b. GTAW for root welding and SAW/SMAW for subsequent passes shall be employed ensuring full penetration for all weld joints of Compressed air & Instrument air system. c. All butt weld shall be full penetration weld. d. All weld joints in pipeline circuit shall be DP tested at root pass and final pass. e. Flange faces shall be kept free from weld spatter and arcstrike. f. Backing rings shall not be used. g. PWHT of pipelines shall be in accordance with ASME 31.3. h. Where welds are to be produced between differing grades of stainless steels, the weld procedures, electrodes, filler wires, welding techniques, etc., shall be those required by the higher grade of material. i. All electrode and filler wires shall comply with AWS A5.4 and AWS A5.9. Electrodes to be used for general butt welding of austenitic stainless steel will be rutile type EXXX-16. j. **Grinding Wheels:** For Austenitic Stainless-Steel Pipes, Grinding shall be carried out using resin bonded alumina or silicon carbide grinding wheels. Rubber bonded wheels or wheels containing Sulphur shall not be used. Wheels previously used on ferritic steels shall not be used on the carbon steels. k. **Wire Brushes:** All wire brushes used on austenitic stainless-steel pipes shall be of stainless steel.	

<table>
<tr><th></th><th></th><th></th><th></th><th>Bidder's Compliance (Yes/No)</th></tr>
<tr><td></td><td></td><td></td><td>Vacuum Receiver Welding:
l. Welding procedure (WPS, WPQ, PQR) should comply ASME Sec-IX and approved weld map.
m. GTAW for root welding and SAW/SMAW for subsequent passes shall be employed ensuring full penetration for Vacuum Receiver.
n. All butt weld shall be full penetration weld.
o. All weld joints in pipeline circuit shall be DP tested at root pass and final pass.
p. Double V shall be used for shell joints and J-Joint should be avoided.
q. All the joints shall be back chipped and DP Tested. Where-ever back chipping is not possible, root weld to be done by GTAW to have full penetration joint. Any other advanced welding methodology can be adopted with prior approval from the purchaser.
r. All joints of Vacuum Receiver shall be stress relieved as per ASME Sec VIII Div.1 (UCS-56).
s. 100% radiography shall be carried out for all butt-weld (longitudinal & circumferential seam i.e., A, B and C type). Acceptance criteria for Radiography shall be as per ASME Sec V with 2-2T sensitivity (UW51-Full Radiography).
t. Root passes for welds including reverse back gouging and grinding shall be inspected and cleared by DP test where ever applicable.
u. Nozzles shall be welded by full root weld by GTAW &final welding by SMAW or SAW and shall be examined by DP test.</td><td></td></tr>
<tr><td>7.</td><td>6.</td><td>4.</td><td>All fittings, Valves & flanges shall have identification marks punched and easy be visible after assembly</td><td></td></tr>
<tr><td>7.</td><td>6.</td><td>5.</td><td>Pipeline circuit shall be hydro tested at Purchaser's site after assembly as per ASME Sec VIII Div.1. After hydro-test, no hot work shall be carried out on vessel.</td><td></td></tr>
<tr><td>7.</td><td>6.</td><td>6.</td><td>Instrument air tubing circuit shall be pneumatic tested at Purchaser's site as per ASME Sec VIII Div.1 after assembly.</td><td></td></tr>
<tr><td>7.</td><td>7.</td><td>0.</td><td>Surface Preparation & Painting Scheme: Refer Section-C/Clause-18 for Surface Preparation & Painting in addition to the below</td><td></td></tr>
<tr><td>7.</td><td>7.</td><td>1.</td><td>Painting scheme
<table>
<tr><th></th><th rowspan="2">Surface Preparation</th><th colspan="3">Painting</th></tr>
<tr><th>Primer Coat</th><th>Intermediate Coat</th><th>Finish Coat</th></tr>
<tr><td>Vacuum Receiver</td><td>Blast cleaning to</td><td>Inorganic Zinc ethyl-</td><td>-</td><td>Berger thane finish/</td></tr>
</table></td><td></td></tr>
</table>

							Bidder's Compliance (Yes/No)
				Sa 2 ½ grade	silicate: Two coats with min. 65µs DFT per coat		epoxy paint or equivalent: Min. 30µs DFT
			Piping	Mechanical Wire Brushing	BP ROZC IS2074 or equivalent: Min. 30 µs DFT	-	Berger thane finish/ epoxy paint or equivalent: Min. 30µs DFT
7.	**8.**	**0.**	**Erection & Commissioning**				
7.	**9.**	**0.**	**Inspection & Testing – Indicative QAP contd..**				

VACUUM SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
	Raw Material Inspection									
1	Plates-Rolled & Normalized for Vacuum Receiver with dished ends, Blinds for ports of the Vacuum Receiver and Reinforcement pads for Nozzles & Ports, Manhole & Cover Flange	Mill Test Certificate & Heat Treatment, Marking Check	100%	ASTM A 285, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts	√	AS	-	I, C	
2		UT for Laminar flow & Surface Defects and macro etch test for forged components	100%	UT as per ATM A 388 & Acceptance level as per ASME SA 578 Level C, Specifications document/Approved drawings.	Test Reports	√	AS	I	C	
3		Dimensional measurement	100%	Specifications document/Approved drawings.	Inspection Reports	√	AS	-	I, C	
4	Seamless pipes for Nozzles/Ports for Vacuum Receiver	Mill certificates, Hardness, Product analysis Heat treatment, Hydro static tests, Metal structure & Macro etch test, Dimensional measurement	100%	ASTM A 106, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts, Inspection reports	√	AS	-	I, C	
5	Nozzle Flanges- forged type	Mill certificates, Hardness, Heat treatment, Hydro static tests, Dimensional measurement	100%	ASTM A 105, Specifications document/Approved drawings.	Material Test Certificates, Lab reports, Heat Treatment Charts, Inspection reports	√	AS	-	I, C	
6	Fittings, Gaskets	Mill certificates, Dimensional measurement	100%	ASTM A 234 ASME B16.5, Specifications	Material Test Certificates, Lab reports, Heat	√	AS	-	I, C	

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
				document/Approved drawings.	Treatment Charts, Inspection reports					
7	Bolting	Mill certificates, Dimensional measurement	100%	ASTM A 193 & A194, Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	AS	-	I, C	
8	Pipes & Fittings for Vacuum System	MTC, Heat Treatment Charts, Pickling & Passivation-Visual inspection, Product analysis, Mechanical Test, Intergranular Corrosion Test, Macro Etch Test, UT-for thickness measurement	100%	ASTM A312, A 403 Specifications document/Approved drawings.	Material Test Certificates, Inspection reports	√	AS	-	I, C	
9	Tubing & Fitting for Vacuum System	MTC, Heat Treatment Charts, Product analysis, Mechanical Test, UT-for thickness measurement, Intergranular Corrosion Test, Proof Pressure test	100%	ASTM A269, A 403, A262-IGC, A450-PPT, Specifications document/Approved drawings.	Material Test Certificates, Test Reports Inspection reports	√	AS	-	I, C	
	Material Stamp transfer									
10	Material Stamp transfer after marking, before cutting.	Stamp transfer.	100%	Approved Drawing	-	√	AS	-	I, C	
	Bought -Out Items /Inward Items Inspection									
11	Details of all bought out items, shall be submitted for Purchaser's approval.	Visual Inspection, Suitability as per Specifications, Approved drawings, & Design reports	100%	Specifications Document, Approved drawings & design report	Visual Inspection report, technical specifications, operation & maintenance manuals, installation	√	V	-	AS, C	

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
					&assembly guide, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address					
12	Flange Gaskets	Visual Inspection, Test Certificates in addition to Suitability as per Specifications, Approved drawings & Design reports	100%	Specifications Document, Approved drawings & design report, Relevant Standards for testing	Visual Inspection report, technical specifications, operation & maintenance manuals, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	-	AS, C	
13	Vacuum pumps	**Mill certificates** for Pump Casing, Impeller, Pump Shaft, Shaft Sleeve. **Hydro-static test** of Casing. **Dynamic balancing & Run-out**< 0.06mm of Impeller & Shaft. **Visual & Dimensional inspection** of Pump Assembly. **Pump Performance Test-** differential head, power	100%	As per ISO 1940-dynamic balancing, ASME Sec VIII Div.1 for hydro test, Vacuum level, Mechanical run & Vibration test	MTC, Test reports, Inspection reports, technical specifications, Characteristic curves, operation & maintenance manuals, data sheets, OEM certification, Warranty certificates, Performance	√	V	I, AS	C	

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
		consumption and efficiency. **Vacuum level test,** **Mechanical run test**for 4 hrs., **Vibration test**			reports along with supplier's address					
14	Cooling water pump-Centrifugal	**Mill certificates** for Pump Casing, Impeller, Pump Shaft, Shaft Sleeve. **Hydro-static test** of Casing. **Dynamic balancing & Run-out**< 0.06mm of Impeller & Shaft. **Visual & Dimensional inspection** of Pump Assembly. **Pump Performance Test-** differential head, power consumption and efficiency. **NPSH test,** **Mechanical run test**for 4 hrs., **Vibration test**	100%	As per ISO 1940-dynamic balancing, ASME Sec VIII Div.1 for hydro test, API-610-Performance of pump, NPSH, Mechanical run & Vibration test	MTC, Test reports, Inspection reports, technical specifications, Characteristic curves, operation & maintenance manuals, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	I, AS	C	
15	Flow regulators & Lubricator, Air Muffler, Strainers	Visual Inspection, Test Certificates in addition to Suitability as per Specifications, Approved drawings & Design reports	100%	Approved design calculations, report and Technical specifications	Visual Inspection report, technical specifications, data sheets, operation & maintenance manuals, installation & assembly manuals, OEM	√	V	I, AS	C	

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
					certification, Warranty certificates, Performance reports along with supplier's address					
16	Pressure, Vacuum, Vacuum cum Pressure& Temperature gauges	Mill test reports, checking of characteristics including the following items as minimum: - type, dial, enclosure material, damper and separator, Pressure test, Calibration check test, Performance test including hysteresis, Final visual / Dimension Inspection	100%	Approved design report and Technical specifications	All inspection reports, Visual Inspection report, technical specifications, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	I, AS	C	
17	Safety Relief Valves for vacuum system	**Original MaterialCertificates**, Body **Hydrostatic and Leak Test**, **Visual & Dimension** Inspection of all Parts before & after assembly, **Seat Leak Test**, **Pop test**, Valve Name Plate marking, Pre-shipment Inspection (Check for end-closures for Valves)	100%	API 526-Design & Construction, API 520-sizing & selection, API 521-guideline for pressure relieving, API 527-Inspection code, Approved Drawing, Calculations and Technical specifications	MTC, Test reports, All inspection reports, Visual Inspection report, operation & maintenance manual, installation & assembly manual, technical specifications, data sheets, OEM certification, Warranty certificates, Performance	√	V	I, AS	C	

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S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
					reports along with supplier's address					
18	Valves (Globe, Check, Ball, Gate, Butterfly), Flow control Valves	**Original Material Certificates**, Body **Hydrostatic and Leak Test**, Visual & Dimension Inspection of all Parts before & after assembly, **Seat Leak Test**, Valve Name Plate marking, Pre-shipment Inspection (Check for end-closures for Valves)	100%	Design: ASME B 16.34, ASTM A-217: Material inspection, API 598-Inspection & Testing, Approved Drawing, Calculations and Technical specifications	MTC, Test reports, All inspection reports, Visual Inspection report, operation & maintenance manual, installation & assembly manual, technical specifications, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	I, AS	C	
	In Process Inspection									
	VACUUM RECEIVER TANK									
	Shell Fabrication									
	Long seam									
19	Weld edge preparation	Root face, angle, cleanliness.	100%	ASME Sec VIII Div. 1, ASME Sec IX, ASME Sec V with 2-2T sensitivity& codes of practice, Specifications Document, Approved Procedure, drawings & design report	Fabrication checklist.	√	AS	-	I, C	
20	Set up of long seam of shell course.	Offset, root gap, profile & Dimensions	100%		Fabrication checklist., SIR	√	AS	-	I, C	

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							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
21	Back chip	Visual, LPT acceptance criteria	100%		LPT Report	√	AS	I	C	
22	Weld Visual Inspection before RT	Visual, bead height	100%		Fabrication checklist.	√	AS	-	I, C	
23	Radiography on weld	RT film Review.	FULL		RT Report	√	AS	-	I, C	
	Cir-Seam Shell to shell setup									
24	Weld edge preparation	Root face, angle, cleanliness & Visual	100%	ASME Sec VIII Div. 1, ASME Sec IX, ASME Sec V with 2-2T sensitivity& codes of practice, Specifications Document, Approved Procedure, drawings & design report	Fabrication checklist.	√	AS	-	I, C	
25	Set up of Cir-seam of shell course (As applicable)	Offset, root gap, profile & Dimensions	100%		Fabrication checklist, SIR	√	AS	-	I, C	
26	Back chip	Visual, LPT acceptance criteria	100%		LPT Report	√	AS	I	C	
27	Weld Visual Inspection before RT	Visual, bead height	100%		Fabrication checklist.	√	AS	-	I, C	
28	Radiography on weld	RT film Review.	FULL		RT Report	√	AS	-	I, C	
	Dished ends fabrication									
	Long seam									
29	Weld edge preparation	Root face, angle, cleanliness. & Visual	100%	ASME Sec VIII Div. 1, ASME Sec IX, ASME Sec V with 2-2T sensitivity& codes of practice, Specifications Document, Approved	Fabrication checklist.	√	AS	-	I, C	
30	Set up	Offset, root gap, profile & Dimensions	100%		Fabrication checklist, SIR	√	AS	-	I, C	

VACUUM SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
31	Back chip	Visual, LPT acceptance criteria	100%	Procedure, drawings & design report	LPT Report	√	AS	I	C	
32	Weld Visual Inspection before RT	Visual, bead height	100%		Fabrication checklist.	√	AS	-	I, C	
33	Radiography	RT film Review.	FULL		RT Report	√	AS	-	I, C	
34	**Dished end Inspection after forming (Final inspection)**	Visual, Profile, Over/Under crowning, Dimensions & LPT acceptance criteria	100%		Dish End Inspection Report.	√	AS	I	C	
35	**Heat Treatment**	Temp. Time, Support Arrangement, Calibration TC of Recorders, Thermocouples	100%		Heat treatment Requisition, Heat Treatment Chart	√	AS	-	I, C	
	Set up and welding of Flange to Manhole Neck / Nozzle Pipe, Cir. Seam Set up of Dished End to Shell, Long seam set up of Manhole Neck									
36	Weld edge preparation	Root face, angle, cleanliness & Visual	100%	ASME Sec VIII Div. 1, ASME Sec IX, ASME Sec V with 2-2T sensitivity& codes of practice, Specifications Document, Approved Procedure, drawings & design report	Fabrication checklist.	√	AS	-	I, C	
37	Set up	Offset, root gap, profile & Dimensions	100%		Fabrication Check list & Nozzle Setup Report	√	AS	-	I, C	
38	Back chip	Visual, LPT acceptance criteria	100%		PT Report, Fabrication checklist.	√	AS	I	C	
39	Weld Visual Inspection before RT	Visual, bead height	100%		Fabrication checklist.	√	AS	-	I, C	
40	Radiography	RT film Review.	FULL		RT Report,	√	AS	-	I, C	
	Set up and Welding of Nozzles on shell and Dished Ends									

VACUUM SYSTEM QUALITY ASSURANCE PLAN										
S. No.	COMPONENT/ OPERATION /ACTIVITY	TO BE CHECKED	QUANTUM OF CHECK	REFERENCE DOCUMENTS	RECORDS FORMAT		AGENCY			REMARK
							P	W	R	
1	2	3	4	5	6	D*	7			8
41	Weld edge preparation	Root face, angle, cleanliness & Visual	100%	ASME Sec VIII Div. 1, ASME Sec IX, ASME Sec V with 2-2T sensitivity& codes of practice, Specifications Document, Approved Procedure, drawings & design report	Fabrication checklist.	√	AS	-	I, C	
42	Set up	Root gap & Dimensions	100%		Fabrication Check list & SIR	√	AS	-	I, C	
43	Back chip	Visual, LPT acceptance criteria	100%		PT Report Fabrication Check List	√	AS	I	C	
44	Final Inspection Weld Visual	Visual, bead height,	100%		Fabrication checklist.	√	AS	-	I, C	
45	**Inside Visual Inspection Before Closing Seam**	Visual, Dimensions	100%	Approved Drawing/Procedure/ Relevant standard	Stage Inspection Report	√	AS	-	I, C	
46	**Setup & welding of non-pressure part and attachments.**	Visual & Dimensions	100%	Approved Drawing/Procedure/ Relevant standard	Fabrication checklist, Stage inspection Report	√	AS	-	I, C	
	VACUUM CIRCUIT									
47	Pipes/Tubes Marking and cutting Dimensions and bevel preparation	Dimensions, Visual Inspection	100%	Approved Drawings, Layout & Specifications Document	---	√	AS	-	I, C	
48	Fit-up inspection - Dimensions bevel details mismatch for pipes/tubes	Dimensions, Visual Inspection	100%	Approved Drawings, Layout & Specifications Document	Dimensional inspection report	√	AS	-	I, C	
49	DPT on root and final pass of pipes	Visual Inspection & LPT acceptance criteria	100%	API 1104	DPT report & Visual Inspection report	√	AS	-	I, C	

VACUUM SYSTEM QUALITY ASSURANCE PLAN										
S. No.	COMPONENT/ OPERATION /ACTIVITY	TO BE CHECKED	QUANTUM OF CHECK	REFERENCE DOCUMENTS	RECORDS FORMAT		AGENCY			REMARK
							P	W	R	
1	2	3	4	5	6	D*	7			8
50	Dimensional Inspection after assembly of all components	Visual Inspection & Dimensional	100%	Approved Drawings, Layout & Specifications Document	Inspection Reports	√	AS	C	-	
	Pre-Delivery Inspection (FAT)									
	Vacuum Receiver									
51	Final inspection Before hydro test	Visual	100%	Approved Drawing/Procedure/ Relevant standard	Stage Inspection Report. Final Dimension Report RT Summary	√	AS	I	C	
		Dimensional Inspection				√	AS	I	C	
		Verification of examination & NDE records				√	AS	I	C	
52	Design Data Punching on Equipment	Verification of Details	100%	Approved Drawing/Procedure/ Relevant standard	Photo Copy	√	AS	I	C	
53	Hydrostatic Test at 1.3 times the design pressure	Leak Proof ness & Deformation, Strain measurement on critical locations	100%	Approved Drawing/Procedure/ ASME Sec VIII Div.1	Pressure test Report.	√	AS	I	C	
54	Draining & drying of equipment after hydro test	Visual inspection	100%	Approved Procedure	Stage Inspection Report.	√	AS	I	C	
55	Final inspection After Successful hydro test	Visual	100%	Approved Drawing/Procedure/ ASME Sec V with 2-2T sensitivity, Relevant standard	Stage Inspection Report. Final Dimension Report RT Summary	√	AS	I	C	
		Dimensional Inspection				√	AS	I	C	
		LPT test on all welds				√	AS	I	C	
	Surface Preparation & Painting									
56	Surface Preparation & Painting	Visual Inspection & Dry Film thickness measurement	100%	As per approved scheme for surface preparation & painting	Inspection Reports	√	AS	I	C	

VACUUM SYSTEM QUALITY ASSURANCE PLAN										
S. No.	COMPONENT/ OPERATION /ACTIVITY	TO BE CHECKED	QUANTUM OF CHECK	REFERENCE DOCUMENTS	RECORDS FORMAT		AGENCY			REMARK
							P	W	R	
1	2	3	4	5	6	D*	7			8
57	Painting Inspection	Shade conformance	100%	As per approved shade	Inspection Reports	√	AS	I	C	
	Final Certification									
58	Design Data Stamping			As per Approved drawing, ASME code & Design reports		√	AS	I	C	
	Final Acceptance (Site Acceptance Test)									
	Vacuum Receiver									
59	Pneumatic Test	Pneumatic test at 1.1 times of design pressure. Pressure measurement at the top of the vessel	100%	ASME Sec VIII Div.1 & specifications document	Inspection report	√	AS	C	-	
60	Weld inspection after pneumatic test	LPT acceptance criteria	100%	Relevant code of practice, specifications document	Inspection report					
61	Functional Test for all equipment of Compressed Air system & Instrument Air system	Each equipment performance as per specifications individually and in assembly	100%	As per specifications document	Inspection report	√	AS	C	-	
62	Functional Test to meet the user requirement	Trial runs of Vulcanization & Pre-heating Cycles	100%	As per specifications document	Inspection report	√	AS	C	-	
	VACUUM CIRCUIT									
63	Inspection of weld joints before pneumatic test	Visual, Dimension & LPT	100%	Approved Drawing, Specifications, API 1104, Relevant standards, Approved procedure	Stage Inspection Report	√	AS	C	-	
64	Pressure tested with dry nitrogen gas at 8 bar(g)	Check for leaks	100%	Approved Drawing, Specifications, API 1104, ASME 31.3, Approved procedure	Test Report	√	AS	C	-	

VACUUM SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
65	Inspection of weld joints after pneumatic test	Visual, Dimension & LPT	100%	Approved Drawing, Specifications, API 1104, Relevant standards, Approved procedure	Stage Inspection Report	√	AS	C	-	
66	Inspection of All Pipe Lines fabricated at the factory as part of valve junctions.	Visual, Dimension, Location of Valves / Fittings, Direction of Piping & Check Valves, Tolerance on Linear Dimensions (Intermediate or Overall), Hydro / leak test Correct class (150/300) of the flanges to be used with the correct bolts and nuts.	100%	Approved Drawing, Specifications, Relevant standards, Approved procedure	Stage Inspection Report	√	AS	C	-	
67	Performance & Functional test for Vacuum System	Performance & functional Test of individual components, Performance of assembled systems, Trail run for user requirement	100%	Approved Drawing, Specifications, Relevant standards, Approved procedure	Inspection Report	√	AS	C	-	
68		Achievable Vacuum level with specified control accuracy in combination with & without pressurization, heating as well as cooling	100%	Approved Drawing, Specifications, Relevant standards, Approved procedure	Inspection Report	√	AS	C	-	
69	**Vacuum stand test for Vacuum system**	Vacuum stand test should be carried out for 30 mins after assembly of all the vacuum lines including vacuum reservoir and vacuum pump. Evacuate the entire system with vacuum pump on, till the	100%	Approved Drawing, Specifications, Relevant standards, Approved procedure	Inspection Report	√	AS	C	-	

VACUUM SYSTEM QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
		dial gauge indicates 760mm of Hg. Hold the vacuum by closing the valve between reservoir and pump. The drop in the vacuum should not be more than 50mm of Hg for 30 mins duration.								
	Surface Preparation & Painting for Piping									
70	Surface Preparation & Painting	Visual Inspection & Dry Film thickness measurement	100%	As per approved scheme for surface preparation & painting	Inspection Reports	√	AS	I	C	
71	Painting Inspection	Shade conformance	100%	As per approved shade	Inspection Reports	√	AS	I	C	
72	Hot Air Autoclave Plant assembled with all sub-systems	Trial Runs & Functional Requirement tests of entire plant for all operations	100%	As per specifications document	Inspection report	√	AS	C	-	
	D* - Records identified with tick [√] shall be essentially included by supplier in QA documentation.	**MTC – Material Test Certificate, SIR-Stage Inspection Reports IR – Inspection Report, LPT-Liquid Penetrant Test,**		**MPT-Magnetic Particle Test, UT-Ultrasonic Test, RT-Radiography P-Perform, W-Witness, R-Review/Clearance**	**AS – Autoclave Supplier, V-Manufacturer / Vendor, I– Third Party Inspector C– Purchaser/Customer (SDSC-SHAR, ISRO),**					

Note:	
1	Testing by suitable method shall be done at NABL certified laboratories only. The NDT Reports shall be certified and approved by minimum ASNT/ ISNT Level-II qualified personnel.
2	Equipment / material shall not be dispatched / shipped to site until written dispatch clearance is given by Purchaser.
3	Authorized inspection engineers shall sign off the approved QAP on completion of inspection from each agency.
4	In the absence of specified standards and where ever there is a conflict between the specification given & the standard code, sound engineering practice shall be followed with the approval of the Purchaser.

				Bidder's Compliance (Yes/No)
8.	**0.**	**0.**	**SAFETY SYSTEMS FOR HOT AIR AUTOCLAVE PLANT**	
			Autoclave Safety systems comprises of **i.** Safety Relief Valves **ii.** Burst Disc **iii.** Excess pressure alarm **iv.** Excess temperature alarm **v.** Man-in-vessel Alarm **vi.** Emergency push button **vii.** Safety on power failure	
8.	**0.**	**1**	Ports for SRVs & Burst Disc shall be in the top portion of Autoclave such that the vent lines do not hinder the path way around the Autoclave vessel	
8.	**0.**	**2.**	There shall be a minimum distance of 500 mm between the ports for SRVs and burst disc.	
8.	**0.**	**3.**	Nozzle height from the shell shall be finalized with the approval of the purchaser.	
8.	**1.**	**0.**	**Specifications**	
8.	**1.**	**0.**	**Safety Relief Valve:** a. 2 Nos. of safety (spring loaded) relief valves shall be assembled on the vessel one set at 6.05 bar g and the other set at 9.35 bar g. Selection, Sizing, design & manufacture shall be as per relevant standards, for relieving autoclave pressure. b. Technical details of the safety relief valve including the response pressure limits, type, model no. as per the technical brochures shall be enclosed to the offer. c. Details of the autoclave port for safety relief valve shall be furnished for purchaser's approval. d. Safety relief valves with handling provision shall be selected. Handling scheme for SRVs shall be submitted to purchaser for review and acceptance for selection of SRVs.	
8.	**1.**	**1.**	**Venting from safety relief valve:** a. Hot air exhaust from safety relief valve shall vent out to a safe place outside the building through vent pipe. b. Material of construction of the vent pipes associated with SRV and Burst disc shall be of stainless steel.	
8.	**1.**	**2.**	**Rupture (Burst) disc:** a. A Rupture disc of pressure rating 10.20 bar g at coincident temperature of 150^0C shall be designed as per the code specified, for independent relieving of the autoclave pressure positively as per ASME Section VIII Div. 1.	

				Bidder's Compliance (Yes/No)
			b. Technical details of the rupture disc including the response limits, type, and model as per the technical brochures shall be submitted for the approval of the Purchaser. c. Details of the autoclave port for mounting rupture disc shall be furnished for purchaser's approval. d. Burst disc shall be of BS&B or any approved make with prior approval by the Purchaser.	
8.	**1.**	**3.**	**Venting from rupture disc:** a. The air/gas relieved upon response from the rupture disc shall vent out to a safe place outside the building. b. Rupture disc vent pipe shall be installed vertically with no/minimum transfer of weight from vent pipe assembly to rupture disc assembly. c. The open end of the vent pipe shall be properly enclosed (without obstructing the flow of air) to prevent the entry of rain water and dust causing damage to the rupture disc. d. Material of construction of the vent pipes associated with SRV and Burst disc shall be of stainless steel.	
8.	**1.**	**4.**	**Excess pressure alarm:** a. Exclusive excess pressure safety alarm shall be consisting of maximum pressure limiter with audio and visual fault indication. b. Excess pressure alarm shall automatically trigger emergency off function upon reaching the set pressure.	
8.	**1.**	**5.**	**Excess temperature alarm:** a. Exclusive excess temperature safety alarm shall be consisting of maximum temperature limiter with audio and visual fault indication. b. Excess temperature alarm shall automatically trigger emergency off function upon reaching the set temperature.	
8.	**1.**	**6.**	**Man-in-vessel safety system:** a. Suitable 'Man-in-vessel' safety system shall be provided to disable all the activities by 'Pull chord' or suitable system, except for door operation by which the door can be opened for the exit of person/ persons inside the vessel. b. This system shall be interlocked with fan drive system, temperature control, pressure control, air outlet valve, shutting off door with audio-visual signal.	
8.	**1.**	**7.**	**Emergency push button** a. Emergency push button shall be provided in the control panel**.** On energizing this button incomer circuit breaker shall be tripped and the autoclave shall be de-pressurized simultaneously by giving an audio- visual alarm.	

					Bidder's Compliance (Yes/No)
			b. The fan drive system, heaters, pressure control shall stop and air outlet valve shall open with a necessary logic in PLC. c. UPS power with minimum 60 min back up shall be provided for operating air outlet and other control valves.		
8.	**1.**	**8.**	**Safety on power failure** i. Safety provisions shall be incorporated as a safeguard in the event of power failure to retain operating conditions inside the autoclave, and to automatically continue the process on restoration of power. ii. Detail of these provisions shall be furnished during detailed engineering.		
8.	**1.**	**9.**	Refer Section-C/ Clause-9, 10 & 11 along with the above specifications.		
8.	**2.**	**0.**	**Documentation – Safety Systems** Refer Section-C/Clause-15 in conjunction with the below		
8.	**2.**	**1.**	Report on selection criteria, detailed specifications& Calculations report on selection and sizing of Safety relief valve & Burst Discshall be submitted to the purchaser		
8.	**2.**	**2.**	Flow charts and respective P&IDs for all the safety interlocks both programmed and wired available in the Hot Air Autoclave system shall be submitted to the purchaser		
8.	**3.**	**0.**	**Preferred makes** In case the supplier is planning to use different make other than as per the list below, prior approval for the same shall be obtained from the purchaser. However, purchaser reserves the right to reject such proposal.		
8.	**3.**	**1.**	Safety Relief Valves	Lesser, Tyco SanMar	
8.	**3.**	**2.**	Burst Disc	BS & B	
8.	**4.**	**0.**	**Inspection & Testing – Indicative QAP contd..**		

SAFETY SYSTEMS QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
1	Rupture Disc (Burst Disc)	Mill test reports for body and trim	100%	Relevant code, Approved Drawing, Calculations and Technical specifications	All inspection reports, Visual Inspection report, Operation & maintenance manuals, Installation & assembly manuals, Technical specifications, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	I, AS	C	
2		Checking of Characteristics (Effective Pressure, Disc Diameter etc.)				√	V	I, AS	C	
3		Rupture Disc Pressure test (as per standard sampling plan)				√	V	I, AS	C	
4		Rupture Disc Performance including set pressure test (as per standard sampling plan)				√	V	I, AS	C	
5		Rupture Disc Final visual / Dimension Inspection				√	V	I, AS	C	
6		Documentation review prior to release (Final activity of Technical Inspection)				√	V	I, AS	C	
7		Pre-shipment Inspection				√	V	I, AS	C	
8	Safety Relief Valves	**Original Material Certificates**, Body **Hydrostatic and Leak Test**, **Visual & Dimension** Inspection of all Parts before & after assembly, **Seat Leak Test**, **Pop test**, Valve Name Plate marking, Pre-shipment Inspection (Check for end-closures for Valves)	100%	API 526-Design & Construction, API 520-sizing & selection, API 521-guideline for pressure relieving, API 527-Inspection code, Approved Drawing, Calculations and Technical specifications	MTC, Test reports, All inspection reports, Visual Inspection report, operation & maintenance manual, installation & assembly manual, technical specifications, data sheets, OEM certification, Warranty certificates, Performance reports along with supplier's address	√	V	I, AS	C	

SAFETY SYSTEMS QUALITY ASSURANCE PLAN										
S. No.	**COMPONENT/ OPERATION /ACTIVITY**	**TO BE CHECKED**	**QUANTUM OF CHECK**	**REFERENCE DOCUMENTS**	**RECORDS FORMAT**		**AGENCY**			**REMARK**
							P	**W**	**R**	
1	**2**	**3**	**4**	**5**	**6**	**D***	**7**			**8**
	Man-in-Clave Arrangement									
9	Final Inspection after Installation of Man-in-Clave Arrangement	Visual, Dimension	100%	Relevant code of practice, Specifications Document, Approved Procedure, drawings	Stage Inspection Report	√	AS	I	C	
	Final Acceptance (Site Acceptance Test)									
10	Hot Air Autoclave Plant assembled with all sub-systems	Trial Runs & Functional Requirement tests of entire plant for all operations	100%	As per specifications document	Inspection report	√	AS	C	-	
	D* - Records identified with tick [√] shall be essentially included by supplier in QA documentation.	**MTC – Material Test Certificate, SIR-Stage Inspection Reports IR – Inspection Report, LPT-Liquid Penetrant Test,**	**MPT-Magnetic Particle Test, UT-Ultrasonic Test, RT-Radiography P-Perform, W-Witness, R-Review/Clearance**		**AS – Autoclave Supplier, V-Manufacturer / Vendor, I– Third Party Inspector C– Purchaser/Customer (SDSC-SHAR, ISRO),**					
Note:										
1	Testing by suitable method shall be done at NABL certified laboratories only. The NDT Reports shall be certified and approved by minimum ASNT/ ISNT Level-II qualified personnel.									
2	Equipment / material shall not be dispatched / shipped to site until written dispatch clearance is given by Purchaser.									
3	Authorized inspection engineers shall sign off the approved QAP on completion of inspection from each agency.									
4	In the absence of specified standards and where ever there is a conflict between the specification given & the standard code, sound engineering practice shall be followed with the approval of the Purchaser.									

				Bidder's Compliance (Yes/No)
9.	**0.**	**0.**	**INSTRUMENTATION AND CONTROL SYSTEM FOR HOT AIR AUTOCLAVE PLANT**	
			Control system for Automatic operation of 'Hot air autoclave plant' has to monitor and control the operation of autoclave vessel and subsystems like compressors, vacuum pumps, cooling tower, rail bogie (job trolley), Autoclave lid/ door, air circulation system, pressurization & depressurization system, cooling system, heating system, vacuum system etc.	
9.	**1.**	**0.**	**Scope of work**	
9.	**1.**	**1.**	Instrumentation and Control System of Hot Air Autoclave comprises the following: i. Fault tolerant hot standby PLC's and remote IO's. ii. SCADA servers, clients and consoles. iii. Field Instrumentation Systems. iv. UPS and DCPS system with cables. v. Procurement of all sub-systems as per specifications. vi. Supply of items as per the technical specifications given. vii. Panel wiring, assembly, pre-delivery inspection. viii. CCTV system. ix. Autoclave operation Qualification trials in fully automatic mode. x. Interfacing of i-MCC, Thyristors, panel meters to PLC	
9.	**1.**	**2.**	The scope of work also includes the following activities. a. System configuration, as per the detailed specifications, (mentioned in Section-C Technical specifications) and other conceptual drawings are enclosed. b. PLC & SCADA application program development at Purchaser site. c. Installation, cable laying, interfacing with associated systems viz. Compressors, Vacuum Systems, Cooling systems, Air dryer, Conveyor system, field instruments (Profibus PA based sensors, Transmitters and positioners) limit switches/proximity sensors, CFU, IO link, electrical systems (i-MCC, Thyristors, multi-function panel meters), compressors (meant for autoclave pressurization as well as pneumatically operated valves etc. i.e., instrument air) and. d. Procurement and Installation of State-of-the-art pneumatic systems (vacuum & pressure) with bus based modular solenoid valves IO link interfaced with PLC, with 16.0 bar pressure rating, SS pressure fittings have to be installed in Pneumatic panels. Control air supply to control valves, field solenoid valves etc., have to be done with SS tubing with proper high pressure rated fittings.	

<table>
<tr><td></td><td></td><td></td><td></td><td>Bidder's Compliance (Yes/No)</td></tr>
<tr><td></td><td></td><td></td><td>e. Testing & commissioning of Instrumentation and Control system for the operation of Hot Air Autoclave Plant at SMPC Unit-2, SDSC SHAR.
f. Site Acceptance Test of System</td><td></td></tr>
<tr><td>9.</td><td>2.</td><td>0.</td><td>Functional requirements</td><td></td></tr>
<tr><td>9.</td><td>2.</td><td>1.</td><td>The process automation system shall operate & control the process parameters through SCADA based GUI for the following major sub-systems, Autoclave temperature, pressure and vacuum control.
a. Cooling system for air circulation fan, main & pre-cooling for autoclave temperature control, vacuum pumps and recirculation of hot water to cooling tower.
b. Rail conveyor, Rail bridge and door.
c. Pneumatic system
d. Miscellaneous systems or any other auxiliary systems.</td><td></td></tr>
<tr><td>9.</td><td>2.</td><td>2.</td><td>The process automation system (DACS-Data Acquisition and Control System) shall acquire data from various types of field instruments, 3rd party devices and execute the control as per sequence given in user requirement document (URD).</td><td></td></tr>
<tr><td>9.</td><td>3.</td><td>0.</td><td>PLC system</td><td></td></tr>
<tr><td>9.</td><td>3.</td><td>1.</td><td>Supply, installation, testing and commissioning of fault tolerant hot standby PLC components like CPU's, communication modules, Power supply modules, I/O modules (Profinet), CFU modules, Encoders (Profinet), sensor IO link (Profinet) modules, IO link splitters (Profinet), 3rd party interface devices (Profinet), i-MCC interface modules and associated PLC accessories all are Profinet interface as per the enclosed technical datasheets. The overall system configuration, PLC & SCADA configuration shall be provided. (Refer Section-D Annexure VI)</td><td></td></tr>
<tr><td>9.</td><td>3.</td><td>2.</td><td>Summary of I/O's to be interfaced to PLC is given in table below and detailed specifications are provided in datasheet. However, the table to be updated based on the final P&I diagram.
<table>
<tr><th>S. No</th><th>Process Instruments</th><th>Qty</th><th>Spare</th><th>Total</th></tr>
<tr><td>1</td><td>Thermocouples Type "K" Dual Channel</td><td>29</td><td>11</td><td>40</td></tr>
<tr><td>2</td><td>Temperature transmitters (RTD's 4-wire) Profibus-PA</td><td>33</td><td>12</td><td>45</td></tr>
<tr><td>3</td><td>Temperature gauge</td><td>5</td><td>3</td><td>8</td></tr>
<tr><td>4</td><td>Pressure Transmitters Profibus-PA</td><td>18</td><td>7</td><td>25</td></tr>
<tr><td>5</td><td>Pressure switch</td><td>2</td><td>2</td><td>4</td></tr>
<tr><td>6</td><td>Pressure gauge</td><td>11</td><td>5</td><td>16</td></tr>
<tr><td>7</td><td>%RH Transmitters Profibus-PA</td><td>4</td><td>4</td><td>8</td></tr>
<tr><td>8</td><td>Vacuum Transmitters Profibus-PA</td><td>10</td><td>6</td><td>16</td></tr>
<tr><td>9</td><td>Vacuum gauge</td><td>5</td><td>3</td><td>8</td></tr>
<tr><td>10</td><td>Proximity Sensors</td><td>60</td><td>10</td><td>70</td></tr>
</table>
</td><td></td></tr>
</table>

				Bidder's Compliance (Yes/No)

			11	Level Transmitters Profibus-PA	4	2	6
			12	Control valves with smart Positioner (Profibus/Profinet) and limit switch (valve open status)	10	2	12
			13	Absolute Encoders Profibus-PA	2	2	4
			14	Flow transmitter Profibus-PA	2	2	4
			15	Flow switch	10	5	15
			16	Plug type pull card	2	2	4
			17	Flanged valves	21	4	25
			18	Pilot operated with integrated quick exhaust Solenoid valve:	2	2	4
			19	Profinet IO link valve manifolds (Pilot operated solenoid valves)	13	2	15
			20	Compact Field Units (PA)	10	2	12
			21	PLC H system, with accessories	1 set	-	1 set
9.	**3.**	**3.**	Bidder has to supply minimum 20% of the Spares related to PLC and Control system items. If any item used in the project for execution and not listed in below table, those items are also can be considered for minimum spares.				
9.	**3.**	**4.**	**Spares Instrumentation & Control**				

S. No	Description	Qty
1	Cables & accessories	1
2	Control Valves & accessories	2
3	Pressure gauges	6
4	Simatic DP, ET200M modules	3
5	DI modules 32 channel modules	2
6	DO module 32 channel modules	2
7	TC module 8 AI 16bit modules	2
8	module front connector	8
9	24V DC POWER SUPPLY module	3
10	Simaticprofinet connector plug	4
11	SCALANCE switch	1
12	Control valve servicing kit	4
13	Profinet fast connectors	12
14	IO link connectors	25
15	Modular Pneumatic regulator manifold	2

<table>
<tr><td></td><td></td><td></td><td></td><td>Bidder's Compliance (Yes/No)</td></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>16</td><td>IO link Pneumatic pilot valve manifold</td><td>2</td></tr>
<tr><td>17</td><td>IO link splitter</td><td>2</td></tr>
<tr><td>18</td><td>IO link master module</td><td>2</td></tr>
<tr><td>19</td><td>Sensor connectors</td><td>15</td></tr>
<tr><td>20</td><td>Solenoid valves</td><td>4</td></tr>
</table>
</td><td></td></tr>
<tr><td>9.</td><td>3.</td><td>5.</td><td>All the field instruments like pressure, level, vacuum, temperature transmitters and control valves etc., shall be provided for measurement and control with Profibus PA interface with Compact field units (CFU-PA) in ring topology.</td><td></td></tr>
<tr><td>9.</td><td>3.</td><td>6.</td><td>The number of transmitters/ devices per ring network shall not exceed 80% current consumption or 80% data load whichever is less.</td><td></td></tr>
<tr><td>9.</td><td>3.</td><td>7.</td><td>PLC shall be provided with Profinet interface ports to interface with Intelligent motor control center (i-MCC) for commanding the electrical equipment's and monitoring of their electrical health parameters as described in Electrical Section-C/Clause-10&11 of this tender document. Ring network in Profinet/ Ethernet communication to i-MCC and Thyristors shall be provided.</td><td></td></tr>
<tr><td>9.</td><td>3.</td><td>8.</td><td>Separate Local Area Network interface cards for PLC to SCADA server, servers to Clients, HMI communication and PLC to i-MCC shall be provided.</td><td></td></tr>
<tr><td>9.</td><td>3.</td><td>9.</td><td>Below tables showed minimum number of Approximated IO list for data requisition and control of the system, this can be increased, added additional devices, final list updated as per the requirement.</td><td></td></tr>
<tr><td>9.</td><td>3.</td><td>10.</td><td>Analog Inputs (AI) - Thermocouples
<table>
<tr><th>S. No.</th><th>Thermocouple (TC-K)</th><th></th></tr>
<tr><td>1</td><td>TC-1</td><td>Air Temperature -1</td></tr>
<tr><td>2</td><td>TC-2</td><td>Air Temperature -2</td></tr>
<tr><td>3</td><td>TC-3</td><td>Air Temperature -3</td></tr>
<tr><td>4</td><td>TC-4</td><td>Air Temperature -4</td></tr>
<tr><td>5</td><td>TC-5</td><td>Air Temperature -5</td></tr>
<tr><td>6</td><td>TC-6</td><td>Air Temperature -6</td></tr>
<tr><td>7</td><td>TC-7</td><td>Air Temperature -7</td></tr>
<tr><td>8</td><td>TC-8</td><td>Air Temperature -8</td></tr>
<tr><td>9</td><td>TC-9</td><td>Air Temperature -9</td></tr>
<tr><td>10</td><td>TC-10</td><td>Air Temperature -10</td></tr>
</table>
</td><td></td></tr>
</table>

						Bidder's Compliance (Yes/No)

11	TC-11	Air Temperature -11
12	TC-12	Air Temperature -12
13	TC-13	Air Temperature -13
14	TC-14	Air Temperature -14
15	TC-15	Air Temperature -15
16	TC-16	Air Temperature -16
17	TC-17	Air Temperature -Main Plc
18	TC-18	Air Temperature -Redundant Plc
19	TC-19	Air Temperature -Main Safety
20	TC-20	Air Temperature -Redundant Safety
21	TC-21	Job Temperature -1
22	TC-22	Job Temperature -2
23	TC-23	Job Temperature -3
24	TC-24	Job Temperature -4
25	TC-25	Job Temperature -5
26	TC-26	Job Temperature -6
27	TC-27	Job Temperature -7
28	TC-28	Job Temperature -8
29	TC-29	Job Temperature -9

Note:
Range of the above Thermocouple's: 0 to +1100ºC, 2xType K, Ø3mm, Length- 3000mm;
Location of the above Thermocouple's: Autoclave chamber

Thermocouple Sensor mounting and connections:

Sample Thermocouple sensors connection drawing:

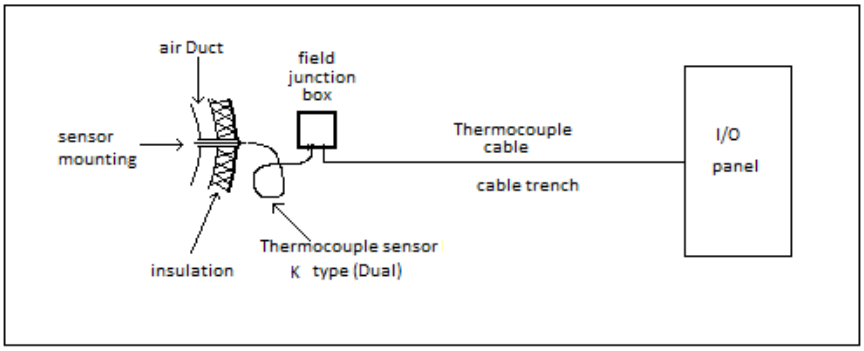


Fig: Typical Thermocouple (TC-K-Dual channel) connection Diagram

The thermocouple sensor to I/O panel have to be extended with thermocouple cable terminated in the field junction box, and IO Panel with TC-K terminals. Refer specifications for details.

All the TC channels (Dual channel) are wired and extended up to IO panel.

<table>
<tr><th></th><th></th><th></th><th></th><th>Bidder's Compliance (Yes/No)</th></tr>
<tr><td></td><td></td><td></td><td>Monitoring Group-1, 16 Nos.
Monitoring Group-2, 16 Nos.
Job Monitoring Group-1, 9 Nos.
Job Monitoring Group-2, 9 Nos.
Control Group-1, 4 Nos.
Control Group-2, 4 Nos.
The field junction boxes have to install on the autoclave chamber with two sensors dual channel TC-K type sensors are terminated with TC-K type terminals (6+6) in the junction box, and all the junction boxes are connected with cable trench.</td><td></td></tr>
<tr><td>9.</td><td>3.</td><td>11.</td><td>Analog Inputs (AI) - Temperature Transmitter (RTD 4 Wire
<table>
<tr><th>S No.</th><th colspan="2">Temperature Transmitter (RTD 4 Wire)</th><th>Range</th><th>Location</th></tr>
<tr><td>1</td><td>TT-RTD-1</td><td>Fan Winding Temperature Main</td><td rowspan="7">0 to 200^{0}C, Profibus-PA</td><td>Blower</td></tr>
<tr><td>2</td><td>TT-RTD-2</td><td>Fan Winding Temperature Redundant</td><td rowspan="6">Water Line</td></tr>
<tr><td>3</td><td>TT-RTD-3</td><td>Fan Cooling Water Return Line Temperature</td></tr>
<tr><td>4</td><td>TT-RTD-4</td><td>Pre-Cooling Return Line Temperature</td></tr>
<tr><td>5</td><td>TT-RTD-5</td><td>Main Cooling Return Line Temperature</td></tr>
<tr><td>6</td><td>TT-RTD-6</td><td>Vacuum Pump-1 Cooling Water Return Line</td></tr>
<tr><td>7</td><td>TT-RTD-7</td><td>Vacuum Pump-2 Cooling Water Return Line</td></tr>
<tr><td>8</td><td>TT-RTD-8</td><td>Cold Water Tank Temperature-1</td><td rowspan="6">0 to 100^{0}C, Profibus-PA</td><td rowspan="2">Cooling Water Tank</td></tr>
<tr><td>9</td><td>TT-RTD-9</td><td>Cold Water Tank Temperature-2</td></tr>
<tr><td>10</td><td>TT-RTD-10</td><td>Hot Water Tank Temperature-1</td><td rowspan="2">Hot Water Tank</td></tr>
<tr><td>11</td><td>TT-RTD-11</td><td>Hot Water Tank Temperature-2</td></tr>
<tr><td>12</td><td>TT-RTD-12</td><td>Circulation Pump Water Return Line</td><td>Water Line</td></tr>
<tr><td>13</td><td>TT-RTD-13</td><td>Compressor-1 Cooling Return Line</td><td rowspan="2">0 to 200 ^{0}C</td><td rowspan="2">Water Line</td></tr>
<tr><td>14</td><td>TT-RTD-14</td><td>Compressor-1 Cooling Line Temp</td></tr>
</table></td><td></td></tr>
</table>

								Bidder's Compliance (Yes/No)
			15	TT-RTD-15	Compressor-2 Cooling Return Line			
			16	TT-RTD-16	Compressor-2 Cooling Line Temp			
			17	TT-RTD-17	Compresdsor-1 Stage-1 Temp	as per design	Compressor-1	
			18	TT-RTD-18	Compresdsor-1 Stage-2 Temp			
			19	TT-RTD-19	Compresdsor-1 Stage-3 Temp			
			20	TT-RTD-20	Compressor-1 Oil Temp	0 to 200^{0}C		
			21	TT-RTD-21	Compresdsor-2 Stage-1 Temp	as per design	Compressor-2	
			22	TT-RTD-22	Compresdsor-2 Stage-2 Temp			
			23	TT-RTD-23	Compresdsor-2 Stage-3 Temp			
			24	TT-RTD-24	Compressor-2 Oil Temp	0 to 200^{0}C		
			25	TT-RTD-25	Dryer Temp-1	as per design	Dryer Temp	
			26	TT-RTD-26	Dryer Temp-2			
			27	TT-RTD-27	Dryer Temp-3			
			28	TT-RTD-28	Autoclave Skin Temperature-1	0 to 100 ^{0}C	Autoclave Chamber	
			29	TT-RTD-29	Autoclave Skin Temperature-2			
			30	TT-RTD-30	Air Temperature-Rtd-1 (Between Door & Air Duct End)	0 to 200^{0}C, Profibus-PA		
			31	TT-RTD-31	Air Temperature-Rtd-2 (Between Door & Air Duct End)			
			32	TT-RTD-32	Ambient Temperature(Room)	0 to 100 ^{0}C	Bay wall mount	
			33	TT-RTD-33	Ambient Temperature(outside)		Outside Building	
9.	**3.**	**12.**	**Analog Inputs (AI) - Pressure Transmitter**					

S. No.	Pressure Transmitter		Range	Location
1	PT-1	Pressure Main PLC PT	0 to 35.0bar,	Autoclave Chamber
2	PT-2	Pressure Redundant PLC PT		

								Bidder's Compliance (Yes/No)
			3	PT-3	Pressure Main Safety PT	Profibus-PA		
			4	PT-4	Pressure Redundant Safety PT			
			5	PT-5	Control Air Tank Pressure PT		Air Reservoir Tank	
			6	PT-6	Process Air Tank Pressure PT			
			7	PT-7	Fan Cooling Water Line Pressure PT	0 to 16.0bar, Profibus-PA	Autoclave Chamber	
			8	PT-8	Pre-Cooling Line Pressure PT		Water Pipe Line	
			9	PT-9	Main-Cooling Line Pressure PT			
			10	PT-10	Vacuum Pumps Cooling Line Pressure			
			11	PT-11	Compressor-1 Cooling Line Pressure		Compressor-1	
			12	PT-12	Compressor-2 Cooling Line Pressure		Compressor-2	
			13	PT-13	Compressor-1 Stage-1 Pressure	as per design Profibus-PA	Compressor-1	
			14	PT-14	Compressor-1 Stage-2 Pressure			
			15	PT-15	Compressor-1 Stage-13pressure			
			16	PT-16	Compressor-2 Stage-1 Pressure		Compressor-2	
			17	PT-17	Compressor-2 Stage-2 Pressure			
			18	PT-18	Compressor-2 Stage-3 Pressure			
9.	**3.**	**13.**	**Analog Inputs (AI) - Vacuum Transmitter**					
			S. No.	**Vacuum Transmitter**		**Range**	**Location**	
			1	VT-1	Vacuum Main PLC	(-1 to 10 bar), Profibus-PA	Vacuum reservoir tank	
			2	VT-2	Vacuum Redundant PLC			
			3	VT-3	Vacuum-1 Main		Vacuum-1 pipe line	
			4	VT-4	Vacuum-1 Redundant			
			5	VT-5	Vacuum-2 Main		Vacuum-2 pipe line	
			6	VT-6	Vacuum-2 Redundant			
			7	VT-7	Vacuum-3 Main		Vacuum-3 pipe line	
			8	VT-8	Vacuum-3 Redundant			

				Bidder's Compliance (Yes/No)

9	VT-9	Vacuum-4 Main		Vacuum-4 pipe line		
10	VT-10	Vacuum-4 Redundant				

9. 3. 14. Analog Inputs (AI) - Flow Transmitter

S. No.	Flow Transmitter		Range	Location
1	FT-1	Pre-Cooling Flow	80 m3/h (or)as per design	water pipe line
2	FT-2	Main-Cooling Flow		

9. 3. 15. Analog Inputs (AI) - Level Transmitter

S. No.	Level Transmitter		Range	Location
1	LT-1	Drain Tank Level-1	0 to 1200 mm	Drain tank
2	LT-2	Drain Tank Level-2		Water Tank
3	LT-3	Cooling Tank Level-1	0 to 1200 mm	Water Tank
4	LT-4	Cooling Tank Level-2		Water Tank

9. 3. 16. Analog Inputs (AI) - Encoder

S. No.	Encoder		Range	Location
1	ENC-1	Bridge Position	16-bit Profibus-PA	Bridge
2	ENC-2	Conveyor Position		Conveyor

9. 3. 17. Digital Inputs (DI) – Flow Switch

S.No.	Flow Switch		Location
1	FS-1	Fan Cooling Water Return Line	Blower
2	FS-2	Pre-Cooling Return Line	Water Line
3	FS-3	Main -Cooling Return Line	
4	FS-4	Vacuum Pump-1 Cooling Return Line	Vacuum Pump-1
5	FS-5	Vacuum Pump-2 Cooling Return Line	Vacuum Pump-2
6	FS-6	Drain Pump Discharge Line	Drain Tank Discharge Line
7	FS-7	Circulation Pump Water Return Line	Water Line
8	FS-8	Compressor-1 Water Return Line	Vacuum Pump-1
9	FS-9	Compressor-2 Water Return Line	Vacuum Pump-2
Note: Range shall be as per design			

9. 3. 18. Digital Inputs (DI) – Pressure Switch

S.No.	Pressure Switch	Range	Location

							Bidder's Compliance (Yes/No)
			1	PS-1	Autoclave Pressure-1	0 to 0.04	Autoclave chamber pressure line has to extend up Pneumatic panel
			2	PS-2	Autoclave Pressure-2		
9.	**3.**	**19.**	**Digital Inputs (DI) – Pressure Switch**				

S.No.	Proximity Sensor		Location
1	PX-1	Detent Wheel Close	Autoclave Chamber
2	PX-2	Detent Wheel Open	
3	PX-3	Door Swinging Open	
4	PX-4	Door Swinging Close	
5	PX-5	Door Turning Open	
6	PX-6	Door Turning Close	
7	PX-7	Door Turning Mid	
8	PX-8	Bridge Up-1	Bridge
9	PX-9	Bridge Up-2	
10	PX-10	Bridge down-1	
11	PX-11	Bridge down-2	
12	PX-12	Conveyor Rear	Conveyor
13	PX-13	Conveyor Home	
14	PX-14	Conveyor Front	
15	PX-15	Conveyor Front over travel	
16	PX-16	Conveyor Rear over travel	
17	PX-17	Hand valve-1 Close	Air, Vacuum, Water Lines
18	PX-18	Hand valve-1 Open	
19	PX-19	Hand valve-2Close	
20	PX-20	Hand valve-2 Open	
21	PX-21	Hand valve-3 Close	
22	PX-22	Hand valve-3 Open	
23	PX-23	Hand valve-4 Close	
24	PX-24	Hand valve-4 Open	Air, Vacuum, Water Lines
25	PX-25	Hand valve-5 Close	
26	PX-26	Hand valve-5 Open	
27	PX-27	Hand valve-6 Close	

							Bidder's Compliance (Yes/No)
			28	PX-28	Hand valve-6 Open		
			29	PX-29	Hand valve-7 Close		
			30	PX-30	Hand valve-7 Open		
			31	PX-31	Hand valve-8 Close		
			32	PX-32	Hand valve-8 Open	Air, Vacuum, Water Lines	
			33	PX-33	Hand valve-9 Close		
			34	PX-34	Hand valve-10 Open		
			35	PX-35	Hand valve-10 Close		
			36	PX-36	Hand valve-11 Open		
			37	PX-37	Hand valve-11 Close		
			38	PX-38	Hand valve-12 Open		
			39	PX-39	Hand valve-12 Close		
			40	PX-40	Hand valve-13 Open	Air, Vacuum, Water Lines	
			41	PX-41	Hand valve-13 Close		
			42	PX-42	Hand valve-14 Open		
			43	PX-43	Hand valve-14 Close		
			44	PX-44	Hand valve-15 Open		
			45	PX-45	Hand valve-15 Close		
			46	PX-46	Hand valve-16 Open		
			47	PX-47	Hand valve-16 Close		
			48	PX-48	Hand valve-17 Open	Air, Vacuum, Water Lines	
			49	PX-49	Hand valve-17 Close		
			50	PX-50	Hand valve-18 Open		
			51	PX-51	Hand valve-18 Close		
			52	PX-52	Hand valve-19 Open		
			53	PX-53	Hand valve-20 Close		
			54	PX-54	Hand valve-20 Open		
			55	PX-55	Hand valve-21 Close		
			56	PX-56	Hand valve-22 Open	Air, Vacuum, Water Lines	
			57	PX-57	Hand valve-24 Close		
			58	PX-58	Hand valve-24 Open		

						Bidder's Compliance (Yes/No)
			59	PX-59	Hand valve-25 Close	
			60	PX-60	Hand valve-25 Open	
			Note: Range shall be 0 to 5mm			
9.	**3.**	**20.**	**Digital Output (DO) – Pneumatic Pilot Valve (Solenoid valve)**			

S.No.	Pneumatic Pilot Valve (Solenoid valve)	
1	SV-1	Air in Control Valve-1
2	SV-2	Air in Control Valve-2
3	SV-3	Air-out Control Valve-1
4	SV-4	Air-out Control Valve-2
5	SV-5	Pre-Cooling Control Valve-1
6	SV-6	Pre-Cooling Control Valve-2
7	SV-7	Main-Cooling Control Valve-1
8	SV-8	Main-Cooling Control Valve-2
9	SV-9	Vacuum Control Valve-1
10	SV-10	Vacuum Vent Control Valve-2
11	SV-11	Vacuum Valve-1
12	SV-12	Vacuum Valve-2
13	SV-13	Vacuum Valve-3
14	SV-14	Vacuum Valve-4
15	SV-15	Drain Valve
16	SV-16	Bridge up
17	SV-17	Bridge down
18	SV-18	Air in ON/OFF Valve-1
19	SV-19	Air in ON/OF Valve-2
20	SV-20	Air-out ON/OF Valve-1
21	SV-21	Air-out ON/OF Valve-2
22	SV-22	Pre-Cooling ON/OF Valve-1
23	SV-23	Pre-Cooling ON/OF Valve-2
24	SV-24	Main-Cooling ON/OF Valve-1
25	SV-25	Main-Cooling ON/OF Valve-2
26	SV-26	Drain Pump-1 ON/OFF Valve

				Bidder's Compliance (Yes/No)

27	SV-27	Drain Pump-2 ON/OFF Valve
28	SV-28	Circulation Pump-1 ON/OFF Valve
29	SV-29	Circulation Pump-2 ON/OFF Valve
30	SV-30	Main cooling Pump-1 ON/OFF Valve
31	SV-31	Main cooling Pump-2 ON/OFF Valve
32	SV-32	Circulation Pump-1 ON/OFF Valve
33	SV-33	Circulation-2 ON/OFF Valve
34	SV-34	Fan Winding & Vacuum Pump-1 ON/OFF Valve
35	SV-35	Fan Winding & Vacuum Pump-2 ON/OFF Valve
Note: Above Valves shall be located in Pneumatic panel		

9. 3. 21. Digital Output (DO) – Pressure Gauges

S. No.	Pressure Gauge		Range	Location
1	PG-1	Control Air Tank PG	0 to 16.0 bar, SS316 L	Air Reservoir Tank
2	PG-2	Process Air Tank PG		Air Reservoir Tank
3	PG-3	Fan Cooling Water-In Line PG	0 to 12.0 bar SS316 L Liquid filled	Water Pipe Line
4	PG-4	Pre-Cooling Water Line PG		
5	PG-5	Main-Cooling Water Line PG	0 to 16.0 bar SS316 L Liquid filled	
6	PG-6	Vacuum Pump Cooling Water Line PG	0 to 12.0 bar SS316 L Liquid filled	
7	PG-7	Circulation Pump Water Line PG		
8	PG-8	Compressor-1 Cooling Water Line PG		
9	PG-9	Compressor-2 Cooling Water Line PG		
10	PG-10	Dryer Out Line PG		Dryer
11	PG-11	Autoclave Pressure PG	(-1 to 15.0 bar), EN 837-1	Autoclave Chamber

9. 3. 22. Digital Output (DO) – Vacuum Gauges

S. No.	Vacuum Gauge		Range	Location
1	VG-1	Vacuum-1		Vacuum Lines

							Bidder's Compliance (Yes/No)
			2	VG-2	Vacuum-2	(-1 to 9.0 bar), EN 837-1, SS316 L	
			3	VG-3	Vacuum-3		
			4	VG-4	Vacuum-4		
			5	VG-5	Vacuum		Vacuum Reservoir Tank
9.	**3.**	**23.**	**Digital Output (DO) – Temperature Gauges**				
			S. No.	**Temperature Gauge**		**Range**	**Location**
			1	TG-1	Fan Cooling Water Temperature	0 to 100^{0}C, EN13190	Water Lines
			2	TG-2	Pre- Cooling Water Temperature		
			3	TG-3	Main Cooling Water Temperature		
			4	TG-4	Vacuum Pumps Cooling Line Temp		
			5	TG-5	Circulation Pump Water Line Temp		
9.	**3.**	**24.**	**Analog Inputs & Outputs, Digital Inputs & Outputs of the feeders of i-MCC, Thyristors:** The following equipment's, devices and systems shall be Installed and parameter like Voltage, Current, Speed, Status & command signals are interfaced with PLC and SCADA (Communication protocol Profinet), by the Vendor.				
			S. No.	**Feeders of i-MCC, Thyristor**			
			1	Conveyor Motor - i-MCC			
			2	Door Swing Motor - i-MCC			
			3	Door Turn Motor - i-MCC			
			4	Blower Motor Feeder - VFD			
			5	Standby Blower Motor Feeder - VFD			
			6	Cooling Tower Circulation Pump Motor-1 - i-MCC			
			7	Cooling Tower Circulation Pump Motor-2 - i-MCC			
			8	Cooling Tower Fan-1 - i-MCC			
			9	Cooling Tower Fan-2 - i-MCC			
			10	Autoclave Main Cooling Pump Motor-1 - VFD			
			11	Autoclave Main Cooling Pump Motor-2- VFD			
			12	Blower Motor Winding and Vacuum Pump Cooling Pump Motor-1 - i-MCC			

				Bidder's Compliance (Yes/No)
			13 Blower Motor Winding and Vacuum Pump Cooling Pump Motor-2 - i-MCC 14 Drain Pump Motor-1 - i-MCC 15 Drain Pump Motor-2 - i-MCC 16 Vacuum Pump Motor-1 - i-MCC 17 Vacuum Pump Motor-2 - i-MCC 18 Control Air Compressor Motor - i-MCC 19 Heater Bank with Thyristors - - i-MCC 20 Spare i-MCC Feeders of Rating 15kw - i-MCC 21 Multi - Function Meter for Compressor-1 22 Multi - Function Meter for Compressor-2 23 i-MCC module-for Dryer-1 24 i-MCC module-for Dryer-2	
9.	**4.**	**0.**	Temperature, Pressure safety in the case of over pressure, or over temperature detects, then Autoclave Plant should be shutdown. Implementation and interfacing with PLC system for event logging, details are as follows. a. Detection of Over Temperature warning-1, for alarm. b. Detection of Over Temperature warning-2, for plant shutdown. c. Detection of Over Pressure warning-1, for alarm. d. Detection of Over Pressure-2, for plant shutdown. Digital Inputs of the above Detections are implemented with persistency check before action.	
9.	**5.**	**0.**	**SCADA System**	
9.	**5.**	**1.**	All the communication between SCADA to PLC shall be provided with dual redundancy.	
9.	**5.**	**2.**	1 No. of HMI/ thin clients shall be provided as per datasheet for the local operation of rail bogie, rail bridge and Door system.	
9.	**5.**	**3.**	Unlimited tag licenses for engineering station, clients, servers and 3rd party devices should be provided along with the approximate count of SCADA tags (including 3rd party devices data, simulation, override, scaling, diagnostics etc.,) are 5,000 Nos. the critical tags approximately 250 are logging in ≤500 ms	
9.	**5.**	**4.**	Sub-system wise mimic screens to monitor the process status and real time operations. a. Autoclave complete overview b. Cooling system. c. Compressor systems including dryer. d. Vacuum system. e. i-MCC	

				Bidder's Compliance (Yes/No)
			f. Profinet& Profibus devices g. Thyristors h. Diagnosis i. User program for process j. Alarms- Set point entry page with privilege for all high, high-high, low, low-low alarms and control set points. k. Trends l. All safety & operational interlocks.	
9.	**5.**	**5.**	Sub-system-wise I/O screens for loop checking, simulation and scaling.	
9.	**5.**	**6.**	MMI-PLC-IO network configuration screens with critical diagnostic information and messages.	
9.	**5.**	**7.**	Diagnostics screen for Profinet IO link of Pneumatic systems manifolds.	
9.	**5.**	**8.**	Diagnostics screen for PLC hardware components, 3rd party devices, transmitters and control valves etc., with faceplates for each device.	
9.	**5.**	**9.**	User administration with access rights shall be provided.	
9.	**5.**	**10.**	Events, Alarms logging shall be provided with sub-system wise filter.	
9.	**5.**	**11.**	Real time Trend display of process parameters.	
9.	**5.**	**12.**	**Report Generation:** a. Reports shall be generated for logged data, alarms & events as per the user defined formats. b. From- & To- date and time shall be user selectable. c. Time interval shall be user selectable. d. Options to export data in PDF, MS Excel, MS Access, SQL formats. e. Print report option shall be provided. f. Consider report generation as per user report. Templet will be provided after award of contact.	
9.	**5.**	**13.**	Suitable color printer shall be provided.	
9.	**5.**	**14.**	Any other screens as per the user requirement.	
9.	**5**	**15.**	User friendly messages and pup-up windows for guiding the operator on steps of operation, warning, alarm & trip conditions etc.	
9.	**6.**	**1.**	**Data Acquisition & Control System (DACS) programming**	
9.	**6.**	**2.**	DACS (PLC & SCADA) programming shall be developed as per IEEE 12207 standard. User requirements document (URD) will be provided after award of the contract. The software shall comprise of the following modules.	
9.	**6.**	**3.**	**Environment software** a. Environment software comprising of fault tolerant hot standby PLC hardware configuration, I/O acquisition, simulation tags for	

<table>
<tr><td></td><td></td><td></td><td></td><td>Bidder's Compliance (Yes/No)</td></tr>
<tr><td></td><td></td><td></td><td>all I/O's, main or redundant signal override function, scaling function, including voting methods etc.
b. The acquired IOs are to be validated by taking into account of concerned channel diagnostics data, channel discrepancy and simulated value etc.
c. System diagnostic software includes PLC CPU, I/O & 3rd party communication, LAN and I/O cards health status
d. The software will be thoroughly reviewed & tested during pre-delivery inspection (Factory Acceptance Test-FAT) by Purchaser.</td><td></td></tr>
<tr><td>9.</td><td>6.</td><td>4.</td><td>The application (process control) software: The application software design shall be carried out based on URD and submit for review & approval by department. The application software shall be developed covering the following general requirements
a. The process control shall have auto/Manual mode of operation with default Auto mode. A provision to be made to changeover to manual mode with appropriate user rights.
b. SCADA shall have a profile-based control, in which Auto Clave parameters are controlled via a predefined profile table called program recipe.
c. Program recipe table should have parameters with engineering Data formats are, Time = HH:MM: SS, Temperature = ^{o}C, Pressure = bar, Vacuum = bar,
d. Program recipe table should have minimum 12 profiles, with provision for selection of no. of profiles.
e. Sample table shown in below
<table>
<tr><th>Parameter</th><th>Time (HH:MM: SS)</th><th>Temperature (0C)</th><th>Pressure (bar)</th><th>Vacuum (bar)</th></tr>
<tr><td>Profile-0</td><td>00:00:00</td><td>30</td><td>0</td><td>-0.99</td></tr>
<tr><td>Profile-1</td><td>02:00:00</td><td>50</td><td>5</td><td>-0.99</td></tr>
<tr><td>Profile-2</td><td>02:00:00</td><td>120</td><td>5</td><td>-0.99</td></tr>
<tr><td>Profile-3</td><td>04:00:00</td><td>120</td><td>5</td><td>-0.99</td></tr>
<tr><td>Profile-4</td><td>01:00:00</td><td>60</td><td>5</td><td>-0.99</td></tr>
<tr><td>Profile-5</td><td>00:05:00</td><td>60</td><td>5</td><td>0</td></tr>
<tr><td>Profile-6</td><td>01:55:00</td><td>35</td><td>5</td><td>0</td></tr>
<tr><td>Profile-7</td><td>02:00:00</td><td>35</td><td>0</td><td>0</td></tr>
<tr><td>Profile-8</td><td>00:00:00</td><td>35</td><td>0</td><td>0</td></tr>
<tr><td>Profile-9</td><td>00:00:00</td><td>35</td><td>0</td><td>0</td></tr>
<tr><td>Profile-10</td><td>00:00:00</td><td>35</td><td>0</td><td>0</td></tr>
<tr><td>Profile-11</td><td>00:00:00</td><td>35</td><td>0</td><td>0</td></tr>
<tr><td>Profile-12</td><td>00:00:00</td><td>35</td><td>0</td><td>0</td></tr>
</table>
In Auto mode of operation, once setpoints, selection of program recipe and type of process (vulcanization/ Pre-Heating) is made, a</td><td></td></tr>
</table>

				Bidder's Compliance (Yes/No)
			start soft key is enabled. When process starts scheduled, after ensuring the safety parameters and initial check list (listed as part of safety interlocks), the following sequence has to be executed. a. Switch ON Fan and stabilized Running with minimum RPM b. Switch ON Heater banks in staggered mode (duration of 1 min each) after 3 minutes all banks should ON c. Pressure, temperature and Vacuum PID control ON. d. Health of Cooling system. e. Auxiliary systems ON.	
9.	**6.**	**5.**	Upon completion of the above, Ramp-up/ down /soaking of Temperature, Pressure, and Vacuum has to Start.	
9.	**6.**	**6.**	Program sequence has to Follow pre-defined Profile Path with Smooth curve with Precise control of parameters. Both the Curves of Actual process parameters and Pre-Defined Profile parameters shall be Plotted dynamically in SCADA Trends.	
9.	**6.**	**7.**	Provision to be given to STOP the running program or jump to next step or any step using soft keys in SCADA drop down Menu.	
9.	**6.**	**8.**	Every subsystem shall have Initial conditions, running interlocks, surveillance checks etc.	
9.	**6.**	**9.**	Application program should have Control accuracy for temperature Control as ±1^{o}C, and for pressure control as ± 0.1 bar	
9.	**6.**	**10.**	The spatial variation of temperature control inside autoclave, during process soaking time are shown below. a. Spatial variation Condition-1, Pressure 8 bar with Temperature 150^{o}C, strictly < 1^{o}C must follow. b. Spatial variation Condition-2, Temperature 150 ^{o}C, strictly < 1^{o}C must follow	
9.	**6.**	**11.**	Failure cases, contingency conditions (process pause/resume, termination) etc.	
9.	**6.**	**12.**	Manual mode of operation a. Every Individual component shall have a command provision to switch from Auto to Manual or vice versa using a pop-up selection on the Mimic during the process cycle. b. Menu driven selection to be provided for operation of any sub-system with all its interlocks when Auto mode is not in use. c. The menu driven sub systems are: i. Door ii. Rail bridge(up/down), iii. Rail bogie (FAST/SLOW operation) iv. Vacuum system with water cooling circulation Pneumatic system.	
9.	**6.**	**13.**	Recipe selected during every process cycle to be saved along with associated trends for Autoclave Programs Recipe Table management and Process data evolution.	
9.	**6.**	**14.**	All Modes of operations shall consist of the following	

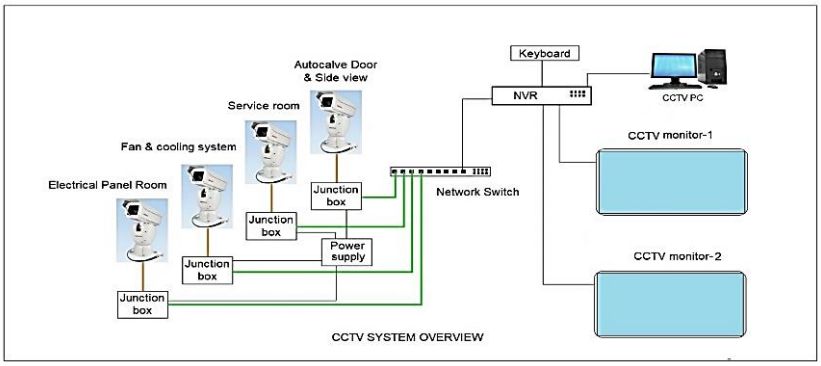
				Bidder's Compliance (Yes/No)
			a. Selection of the type of segment / type of curing cycle b. Selection of the subsystems like vacuum pumps, compressors etc. c. Storing and editing of any curing cycle. d. Storing the necessary product information. e. System checks before starting the cure.	
9.	**6.**	**15.**	Upon completion of the above, Ramp-up/ down /soaking of Temperature, Pressure, and Vacuum has to Start.	
9.	**7**	**0.**	**Safety &interlocking systems**	
9.	**7.**	**1.**	Start-up & running interlocks with persistence check where applicable has to be implemented.	
9.	**7.**	**2.**	Necessary safety features and interlocks to be provided to ensure the safety of operator and the safety of autoclave system. The alarms or safety actions shall be implemented either from hard-wired pull cord switches or process deviations. The surveillance safety interlocks which are active in all modes of operation.	
9.	**7.**	**3.**	**Interlocks during process** a. Autoclave on rapid temp. raise: If temperature, sensed by selected number of thermocouples (K type), shoots up more than 5^0C/min w.r.t set point, then heaters, blowers and pressurization to be stopped. b. Power failure condition: During the live process if power fails, system has to detect power failure condition and running program timers, should be hold condition. at this stage the control outputs are in safe condition and all the Thyristors, Control valves are should be in off condition. c. Power restores back: System has to detect this and after delay of 30 seconds, the control system action enables the restoration of temperature, pressure and vacuum. Once the set points are reached then only program timers hold has to release and ensure normal run, and duration of power failure time has to be logged. The compensation of time delay caused by power fail, has to be added in the program. d. Temperature Process Hold: during the live process if the set point and process variable difference ≥3℃ then the program timers have to hold, but the control action has to follow for correction. If the difference become < 3 ˚C, program timers hold, have to release and enable normal run. e. Pressure Process Hold: during the live process if the set point and process variable difference ≥0.2 bar then the program timers have to hold, but the control action has to follow for correction. If the difference become < 0.2 bar, program timers hold, have to release and enable normal run. f. Over Temperature: This condition will put off all the heaters, stops pressurizing and initiate de-pressurization of vessel to operating pressure.	

				Bidder's Compliance (Yes/No)
			g. Over Pressure: This condition will stop pressurizing and put-off all heaters and start depressurization of vessel to operating pressure. h. Door opening & unlock: Only possible when Auto clave completely depressurized, and Rail bridge in up condition. i. Door closing and lock: when man in vessel not active and Rail bridge in up condition. j. Man-in-vessel: If this condition is present air outlet valve shall be opened and all the activities must be disabled by pull chord or suitable method, except door operation, by which the door can be opened and the person can be saved. The pull cord system is to be interlocked with fan drive system, pressure control, air outlet valve, shutting off of door with audio-visual signal.	
9.	**7.**	**4.**	**Emergency push button** a. Software Emergency soft key in SCADA mimic: by clicking running program should hold. b. Hardware emergency at Operator console: The Emergency push button provided in control console shall be hardwired with incoming circuit breaker trip circuit. When pressed, put off all the heaters and fan drive, stop pressure control, open air outlet valve and depressurize the autoclave. c. Hardware emergency at Local HMI panel: when this Emergency push button is pressed, this shall trip MCCB of Bogie, door & Lighting systems only.	
9.	**7.**	**5.**	All the unsafe conditions mentioned above shall also produce an audible alarm (Hooter) and visual indication in control panel.	
9.	**7.**	**6.**	User Requirement Document covering all the process and safety requirements will be provided after awarding the contract prior to commencement of DACS software development.	
9.	**8.**	**0.**	**Steps in DACS software Development, Review & Testing**	
9.	**8.**	**1.**	Submission of environment software design document for approval from Purchaser.	
9.	**8.**	**2.**	Development of environment software by bidder at site.	
9.	**8.**	**3.**	Review & testing of environment software by bidder & Purchaser.	
9.	**8.**	**4.**	Modify/update environment software based on review, documents and submit to Purchaser for approval.	
9.	**8.**	**5.**	URD document for application software design will be given by Purchaser, if any modifications are required, same shall be carried out by bidder.	
9.	**8.**	**6.**	Submission of application software design documents (SRD, SRS, SDD and SCADA design documents) shall be submitted to Purchaser for approval.	
9.	**8.**	**7.**	Application software development & testing by bidder.	

				Bidder's Compliance (Yes/No)
9.	**8.**	**8.**	Submission of test case (black & white box with nominal & off-nominal test cases) documents for Purchaser review & approval.	
9.	**8.**	**9.**	Review & testing of application software by bidder & Purchaser at site.	
9.	**8.**	**10.**	Modify/update application software, documents (including URD) and submit to Purchaser for approval.	
9.	**8.**	**11.**	Carry out trial runs of individual sub-systems, simulation and dry runs of integrated system for Autoclave process, Autoclave process trials and live Autoclave process by bidder and Purchaser.	
9.	**8.**	**12.**	Modify/update environment and application software for fine tuning during system commissioning and update documents, then submit to Purchaser for approval.	
9.	**8.**	**13.**	After successful testing & commissioning, the source code should be handed over to purchaser.	
9.	**9.**	**0.**	**Control Console**	
9.	**9.**	**1.**	a. Three no's (2 bay each) control console shall be provided with elegant, modular, aesthetic and state of the art design. The console shall house engineering stations, operator stations (SCADA-Clients), Human Machine interface (HMI-Intrinsically safe thin client), and associated items like Emergency push button, telephones etc., a datasheet is enclosed. The console & chairs design and colour etc., shall be submitted for approval prior to procurement. b. 2 No's (two bay) Control console for SCADA systems, and 1 no's (two bay) Control console for CCTV system. (Total Control consoles are 3 no's) c. Each bay minimum size 750x750x800mm (LxWxH). d. 1No. Emergency push button with key in each console e. 10 Nos. of ergonomically designed executive type revolving chair with wheels	
9.	**10.**	**0.**	**Power Supply System**	
9.	**10.**	**1.**	Supply, Installation & commissioning of parallel redundant 230V AC Uninterruptible Power Supply (UPS) system and 230V AC power distribution panel with suitable surge protection devices (SPD) shall be provided as per datasheet.	
9.	**10.**	**2.**	Supply, installation and commissioning of diode OR-ed redundant 24V DC power supplies and 24V DC power distribution shall be provided.	
9.	**10.**	**3.**	Status monitoring for the following shall be provided and wired to DACS. a. ON/OFF status of UPS input/ output MCCB/ MCB. b. ON/OFF status of critical MCBs in AC & DC PDB. c. UPS output load current & voltage. d. Battery banks voltage.	

				Bidder's Compliance (Yes/No)
			All accessories, devices, cables and Installation material related to this work under Bidder Scope.	
9.	**11.**	**0.**	**Panels**	
9.	**11.**	**1.**	All the panels, housing the 230V AC power distribution boards with required ON/OFF switches, Din rails, circuit breakers, surge protection devices and necessary wiring should be provided. Supply & installation of these are in the scope of Bidder.	
9.	**11.**	**2.**	Completely wired PLC panel (1 No.) housing fault tolerant hot standby CPU rack & I/O racks and Redundant CPU rack & I/O racks, shall be provided.	
9.	**11.**	**3.**	Completely wired server panel (1No.) housing 2 no's servers and associated accessories shall be provided.	
9.	**11.**	**4.**	Intermediate Junction boxes (IJB-2 No. or as per design) for housing the panel instruments like isolators & relays etc. shall be provided.	
9.	**11.**	**5.**	Field Junction boxes (FJB-12 No.) at service room, near autoclave chamber, Rail bogie and cooling system etc., shall be provided.	
9.	**11.**	**6.**	Network panel (1 No.) housing 6 Nos. of Layer-2 network (Ethernet) switches and associated items like PDU, LIU, Patch panel for splicing of FO cables & Cat 7 Ethernet cable connections etc., shall be provided in instrumentation panel room as per datasheet.	
9.	**11.**	**7.**	CCTV panel 1 No. housing, NVR, POE or POE+ switches, and associated accessories shall be provided.	
9.	**11.**	**8.**	Pneumatic panel (1 Nos.) housing, Profinet based IO link, pneumatic manifold regulator and manifold solenoids and related accessories, Pneumatic SS tubing lines terminations shall be provided with necessary high-pressure fittings.	
9.	**11.**	**9.**	DCPS panel 1 Nos., housing of 230V AC, 24 DC power supply main & redundant, measuring chain, control chain racks, with related accessories shall be provided.	
9.	**11.**	**10.**	Remote IO panels 4 Nos., housing PLC associated devices and related accessories and main and redundant racks shall be provided.	
9.	**12.**	**0.**	**Field instruments**	
9.	**12.**	**1.**	Impulse tubing (SS316) for all transmitters from isolation valve to transmitters shall be provided by the bidder as per standard.	
9.	**12.**	**2.**	Transmitter rack (1 No.) shall be provided for housing 8 No. of vacuum transmitters in service room. All other transmitters shall be mounted on pipeline or nearest location from pipeline tapping/ as per user requirement.	
9.	**12.**	**3.**	All field instruments shall be factory calibrated as per the standard traceable to NIST and certificates shall be submitted to Purchaser. Positioning of sensors, conduit inside the autoclave, cable specifications, terminating connector specifications, position of ports etc. shall be submitted for purchaser's approval.	

				Bidder's Compliance (Yes/No)
9.	**12.**	**4.**	SMART pressure transmitters for measurement of pressure and vacuum. SMART differential pressure shall be provided. (Output as Profinet or Profibus PA).	
9.	**12.**	**5.**	1 Nos. of licensed Process device (transmitter) management software for configuration, calibration, loop checking and health checking etc., of Profibus PA transmitters shall be provided in MMI.	
9.	**12.**	**6.**	Exclusive compressor with surge tank of suitable capacity shall be provided to supply clean, dry and oil free control air to cater the needs of all electro-pneumatically operated valves. The surge tank rating shall be calculated so that it can supply instrumentation air supply for all the valves even in the case when the compressor is not in operation for duration of >30 minutes.	
9.	**12.**	**7.**	Bidder has to provide Compressors and Dryers with inbuilt Communication protocols like Profinet/Profibus-PA/Profibus-DP for interfacing with PLC system for remoter operations and data requisition.	
9.	**13.**	**0.**	**Cables & Miscellaneous items**	
9.	**13.**	**1.**	Supply, laying, termination & testing of Power, Control, Signal, Data cables as per the specification given in datasheet is in the scope of Bidder.	
9.	**13.**	**2.**	All the miscellaneous items like instrument fittings, cable glands, lugs, terminal blocks & internal wirings required for realizing the above scope of works are in the scope of Bidder. Bidder shall obtain approval prior to procurement of the above items for its make & model (refer datasheet & list of approved vendors).	
9.	**13.**	**3.**	The cables within the buildings shall be laid over perforated type, modular SS cable trays with SS cover. Preformed bends/ reducers/Tees only shall be used as per actual requirement. Party shall supply 300mm wide – 100 meters or as per requirement, 150 mm wide – 200 meters or as per requirement, 50mm wide - 100 meters or as per requirement. Supply & installation of these trays are in the scope of Bidder.	
9.	**14.**	**0.**	**CCTV System**	
9.	**14.**	**1.**	Supply, installation, testing and commissioning of Weather proof PTZ camera- 4 Nos. and suitable network video recorder (1 Nos.), CCTV PC, network Switches and related cables, connectors and accessories are as per the technical specifications given in the data sheet.	
9.	**14.**	**2.**	Supply & installation of wall mounted LED display as per the following specifications: a. Make: LG/SAMSUNG/VU/TCL b. Size: minimum 65 inch (diagonal size). c. Inputs: PC, video & HDMI inputs. d. Resolution: Full HD or better (for PC input). e. All associated cables & accessories.	

<table>
<tr><th></th><th></th><th></th><th></th><th>Bidder's Compliance (Yes/No)</th></tr>
<tr><td>9.</td><td>14.</td><td>3.</td><td>Quantity: Bidder have to supply CCTV system total quantity of items as per below table.
<table>
<tr><th>S.No.</th><th>Description</th><th>Qty</th><th>Spare</th><th>Total Qty</th></tr>
<tr><td>1</td><td>PTZ Camera with enclosure</td><td>4</td><td>2</td><td>6</td></tr>
<tr><td>2</td><td>NVR 2TB Storage</td><td>1</td><td>1</td><td>2</td></tr>
<tr><td>4</td><td>Monitors 65 inch</td><td>2</td><td>1</td><td>3</td></tr>
<tr><td>5</td><td>Monitors 27 inch</td><td>1</td><td>1</td><td>2</td></tr>
<tr><td>6</td><td>Network Switch</td><td>1</td><td>1</td><td>2</td></tr>
<tr><td>7</td><td>CCTV PC</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>8</td><td>keyboard</td><td>1</td><td>1</td><td>2</td></tr>
<tr><td>9</td><td>Junction box</td><td>4</td><td>2</td><td>6</td></tr>
<tr><td>10</td><td>CCTV panel</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>11</td><td>consoles</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>12</td><td>CCTV tools</td><td>1</td><td>0</td><td>1</td></tr>
</table></td><td></td></tr>
<tr><td>9.</td><td>14.</td><td>4.</td><td>Supply, laying and interfacing of video, NVR, related software, power cable, HDMI interface cable and Video matrix switcher, accessories, Ethernet switch, cables & termination in the CCTV panel, Junction boxes etc. is in the scope of this contract.</td><td></td></tr>
<tr><td>9.</td><td>14.</td><td>5.</td><td>Typical CCTV System Configuration to be supplied is shown below.

</td><td></td></tr>
<tr><td>9.</td><td>15.</td><td>0.</td><td>Earthing
a. Instruments shield earth shall be connected to instrumentation earth strip provided by department at instrumentation panel room using insulated copper cable by Bidder.
b. Panel body earth shall be connected to power earth strip provided by department at concerned area.
c. In addition to the above, if any special earth pits (like dedicated earth for Profibus shield/ UPS etc. are required as per OEM</td><td></td></tr>
</table>

				Bidder's Compliance (Yes/No)
			recommendation, same shall be provided by the bidder as per standard.	
9.	**16.**	**0.**	All inter cubical and internal wiring for all Control Panels shall be carried out with 1100V grade, stranded tinned copper conductors with HFFR insulation. The minimum size of the stranded copper conductor used for the panel wiring shall be 1.5 mm2 for 24 VDC control commands. For power supply, the conductor size shall be provided as per the load rating (min. 2.5 sq. mm for 230 V AC and 1.5 sq.mm. for 24 V DC). Control & Power wiring shall be segregated and routed in PVC troughs. Suitable colour coding shall be provided for cables.	
9.	**17.**	**0.**	Engraved core identification plastic ferrules, marked to correspond with the panel-wiring diagram shall be fitted at both ends of each wire. Cross ferruling shall be done. Crimped pins/lugs shall be provided.	
9.	**18.**	**0.**	All necessary cable terminating accessories such as removable gland plates, compression glands, supporting clamps and brackets, wiring troughs and gutters, etc. shall be included in the Supplier's scope of supply.	
9.	**19.**	**0.**	Supply of spares storage units 4 Nos., with transparent glass window doors, under bidder scope.	
9.	**20.**	**0.**	Supply of 4-bay network attached storage (NAS) systems of 24 TB, 2 Nos., under bidder scope. all the Servers, engineering station, clients, HMI, and software's, complete backups have to be provided in one unit after commissioning and satisfactory working of the systems, another unit for CCTV backup.	
9.	**21.**	**0.**	**General Terms**	
9.	**21.**	**1.**	Bidder shall obtain clearance for panel engineering drawings, I/O wiring schemes and technical specifications of all the items from Purchaser prior to the commencement of Procurement, supply, erection and commissioning activities.	
9.	**21.**	**2.**	Much care has been taken in arriving the list of equipment's and quantities, however if any equipment or components which is not mentioned explicitly but essentially required for the completion of system is in the scope of the Bidder.	
9.	**21.**	**3.**	The configuration of major bought out items like PLC, SCADA, etc., shall be reviewed and vetted by original equipment manufacturer (OEM). If any of the item supplied as part of this contract is not meeting the system requirement or any compatibility/ interface issues with other systems are found at any stage of the project, same shall be replaced with suitable items without any additional cost.	
9.	**21.**	**4.**	Bidder shall employ an authorized & reputed system integrator of OEM (Siemens), in case of outsourcing DACS works. This system integrator shall be approved by Purchaser.	

				Bidder's Compliance (Yes/No)
9.	**21.**	**5.**	Bidder shall arrange training of two department engineers, by OEM trainers for PLC & SCADA and sub-systems interfacing, configurations and programming.	
9.	**21.**	**6.**	Factory Acceptance Test (FAT) procedures (verification of BOM, functional checks, compliance to specifications, load test, burn-in test, environment software testing, diagnostics data, alarms and report generation check etc.,) shall be submitted to Purchaser for approval.	
9.	**21.**	**7.**	The following items will be inspected by department at factory before dispatch (FAT), necessary test set up and test equipment's shall be arranged by supplier a. UPS. b. 24V DC power supply modules. c. PLC & SCADA systems assembled as per system configuration with environment software. d. All panels & control consoles. e. All types of cables.	
9.	**21.**	**8.**	After delivery of items to site, the installation works shall be taken up after obtaining site clearance from Purchaser.	
9.	**21.**	**9.**	Site Acceptance Test (SAT) procedure shall be submitted to Purchaser for the approval prior to inspection with includes a. Bill of Material verification. b. Functional checks, compliance to specifications, load test and burn-in test of all items. c. I/O loop End to End checks, line calibration and environment software validation. d. DACS software testing including failure modes, validation of diagnostics data, event & alarms log view, data logging, report generation etc., e. Trial runs with nominal & off-nominal cases.	
9.	**21.**	**10.**	Bidder shall employ minimum 2 persons for 30 days after commissioning for fine tuning/ to carry out modifications in DACS and training the operators. Both should have thorough knowledge on PLC & SCADA systems and worked for this project. Accommodation and transportation for them is in the scope of Bidder.	
9.	**21.**	**11.**	During the warrantee period, the bidder has to arrange for periodical maintenance once in every four months and unlimited breakdown calls and replacement of failed/ malfunctioning components without any additional cost.	
9.	**21.**	**12.**	List of documents to be submitted (3 sets of soft & 1 set of printed copy) a. Full set of as built drawings (system configuration, as built wiring, cable layout, instrument layout etc.,). b. Software design documents, test case documents, contingency procedures and operational check lists. c. Final BOM with make & model number.	

<table>
<tr><th></th><th></th><th></th><th></th><th>Bidder's Compliance (Yes/No)</th></tr>
<tr><td></td><td></td><td></td><td>d. All technical catalogues and datasheets of all items.
e. All test results (Internal tests by vendor, FAT, software test results, SAT etc.)
f. Warranty certificates.
g. Passwords/ Licenses/ Operating keys etc.</td><td></td></tr>
<tr><td>9.</td><td>21.</td><td>13.</td><td>Any other relevant document not listed above shall be supplied.</td><td></td></tr>
<tr><td>9.</td><td>22.</td><td>0.</td><td>Earth pits, telephones, wireless sets are not in the scope of the vendor.</td><td></td></tr>
<tr><td>9.</td><td>23.</td><td>0.</td><td>Technical specifications (Data sheets)
Supply of any other brand other than the specified below shall be with the approval of the Purchaser prior to its procurement.
The listed below preferred make and specifications are tentative, any other make assured to meet the project can be considered, subject to approval of department.</td><td></td></tr>
<tr><td>9.</td><td>23.</td><td>1.</td><td>Preferred Makes
<table>
<tr><th>Name of the Item</th><th>Preferred Makes</th></tr>
<tr><td>PLC & IO Modules</td><td>SIEMENS</td></tr>
<tr><td>SCADA</td><td>SIEMENS</td></tr>
<tr><td>Network Switch for Automation network</td><td>SIEMENS</td></tr>
<tr><td>SCADA/ Servers, workstations & clients</td><td>HP / Dell</td></tr>
<tr><td>PLC CPU Power supply</td><td>Siemens</td></tr>
<tr><td>UPS</td><td>Numeric/APC/Riello</td></tr>
<tr><td>24 V DCPS</td><td>Siemens /Aplab</td></tr>
<tr><td>RTD</td><td>Rosemount / Omega/ Wika</td></tr>
<tr><td>Temperature Transmitter</td><td>Honeywell /Rosemount / Siemens</td></tr>
<tr><td>Pressure Transmitter</td><td>Rosemount/ Honeywell/ Siemens</td></tr>
<tr><td>Level Transmitter</td><td>Rosemount/ Honeywell/ Siemens</td></tr>
<tr><td>Flow Transmitter</td><td>Siemens/IFM/ Switzer / Honeywell / Sigma / Danfoss/ Omran/ Minilec</td></tr>
<tr><td>Angle measuring encoder</td><td>Siemens /P&F/ Lika</td></tr>
<tr><td>Weatherproof PTZ CCTV Camera</td><td>Honeywell/Infinova/Safepro</td></tr>
<tr><td>Network Video Recorder</td><td>Honeywell/Infinova/Safepro</td></tr>
<tr><td>Panels & Junction boxes</td><td>Rittal</td></tr>
<tr><td>Control Console</td><td>Pyrotech/Cosmos/Evans</td></tr>
<tr><td>Emergency Push Buttons/ Indication Lamps/ hooters/MCB</td><td>Siemens/ Schneider</td></tr>
<tr><td>Relay</td><td>OEN/OMRAN/Phoenix/Wago</td></tr>
<tr><td>Isolators</td><td>P&F</td></tr>
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					Bidder's Compliance (Yes/No)
			Power, Signal Cables & Control Cables	Lapp /Uniflex / Thermocables / Delta / Paramount cables	
			FO Cables	HFCL/Birla Ericsson/LAPP/TYCO	
			Terminal Blocks/Fuse TBs	Pheonix/Wago	
			Surge Protection Devices	Siemens /Dhen/Citel/Phoenix/Wago	
			Armored CAT6 / 7 Cable	Siemens/ Schneider/D link	
			Pneumatic Solenoid valves	Gemu/Asco/Festo	
			Pneumatic manifolds	Gemu/Asco/Festo	
			Thermocouple TC-K- dual channel sensors	Wika/Rosemount/ Siemens/eurotherm	
			Thermocouple TC-K, 2-pair cable	Wika/omega/Tempsense/eurotherm	
			Control valves	Flowserve/Siemens	
9.	**23.**	**2.**	**Hot standby Server for SCADA**		

Description	Specifications
Make & Model	HP/ Dell
Processor	2 x Intel twelve core Xeon processor or better.
Memory	64GB ECC DDR4 memory @2133 MHz or more.
Drive bays	6 or more SATA/ SAS hot pluggable drive bays.
Drive controller	Integrated or add-on SATA/SAS controller.
Hard drives	4X2 TB SATA/ SAS HDD for RAID 5 or RAID 1 configuration.
RAID controller	Onboard or add-on RAID controller to configure the above RAID.
Optical drive	DVD-RW
HBA	Dual port 8 Gbps SAN host bus adapter.
Expansion slots	2 slots or more after configuring the requirements.
Graphics	Integrated graphics controller.
Network interface cards	6 x 100/1000 Mbps Ethernet ports (Excluding management Ethernet ports bundled for redundant and load balancing).
I/O ports & connectors	4 USB
Input device	USB keyboard and mouse
Monitor	27" LED monitor
Power supply	2 x hot plug power supply (230V AC @50 Hz) unit. Indian power cords to be supplied.
Form factor	Rack mountable.
Warranty	3-3-3 years

				Bidder's Compliance (Yes/No)

Hard Disk Drive (HDD)	Minimum. 4 Nos. of HDD with each Min. 2TB capacity
RAM	32GB or better
Operating system (OS)	Windows server latest edition and compatible with the latest SCADA version.
Software	System management software to monitor the system health at local console & over network.
DVDs to be included.	Server Hardware drivers, OS and associated software.
Monitor & qty	27" – LED, 2 Nos. Supported resolution 1920x1080 and above.
Location	Server shall be mounted in server rack with monitor and located in Instrumentation panel room
Quantity	2Nos. SCADA (2 Nos. in hot standby configuration).

9. 23. 3. Engineering station

Description	Specifications
Manufacturer	HP / DELL
Processor	Intel Xeon processor eight core or more.
Hard disk capacity	1TB SATA HDD.
Memory (RAM)	32 GB ECC DDR4 RAM or Latest
Drive controller	Integrated or add-on SATA controller.
Network Interface card	2 x 1Gbps.
Removable media	Blue ray disc drive.
Graphics	8 GB graphics card with quad HDMI.
Cables	HDMI cables are to be provided.
Expansion slots	One slot for graphics and two slots free.
I/O ports and connectors	4 Nos. USB
Power supply	230V AC, 50Hz Indian power cords to be supplied.
Operating system	Licensed version of Windows 10 (64 bit) or latest (Compatible with SCADA version).
Software to be supplied and loaded on system.	Blue ray associated RW software. MS Office 2016 or latest. Licensed and Latest version of 'adobe acrobat' read & write software. System management, drivers and utilities software to be provided.
Monitor	27" - LED Supported resolution 1920x1080 and above.
Keyboard	Standard qwerty full stroke type
Optical Mouse	Standard with scroll.
CDs for all software & drivers	Required.
Quantity	1 Nos.

				Bidder's Compliance (Yes/No)
9.	**23.**	**4.**	**Programmable Logic Controller**	

Description	Essential Specification
Manufacturer	Siemens- S7-414-5H, (or) latest
Type	Hot standby fault tolerant CPU
CPU rack power supply	Main & Redundant CPU rack shall have 2 Nos. of power supply modules in redundant configuration in each rack.
Interface for communication between PLC to I/O modules & 3rd party devices.	Add-on card required to support redundancy in each CPU rack. Communication technologies like – Profibus/ Profinet/ Ethernet shall be used as per OEM standard. These interfaces shall acquire data from other microprocessor-based systems like Intelligent MCC, Thyristor and Compressor controller etc. Bus/Ring topology with redundancy. Max. 8 Nos. of I/O modules per rack.
Interface for communication between SCADA Server to CPU	Ethernet communication. 2 Nos. of communication modules in redundant configuration in each CPU rack. Communication speed at 100 Mbps or better.
Synchronization between CPUs	FO communication between CPUs shall be provided. Hot standby CPU shall support Event synchronization for bump less transfer.
Programming and downloading to PLC	1 Nos. of latest and licensed version of PDM. Any other necessary license required to configure PLC-to-peripherals communication shall also be provided.
Quantity	2 Nos. in hot standby configuration.

				Bidder's Compliance (Yes/No)
9.	**23.**	**5.**	**Input/output modules**	

Description	Essential Specification	
Manufacturer	Siemens	
Type	Suitable for hot standby configuration	
Location	Instrumentation panel room	
I/O rack power supply	Redundant power supply module (2 Nos.) for each I/O rack is required.	
Interface module	Required with redundancy (2 Nos.) to communicate with CPU rack.	
Analog input module	Channels per module (Nos.)	Min. 8 Channels.
	4-20 mA and RTD/TC	2, 3 & 4 wire selectable
	Accuracy	0.2% of FS or better
	Resolution	16bits with sign or better

						Bidder's Compliance (Yes/No)
				Type of isolation	Galvanic / optical	
				CMRR	>100db	
			Analog output module	Channels per module (Nos.)	8 Channels.	
				4-20 mA	2 wired	
				Accuracy	0.2% of FS or better	
				Resolution	16bits with sign or better	
				Type of isolation	Galvanic / optical	
				CMRR	>100db	
			Digital input module	Channels per module (Nos.)	32	
				Type of input	Potential free/ NAMUR (proximity sensors).	
				Interrogation voltage	24V DC	
				Type of isolation	Optical	
				LED status indication	Required for each channel.	
			Digital output module	Channels per module (Nos.)	32	
				Type of output	Relay/ TTL outputs for operating solenoid valves, relays, indication lamps etc.,	
				Interrogation voltage	24V DC	
				Type of isolation	Optical	
				LED status indication	Required for each channel.	
			3rd party devices interface to both Main & Redundant CPUs.	All 3rd party devices like compressors etc. are having Profibus DP interface for communicating with PLC. Suitable interface device like Y Link shall be used to connect these devices data to both Main & Redundant CPUs.		
			LED display	Required for all channels in all modules.		
			Short circuit/ wire break/ reverser polarity protection/ monitoring.	Required.		
			Isolation required	Between channels and backplane bus. Between channels and power supply of the electronics. Between channels and load voltage (L+). Between channels in group.		

				Bidder's Compliance (Yes/No)
			Self-diagnostics data: Required for analog modules. Hot swappable features: Required for all modules including power supply and communication interface modules. Quantity: As per the requirement	
9.	**23.**	**6.**	**Supervisory Control and Data Acquisition system (SCADA)** **Description** / **Essential Specification** Manufacturer: WinCC 7.5 or above SCADA package: Multi Server-Multi Client Type: Data acquisition, Control & Process monitoring. Operating system: Windows latest edition Graphical user interface: Man-Machine Interface (MMI)/ Human Machine Interface (HMI) License: Supply of Run-time licenses suitable for operator, Engineering, and HMI stations including all related. Quantity: As for requirement	
9.	**23.**	**7.**	**Field operator station - HMI panel PC (SCADA thin clients)** **Description** / **Specifications** Manufacturer: Siemens/ Advantech/ Schneider/ STAHL/ MTL/P&F/Apple/HP/Dell/ FUJITSU Design: Idustrial type Tuch screen Panel PC built in unit with protective enclosure. Front Display: Minimum 12" touch screen display with 8 function keys (as per requirement) Processor: Intel Atom N270 with 1.6 GHz or As per OEM Main memory: 1 GB DDR2 SDRAM or better Operating system: Windows 10 or latest (suitable to SCADA version) Mass storage: Minimum Hard disk 1TB. Power supply: 230AC/ 24V DC Interfaces: Ethernet: 10/ 100 Mbit, USB 2.0: 2 Relative humidity: 80% at +40 °C, no condensation. Enclosure: Stainless steel, support arm including coupling for rotation and Hight adjustment. 1 Nos. of emergency PBs. Hooter-1 Nos. Keyboard: Required. USB drive: Min.16GB with recovery option. CD's for all software & drivers: Required. Quantity: 1 Nos.	
9.	**23.**	**8.**	**Process monitoring stations (SCADA clients)** **Description** / **Specifications**	

				Bidder's Compliance (Yes/No)

Manufacturer	HP /DELL/ FUJITSU
Processor	INTEL i7 processor - 8 core Xeon or latest.
Hard drives	2TB SATA HDD
Drive controller	Integrated or add-on SATA controller.
DDR RAM	16 GB DDR4 (2 x 8GB)
Network Interface (Ethernet) card	2 x 1Gbps. Redundant network access software with licence for PRP network structure.
Graphics	4 GB graphics card with quad HDMI. HDMI cables are to be provided.
Optical Drive	Blue ray disc.
Power supply	230V AC, 50Hz Indian power cords to be supplied.
Operating system	Licensed version of Windows 10 (64 bit) or latest (Compatible with SCADA version).
Software to be supplied and loaded on system.	Blue ray associated RW software. MS Office 2013 Professional or latest. Licensed and Latest version of 'adobe acrobat' read & write software. System management software, drivers and utilities software to be supplied. PLC and SCADA related software's.
Monitor	27" – LED, Qty-4 no's Supported resolution 1920x1080 and above.
Keyboard	Standard qwerty full stroke type
Optical Mouse	Standard with scroll.
CDs for all software & drivers	Required.
Quantity	3 Nos.

9. 23. 9. Specification of 230V AC Uninterruptible Power Supply (UPS)

Description	Essential Specification
Make	Numeric/ APC
Converter technology	Switch mode rectifier/ Phase controlled rectifier/ IGBT
Output characteristics	DC- Constant voltage & Constant current
Power device	IGBT
Protection	Advanced electronic protection for device safety backed up with MCBs/MCCBs and fast acting fuses. Soft start for 0-20 secs, power walk-in.
Input power factor	>0.95 with harmonic suppression or better

9. 23. 10. Inverter

Technology	Digital SPWM IGBT design

				Bidder's Compliance (Yes/No)
			Output voltage, Frequency & Waveform: Single phase, 230V AC, 50Hz ± 0.1%, Pure Sine wave Switching frequency: 12-24 kHz Harmonic distortion: THD < 2% for linear loads, THD<5% for non-linear loads. Efficiency: 85 to 92% or better Crest factor: 3:1 Overload: 150% for 1 min and 125% for 10 min. Power factor: 0.6 to Unity or better Power device: IGBT Protection: Advanced electronic protection for device safety backed up with MCBs/MCCBs and fast acting fuses. High speed pulse blanking. Electronic over voltage/under voltage protection. Electronic over current trip with reset.	
9.	**23.**	**11.**	**General** Redundancy configuration: 2 Nos. of UPS in Parallel redundant configurations with servo stabilizers. Bypass line conditioners: Isolation transformers and servo stabilizers shall be provided. Auto retransfer: Required. Communication interface: RS232 port for software interface SNMP Management (Web enabled interface) Parallel port for communication with other UPS in N+1 configuration Battery type: Sealed Maintenance Free Lead Acid Battery backup time: One hour @ full load. Individual battery bank for each UPS. Location: Instrumentation panel room Quantity & Capacity: 1 set, 10KVA, (Parallel redundant configuration) Capacity to be selected such that maximum load will be 60% Servo stabilizer- 1 No.	
9.	**23.**	**12.**	**Specification of 24 V DC power supply (DCPS)** **Description** / **Essential Specification** Make: Siemens, PULSE, APC, Lambda, Alpha b Input voltage: 230 V AC ± 10%, 50 Hz Output voltage: 24 V DC ± 20% variable by multi-turn potentiometer & output to be isolated from input. Output current: Continuously variable by current limit control	

				Bidder's Compliance (Yes/No)

Overload & short circuit protection type	Required
Over voltage protection	Required
Quantity & Load	4 Nos. or as per requirement
Line regulation	± 0.25% for ±15% variation in AC supply voltage
Load regulation	± 0.25% from No-load to Full-load variation.
Ripple	1 mV peak – peak
DC current output voltage	Fully floating up-to 300 V w.r.t ground.
Front panel (optional)	ON / OFF toggle switch Output DC voltage indicator Load current drawn indicator Short circuit protection status Over voltage protection status
Mounting	Shall be mounted in DCPS distribution panel at instrumentation panel room.
Operating temperature	Ambient to 50° C
Note: The output terminal of the power supply module shall be provided with suitable diode, in-built or external to the power supply. Two such power supply modules (1 set) shall be connected in diode OR-ed configuration for redundancy. Measurement chain – 1 Set (20 A) (main & redundant) Command chain – 1 Set (20 A) (main & redundant)	

9. 23. 13. Specification of Panels/ Junction boxes/ Network enclosures

Manufacturer	Rittal /President/ Valrack
Service	Housing PLC CPU racks, I/O racks, DCPS, Ethernet switches, SCADA Servers, Weight indicators, AC PDB, DC PDB and JBs etc.
Location	Control room, Instrumentation panel room, Service room or as per design.
Type	Free standing for panels, Wall mounting for FJBs and N/w enclosures.
Cable entry	Bottom entry
Door	Front door: Transparent glass door.
	Rear door: Honeycomb perforated type for better ventilation.
	Concealed type hinges & 180o swing.
Painting	RAL7032 Powder coating thickness of 80 to 100 microns and powder coating process shall comply to ROHS standards. The rack shall be powder coated with a special texture finish to give very good aesthetic appearance & long life.

							Bidder's Compliance (Yes/No)
			Earthing strip	Insulated Copper earth strip for Instrumentation shield earth. Copper earth strip for body/power earth.			
			Mounting and wiring	Double compression SS glands (FCG, Baliga or equivalent) Separate TB (Make: Wago) for analog, digital and different voltage level signals.			
			Lightning and surge protection	All 230V AC and 24V DC power distribution shall have lightening & surge protection. Profibus signal cables, 4-20 mA cables, Ethernet & other control cable shall have suitably rated surge and lightening protection devices.			
			Quantity	S. No	Description	Quantity (Nos.)	
				1	PLC CPU panels	1 (or) as per requirement	
				2	Server panel	1 (or) as per requirement	
				3	Intermediate JB panel	2 (or) as per requirement	
				4	Field junction Box	12 (or) as per requirement	
				5	Network panel	1 (or) as per requirement	
				6	CCTV panel	1 (or) as per requirement	
				7	Pneumatic Panel	1 (or) as per requirement	
				8	230V AC & 24V DC PDB panel	1 (or) as per requirement	
				9	Remote IO panels	4 (or) as per requirement	
			Enclosure	Dimensions (W x D x H): 800 x 800 x 2100 mm			
				Solid all Aluminum frame construction with structures across the X, Y & Z axis with CRCA coverings of minimum 1.2 mm thickness.			
				All aluminum frame construction shall have a load carrying capacity of minimum 1000 Kg.			
				The cabinet shall be designed with top cover ventilated on all sides along the width and depth thereby enhancing exhaust of hot air via ventilation slots and rear honeycomb type perforation for maximum air circulation.			
				Removable side plates of 1.2 mm thickness on both the sides.			

					Bidder's Compliance (Yes/No)
				Equipment mounting angles shall be fully electroplated and adjustable depth wise with U marking for height.	
				Gland plates thickness: 3mm	
				Gasket for door & cover: Neoprene	
				Plugs for spare cable entries: required	
			Anti-vibration pads	15 mm thickness	
			Blower	Required, in each Section with brass mesh.	
			Louvers	Required, with fine brass wire mesh in each door/Section	
			Light	Fluorescent lamp	
			Lock & key	Modular, compact, spring return and door center lock.	
			Spares	20 % spare entries to be provided for incoming & outgoing cables. 20 % spare for terminal blocks. 20 % spare space for future requirement.	
9.	**23.**	**14.**	**Specification of control consoles**		
			Manufacturer	Pyro tech/Cosmos/Evans/Winstead	
			Service	Housing MMIs (4Nos.), CCTV monitor (1Nos.), Telephones (2Nos.) & wireless sets (1 Nos.) etc.,	
			Location	Control room	
			General	Control consoles shall consist individual modular units of fabricated/ angled Section, each designed to be assembled into a complete console structure. The consoles shall be fully modular in design and construction. Consoles shall be ergonomically designed for operator comforts and suitable for housing MMIs, CCTV, Telephones & wireless sets etc., Console system shall have option of being one or two tiers high.	
			Construction features	Structure shall be made up of heavy duty Extruded Vertical and Horizontal Aluminum alloy profiles. The Extrusions shall be duly powder coated with minimum 40 microns over all surfaces. Console Base Foot surface should be made of Stainless Steel. It should be modular and weld free self-sustainable structure system Work surface material shall be Acrylic Solid Surface (ASS/ Corian- min. 12 mm thick) with base made up of minimum 25 mm thick MDF. The top finish shall be fire retardant, Insulated, Water Proof, Scratch resistance and high hardness. Mosaic type key operated emergency switches (min 4 nos.) to be incorporated in the console.	

					Bidder's Compliance (Yes/No)
				Fixed thermoformed Side Panel in min. 6mm Solid Acrylic on Laminated 12mm MDF Board (±1mm). Fixed front door & openable rear door through Lock in min. 6mm Solid Acrylic on Laminated 12mm (±1mm) MDF Board. Rear doors shall have swing arm arrangement. Cabinet shall house the CPU Slide out trays for easy accessibility of CPUs, the tray shall have load bearing capacity up to 25 kgs. The CPU tray shall be mounted on 3mm thick gland plate which will have perforations in it for proper ventilation. Cable Managers - For routing LAN & Power Cables within the desk. Articulated keyboard tray to fix keyboards and shall have various adjustments. Articulating die cast Aluminum monitor arm with MS Pole shall be provided for fixing the monitors. Comfortable, High Back Chair with Adjustable P.U Arms and revolving with wheels shall be provided. Quanity-10 Nos. The design and color of the console will be decided by department after award of the contract. All bolts must be of SS material to avoid rust due to environment. Remaining hardware shall be Nickle Plated with RoHS certificate. Complete control desk shall be built using RoHS certified materials (from UL/Intertek or other reputed third party NABL accredited labs.) to ensure restriction of hazardous substance in any of the materials. The Control desk shall be 100% modular with Acrylic Solid Surface (ASS/ Corian) and MDF with ANSI Nema LD3 certified laminate finish. Under structure shall be made up of heavy duty Extruded Vertical and Horizontal Aluminum profiles of HE9WP grade.	
				Quantity: 3 Nos (2bay each), (or) as per requirement	
9.	**23.**	**15.**	**Specification of RTD Sensors**		

Description	Essential Specification
Make	Rosemount / Omega/ Wika
Type of sensor	Pt100 4 – wire RTD stem dia. min 6 mm.
Accuracy	IEC 751 Class AA & DIN 60751
Temperature Coefficient:	0.00385 Ohms/ 0C
Temperature Range:	0 to 650^{0}C
Sensor wire	PTFE insulated, Nickel coated copper stranded wire.
Sensor Immersion length	Refer below table.
Sheath	Sensor shall be housed in ¼" SS 316 sheath.
Protection	IP 65
Calibration certificate	Required and traceable to NIST/ NABL.

				Bidder's Compliance (Yes/No)

End connection	Head with screwed cover in die-cast Aluminum & chain.		
Cable Entry	½" NPT Female with double compression cable gland		
Thermowell	SS316, Bar-stock assembly, tapered construction and suitable to RTD immersion length.		
Application	Water/Air temperature measurement.		
Location	Quantity (Nos.)	Immersion length (mm)	Thermowell
Autoclave Fan winding temperature	2 (or) as per requirement	200 or (as per design)	Thermowell required.
Autoclave Temperature	2	as per design (suitably air duct width, inside autoclave)	As per requirement
Cooling water return pipe line with thermos-wells	16 (or)as per requirement	75 or (as per design)	1" NPT (M) Threaded type. Or as per requirement
compressors	6 (or) as per requirement	As per requirement	As per requirement
Dryer	3 (or) as per requirement	As per requirement	As per requirement
Ambient temperature (Room & Outside)	2	As per requirement	N/A
Autoclave skin temperature	2	As per requirement	As per requirement

9. 23. 16. Specification of Temperature Transmitter

Description	Essential Specification
Make& model	Rosemount/ Yokogawa/ Honeywell/ Siemens/E.H
Primary element type	4 wire RTD Pt100 (Suitable to above RTDs)
Type of Transmitter & mounting location	Refer below.
Integral display	LCD display
Output	Linearized
Isolation	Required between Input & Output
Accuracy	±0.10C
Long term stability	0.2% full scale over a period of 5 years.
Electro Magnetic Compatibility (EMC)	As per EN 61326 or equivalent.
Ambient temperature range	10 to 48 0C (or) as per requirement.

				Bidder's Compliance (Yes/No)

Calibration certificate	Required and traceable to NIST/ NABL.	
Power supply	Bus powered.	
Output signal	Profibus PA	
Span/ Zero adjustment	Required.	
Transmitter diagnostics	Standard & all advanced diagnostics are required.	
Protection	IP 65	
Temperature Range:	Refer below.	

Location	Quantity (Nos.)	Range	Unit
Skin temperature	2 (or) as per requirement	0 to 100	Centigrade
Autoclave temperature	2 (or) as per requirement	0 to 200	Centigrade
blower Temperature	2 (or) as per requirement	0 to 200	Centigrade
Chamber Cooling Line	3 (or) as per requirement	0 to 200	Centigrade
Cooling water tank	2 (or) as per requirement	0 to 100	Centigrade
Hot water tank	2 (or) as per requirement	0 to 100	Centigrade
Cool water returns pipe lines	as per requirement	0 to 100	Centigrade

9. 23. 17. Specification of Pressure/ Vacuum Transmitter

Description	Essential Specification
Make	Rosemount/ Yokogawa/ Honeywell/ Siemens/E.H
Operating Principle	Capacitance / Piezo-resistive type/ silicone resonant
Integral display	LCD display
Mounting location, Range & Quantity.	Refer below
Output	Linearized
Accuracy	0.1% of span
Long term stability	0.2% full scale over a period of 5 years.
Electro Magnetic Compatibility (EMC)	As per EN 61326 or equivalent.
Calibration certificate	Required and traceable to NIST/ NABL.
Power supply	Bus powered

				Bidder's Compliance (Yes/No)

Output signal	Profibus PA. For the transmitters wired to PID controllers 4 to 20mA or suitable to the controller input.	
Span / Zero adjustment	Required.	
Transmitter diagnostics	Standard & all advanced diagnostics are required.	
Protection	IP 65	
Over range protection	Required. 150 % of maximum pressure.	
Process connection	½" NPT (F)	
Cable Entry	½" NPT Female with double compression cable gland.	
2-valve manifold	SS316 and shall be suitable to pressure ratings.	

Location	Quantity (Nos.)	Range	Unit
Chamber Pressure Control	6	0 to 35	Bar g
Air receiver tank	1	0 to 35	Bar g
Control air Tank	1	0 to 35	Bar g
Cooling lines	8 (or) As per requirement	0 to 16	Bar g
compressors	6	0 to 16	Bar g
Dryer	2	0 to 16	Bar g
Vacuum reservoir	4	-1 to + 10	Bar g
Vacuum pipe line	8	-1 to + 10	Bar g

9. 23. 18. Specification of Level Transmitter

Description	Essential Specification
Make	Rosemount/ Yokogawa/ Honeywell/ Siemens
Type	Differential pressure type
Operating Principle	Capacitance / Piezo-resistive type/ silicone resonant
Integral display	LCD display
Mounting location	Water tank bottom ~ 100 0 Centigrade
Output	Linearized
Accuracy	0.1% of span
Long term stability	0.2% full scale over a period of 5 years.
Electro Magnetic Compatibility (EMC)	As per EN 61326 or equivalent.

				Bidder's Compliance (Yes/No)

Calibration certificate	Required and traceable to NIST/ NABL.
Power supply	Bus powered
Output signal	Profibus PA
Transmitter diagnostics	Standard & all advanced diagnostics are required.
Span / Zero adjustment	Required
Protection	IP 65.
Pressure Range:	As per design
Process connection	½" NPT (F)
Cable Entry	½" NPT Female with double compression cable gland.
5-valve manifold	Required SS316
Quantity (Nos.)	4 (or) as per design

9. 23. 19. Push buttons/ Emergency Push Buttons/ Indication Lamps/ Hooters/MCCB/MCB

Description	Essential Specification
Make	Siemens
Power supply	24 VDC
Approval	Suitable to use in safe area.
Quantity	As per the requirement
Note: 1 No. of Minimum 16 no. of windows alarm annunciator of Minilec or equivalent make shall be supplied.	

9. 23. 20. Specification of Water Flow Switch

Description	Essential Specification
Make	IFM/ Switzer / Honeywell / Sigma / Danfoss/ Omran/ Minilec
Type	Non-contact
Sensing element	Ultra-sonic or as per standard
Mounting location	Pipe line (25 NB (or) as per requirement)
Switch type	Micro switch
Flow range (LPM) & line pressure	20 - 50 LPM, 3 bar (or) as per design
Over range protection	1.5 times of Max. flow
Accuracy	± 2% of span
Switch contacts	DPDT, Potential free
Contact rating	5A resistive load at 24 V DC
Switch setting	Tamper proof and external adjustment

				Bidder's Compliance (Yes/No)

Protection	IP 65.
Cable Entry	½" NPT Female with double compression cable gland.
Body material	SS or as per Standard
Temperature of water	10 to 400C
Certificate	Calibration test certificates are required.
Quantity (Nos.)	10 (or) as per requirement

9. 23. 21. Specification of Relays

Description	Essential Specification
Make	OEN, OMRAN, Phoenix
Primary element type	Electro-magnetic/ Solid state relays
Input	24V DC/230V AC
Mounting location	I/O racks/ IJB
Output	Potential free contacts with minimum 8 Nos. of NO/NC.
Quantity	200 Nos. (or) as per requirement

9. 23. 22. Specification of Proximity sensor

Description	Essential Specification
Make	P&F/ IFM/ Honeywell
Type	Inductive
Switching element function	NAMUR NC
Operating distance & Quantity	5 mm – 35 Nos. (Or) as per requirement
Nominal voltage	8 V DC
Switching frequency	0 to 400 Hz
Reverse polarity & short circuit protection	Required.
Indication of switching state	Required (LED).
Mounting type	Cylindrical, threaded type with check nuts.
Protection	IP 65 or better.
Connection type	Multi pin circular connector and suitable cable with min. 30 m length shall be supplied with each proximity sensors.
Sensing face	PBT
Housing material	SS
Standards	IEC/EN 60947

				Bidder's Compliance (Yes/No)
			DIN EN 60947 (NAMUR)	
			Certificate: Test certificates are required.	

9. 23. 23. Specification of Isolators

Description	Essential Specification
Make	Pepperl +Fuchs/Wieland
Primary element type	Intrinsically safe
Digital Input (DI)	Potential free/ Namur type sensor
Inputs isolators	1 in 2 Out.
Power rails with cover and power modules	Required with redundancy.
Quantity	as per IO's requirement

9. 23. 24. Specification of Control valve

Description	Essential Specification
Make	Fisher/ El-o-matic/ Micropneumatic/ Flowserve/ MIL controls/ Siemens
Actuator type	Electro-Pneumatic operation.
Seat type	Ball valve/globe valve (Purchaser approval shall be obtained)
Direct/ reverse acting	Direct acting (or) as per design
Material for Body, Stem & Seat.	SS
Valve size	As per Design of the project
Process connection	150 class SS Flange as per ANSI standard.
Pneumatic input	0 to 7 bar (g)
Manual override	Yes.
Fail safe	(Air or Power) Fails to close.
Application (Process Fluid/ medium)	Vacuum/pressure/cooling water control
Electrical input & output	Profinet /Profibus-PA / Smart positioner. Built-in I/P converter and position transmitter.
Cable entry	½" NPT (F) or as per standard.
Diagnostics	Standard and all advanced diagnostics are required.
Pressure gauges	Required. (Make: Wika/ General Instruments/ AN instrument or equivalent)
Air filter regulator	Required.

				Bidder's Compliance (Yes/No)
			(Make: Placka/ Norgren/Shavo or equivalent)	
			Location: Indoor and Non-Hazard location.	
			Test certificates: Calibration, Materials and Leak test certificates are required.	
			Quantity: 10 Nos. (or) as per Requirement	

9. 23. 25. Power, Signal Cables & Control Cables

Description	Essential Specification	
Manufacturer	Uniflex, Thermocables, NICCO, Deccan, Delta, Lapp, Paramount cables.	
Code used	BS-5308	
Cable type	Signal Cables	Control Cables
Conductor	0.5 Sq.mm annealed tinned copper conductor of 7 strands.	1.0 Sq.mm annealed tinned copper conductor of 14 strands.
Primary insulation	XLPE insulated core.	
No. of twists/meter	Minimum 20 twists/meter	N/A
Core identification	By color	With numbers at interval of not more than 250 mm as per vendors standards.
Voltage grade	1100 V	
Cable identification	Running length of the cable shall be printed at least at every 5 m interval.	
Pair identification	With numbers at interval of not more than 250 mm as per vendors standards.	N/A
Shielding	Individual + Overall: Aluminum Mylar tape & ATC drain wire with PTP tape.	Overall: Aluminum Mylar tape & ATC drain wire with FG tape.
Drain wire size	0.5 Sq.mm	
Drain wire material	Multi-stranded bare tinned annealed copper in continuous contact with aluminum side of the shield.	
Drain wire resistance	Drain wire resistance including shield shall not exceed 40Ω/km	
Tape thickness	0.05mm	
% coverage / overlap	100% / 25%	
Inner sheath	Extruded Black FRLS PVC type ST-2.	
Armoring	Galvanized steel round wire.	
Outer sheath	Extruded flame retardant 90 °C PVC to IS-5831 type ST-2/IEC 502. Color light blue. PVC oxygen index: over 30% PVC temperature index: over 250 °C Fire retardant: yes, as per IEC-332 part3, CAT A Smoke density: 0.6 Acid gas emission: 0.2	

				Bidder's Compliance (Yes/No)

Electrical properties @ 20 °C	Conductor resistance: maximum 40Ω/km.	Conductor resistance: maximum 20Ω/km.
	Insulation resistance: minimum 5000M Ω. Mutual capacitance: maximum 75pF. L/R ratio: maximum 25µH/ Ω. Test voltage: Conductor to conductor: 1000 V for 1 minute. Conductor to shield & Armor: 1000 V for 1 minute.	
Tests	All the tests shall be conducted as the part of pre-delivery inspection.	

Cable type	Cable Size	Quantity (Meters)
Control cable	18C x 1.0 Sq. mm	500 (or) as per requirement
Control cable	3C x 1.0 Sq.mm	800 (or) as per requirement
Signal cable	33C x 0.5 Sq.mm	1200 (or) as per requirement
Signal cable	3C x 0.5 Sq.mm	1500 (or) as per requirement
Signal cable	6P x 0.5 Sq.mm	1000 (or) as per requirement
Signal cable	2P x 0.5 Sq.mm	800 (or) as per requirement
Power cable	4C x 10 Sq.mm	500 (or) as per requirement
Power cable	3C x 6 Sq.mm	500 (or) as per requirement
Power cable	3C x 2.5 Sq.mm	2500 (or) as per requirement
Profibus-PA cable		1000
Profinet cable		1000

Notes:

a. Copper conductor size for power cable shall be as per current rating & voltage drop. Accordingly, other electrical properties may vary as per the above referred standard.
b. Shield/ drain wires are not required for power cable. Other specifications are remains same as per above referred standard.
c. The above-mentioned power cable quantities are only for 230V AC UPS & 24 V DC power distribution only.
d. Power cables for MCC & electrical equipment are given in electrical Section-C/Clause-10&11.
e. The above quantity does not include the flexible cables required for Transfer cars & working platform. Same shall be provided at actual.

9. 23. 26. Pressure Switch

Description	Essential Specification
Make	IFM/ Switzer / Honeywell / Sigma / Danfoss/ Omran/ Minilec
Medium	Hot air 150^0C
No of contacts	2 NO + 2 NC 5 A rated at 230 V A.C
Mounting location	Autoclave Chamber or as per design

				Bidder's Compliance (Yes/No)

Protection	IP 65 Safe area.
Range:	0.04 to 1 bar
Process connection	½ "NPT/ as per manufacturer standard (or) as per design
Cable Entry	½ "NPT
Quantity (Nos.)	Minimum 2 or as per requirement

9. 23. 27. Specifications of humidity Transmitter

Description	Essential Specifications
RH Sensor	Capacitance Polymer
Temperature Sensor	Solid state band gap
Relative Humidity	0 to 100%
Temperature Range	-40 to 140ºF (-40 to 60ºC)
Accuracy	±2% 10 to 90% RH, ±0.9ºF at 72ºF (±0.3°C at 25°C)
Hysteresis	±1%
Repeatability	±0.1% typical
Drift	< 1% RH/year
Temperature Limits	-40 to 140°F (-40 to 60°C)
Compensated Temperature	-40 to 140°F (-40 to 60°C)
Power Requirements	16 to 28 VDC (intrinsically safe)
Output Signal	4 to 20 mA, 2 channels for humidity/temperature models (loop power on RH)
Response Time	15 seconds
Display Type	LCD
Display Resolution	RH: 0.1%; Temperature: 0.1°F (0.1°C)
Electrical Connections	Screw terminal block
Conduit Connection	½" female NPT
Housing Material	Aluminum
Warranty	Minimum 1 year from the date of supply
Quantity	2 Nos.

9. 23. 28. Specification of Angle Measuring Encoder

Description	Essential Specification
Make	P&F/ Lika
Application	To measure the angle of hydro motor in a Mixer System.

				Bidder's Compliance (Yes/No)

Mounting location	Rotating shaft.
Primary element type	Absolute multi turn optical encoder
Output signal	Profinet
Resolution	16- bit or better.
Distance Range	0 – 360 deg& 0 – 16000 mm
Power supply	Bus Powered/ 24 V DC
Isolation	Required between Input & Output.
Electro Magnetic Compatibility (EMC)	Required.
Span / Zero adjustment	Required.
Diagnostics	Required.
Protection	IP 65 or better (as per EN60529)
Ambient temperature	Min. 15ºC to 45 ºC
Cable Entry	If integrated cable or special connector, then minimum 30-meter cable length shall be supplied with suitable connector.
Certificate	Calibration test certificates are required.
Quantity	2 Nos

9. 23. 29. Programming device

Description	Specifications
Manufacturer	Dell/HP
Processor	INTEL i7 processor or latest.
Hard disk capacity	500 GB or above Solid-State Drive
Motherboard	INTEL original (Suitable for the configuration)
DDR RAM (DDR4)	16 GB
Network cards	Ethernet card:1 Nos. (100Mbps/1Gbps)
Optical Drive	DVD RW (Multi-layer)
Power supply	Suitable 230V AC Adapter with Indian Pin
Operating system	Licensed version of Windows 10 (64 bit) or latest (Compatible with SCADA & PLC software versions).
Software to be supplied and loaded on system.	MS Office latest. 2. PDF read & write
Monitor Screen	14", supported resolution of Full HD and above.
Optical Mouse (additional)	Standard USB Mouse with scroll.
CD's for all software & drivers	Required.
Quantity	3 Nos.

9. 23. 30. Network Switch

				Bidder's Compliance (Yes/No)
			Description / **Essential Specifications** Type: Manageable, Layer-2 Fast Ethernet switches. Make & Model: Extreme, Net gear, cisco Quantity: As per requirement (Main & Redundant)	
9.	**23.**	**31.**	**Specification of the Network switch for the PLC to Field layer (Control Room End)** Description: SCALANCE XB213-3LD managed Layer 2 IE Switch 13x 10/100 Mbit/s RJ45 ports, 3x SM FO SC port 1x console port, diagnostics LED, redundant power supply, temp. range 0 °C to +60 °C Quantity: As per requirement (Main & Redundant)	
9.	**23.**	**32.**	**Specification of the Network switch for the PLC to SCADA (FIR End)** Description: SCALANCE XR-324 managed Layer2 IE Switch Quantity: As per requirement (Main & Redundant) Note: Connections between Ethernet switch Up/ Down links shall be done through pluggable transceivers of Enterasys make Cables & connect to Ethernet switch is in the scope of the Bidder. These items shall be procured from a reputed vendor duly approved by Purchaser. Communication between MMIs, PLCs, i-MCC & 3rd party devices to Ethernet switch shall be done using LAPP/ Molex/ Moxa make standard CAT 7 cables with suitable RJ-45 connectors. Total Ethernet cable length requirement is 1000 meters.	
9.	**23.**	**33.**	**Technical specifications for Weatherproof PTZ CCTV Camera**	

Description	Essential Specifications
Make	Honeywell/Infinova/norden
Image Sensor	1/2.8" CMOS or better (Better implies bigger sensor size)
Optical Zoom	23x or more
Focus Mode	Auto/Manual
Focal Length	4-6mm
Aperture Range	F1.5/F1.6 to F3.5 or better
PAN	360°
TILT	-90 to +90(bullet type)
Video compression	H.265+/H.265/H.264

				Bidder's Compliance (Yes/No)

Image resolution	2MP, Full HD, 1920x1080pixel or better
Network Storage	Built-in memory card slot with minimum 128GB memory unit
Protocols	IPv4/IPv6, HTTP, HTTPS, FTP, TCP/IP
API	ONVIF Profile S must be supported
Network Interface	1 RJ45 10 M/100 M Ethernet Interface 1 ANALOG (optional)
Power Supply	230AC or 24V DC / POE/POE+
Protection Level	IP65 or better
Mounting accessories	Camera wall mounting kit/stand required.
Quantity	6 Nos.

9. 23. 34. Specification of Network Video Recorder (NVR)

Description	Essential Specification
Manufacturer	Honeywell/Infinova/Norden
Type	Network Video Recorder
Location	Control Room
No. of recording channels	16 channel IP camera
Video Output	1-ch HDMI video output
Screen Display	Multi-screen display (1/4/8)
Playback Options	Max. 32-ch synchronous playback
Ports	1No. of RS485 port for control of the PTZ camera control system, supporting multi-protocols. 2Nos. of RJ45 10/100/1000Mbps Ethernet port, self-adaptive.
Hard-disk Capacity	4TB
Input voltage	230 V AC
Joystick Keyboard	2No. of suitable model of joystick keyboard compatible with NVR for camera selection and PTZ control shall be provided with each NVR. (Make of NVR and joystick keyboard shall be same.)
No. of clients for video monitoring	Each NVR shall support minimum 4 clients for monitoring the videos simultaneously. Any necessary licensed software is required, same shall be provided.

				Bidder's Compliance (Yes/No)
			Quantity: 2 Nos.	
9.	**23.**	**35.**	**CCTV Monitoring Stations**	

Description	Specifications
Manufacturer	HP /DELL/ FUJITSU
Processor	INTEL i7 processor - 8 core Xeon or latest.
Hard drives	2TB SATA HDD
Drive controller	Integrated or add-on SATA controller.
DDR RAM	16 GB DDR4 (2 x 8GB)
Network Interface (Ethernet) card	2 x 1Gbps. Redundant network access software with licence for PRP network structure.
Graphics	4 GB graphics card with quad HDMI. HDMI cables are to be provided.
Optical Drive	Blue ray disc.
Power supply	230V AC, 50Hz Indian power cords to be supplied.
Operating system	Licensed version of Windows 10 (64 bit) or latest (Compatible with SCADA version).
Software to be supplied and loaded on system.	Blue ray associated RW software. MS Office 2013 Professional or latest. Licensed and Latest version of 'adobe acrobat' read & write software. System management software, drivers and utilities software to be supplied. NVR, Camera related software's and Video management software's
Monitor	27" – LED, Qty-1 no's Supported resolution 1920x1080 and above.
Keyboard	Standard qwerty full stroke type
Optical Mouse	Standard with scroll.
CDs for all software & drivers	Required.
Quantity	1 Nos.

9.	**23.**	**36.**	**Specification of Thermocouple Sensors**	

Description	Essential Specification
Make	Wika /Rosemount / Omega/ Euro-therm
Type of sensor	2 X type "K" TC-720 model, Sheathed Design Thermocouple stem dia. min 3 mm, length 3000 mm
Accuracy	Class 1 per DIN EN 60584

				Bidder's Compliance (Yes/No)
			<table><tr><td>Temperature Range:</td><td colspan="3">0 to 1200 0C</td></tr><tr><td>Sensor Immersion length</td><td colspan="3">As per Design requirement</td></tr><tr><td>Sheath material</td><td colspan="3">Ni alloy 2.4816 (Inconel 600)</td></tr><tr><td>Sheath Diameter</td><td colspan="3">3.0mm (or) as per Design requirement</td></tr><tr><td>lead Length</td><td colspan="3">3000 mm (or) as per requirement</td></tr><tr><td>Conductor</td><td colspan="3">Thermo-wire, Diameter 0.5 mm</td></tr><tr><td>Protection</td><td colspan="3">IP 65</td></tr><tr><td>Calibration certificate</td><td colspan="3">Required and traceable to NIST/ NABL.</td></tr><tr><td>End connection</td><td colspan="3">“K” type terminals or as per Design requirement</td></tr><tr><td>Thermowell</td><td colspan="3">As per Design requirement</td></tr><tr><td>Application</td><td colspan="3">Air temperature measurement.</td></tr><tr><td>Location</td><td>Quantity (Nos.)</td><td>Immersion length (mm)</td><td>Thermowell</td></tr><tr><td>Autoclave Chamber</td><td>Min qty -33, Qty can be added as per design requirement</td><td>as per requirement</td><td>as per requirement</td></tr></table>	
9.	**23.**	**37.**	**Network Attached Storage System** <table><tr><th>Description</th><th>Specifications</th></tr><tr><td>Manufacturer</td><td>Dell/HP/WD/NETGEAR/SYNOLOGY/SEAGATE</td></tr><tr><td>Interface</td><td>Gigabit Ethernet x 2, Power inlet (DC in) x 2 USB 3.0 expansion port x 2, USB 3.0 port with direct copy x1 front</td></tr><tr><td>Drive bays</td><td>4 x 3.5-inch hard drive bays, hot swap capable, tray less design</td></tr><tr><td>Processor</td><td>Marvell ARMADA 388 1.6 GHz Dual-core (or) latest</td></tr><tr><td>Memory</td><td>4 GB DDR3 or latest</td></tr><tr><td>Network protocols</td><td>DHCP Client or static IP, IPv4 and IPv6, NTP client, Dynamic DNS (DDNS), Apple Bonjour and windows rally jumbo frame support up to 9k, VLAN(802.1Q), Link Aggregation and failover for 2 Gigabit Ethernet ports UPnP port forwarding, LLTD Link Topology Discovery Protocol, iSCSI, SSH</td></tr><tr><td>Network file Services</td><td>CIFS/SMBv3 for Windows, Mac OS X and Linux, AFP for Mac OS X, NFSv3 for Linux and UNIX Linux Distributed File System (DFS), FTP/SFTP Server, WebDAV server</td></tr><tr><td>Security</td><td>Active Directory Support for Windows Server 2003/2008/2012 (or) latest Volume Encryption (256-bit AES)</td></tr></table>	

				Bidder's Compliance (Yes/No)

File system	EXT4 for internal HDD, support externally attached USB drives: FAT/FAT32, NTFS (read and write capability), HFS+J (case sensitive), Linux EXT2, EXT3, EXT4 support for mounting ISO-Image
Disk management	RAID: JBOB, spanning, 0/1/5/10 + hot spare support RAID migration: HOT swapping; Hot spare (in four disk model); Disk roaming; Array roaming
Power management	Drive Spin Up/Down (Including Attached USB drives), Automatic power recovery (with UPS), schedule power on/off, graceful shutdown on UPS low battery, UPS connection via USB or Network, Wake On LAN
Remote access	Desktop apps, mobile apps
User/Group management	Max No. of users: 512 for samba, 800 for ADS, Max No. of groups: 64 for samba, 200 for ADS, Max no. of Network Shares: 128 Quotas for groups or users.
Backup management	Remote backups: My Cloud Expert series to My Cloud Expert series locally or remote, Backup internal files or folders on the device to other files/ folders on the NAS or Attached USB Cloud-based backup services: Amazon s3 and Elephant Drive, Automatic backup software: required
Third-party app support	Required
Capacity	12TB (3 x 4 TB) (or) latest
Quantity	2 Nos.

9. 23. 38. Flanged Valve Specifications

Description	Specifications
Nominal sizes	DN 15 up to DN 50
Body material	1.4408 and 1.4436
Connector	Flanges acc. DIN 2635 PN 40
Nominal Pressure	PN 40
Media temperature	-30 °C up to +170 °C
Ambient temperature	-30 °C up to +60 °C
Viscosity of media	Maximum 600 mm^2 /s (600cSt, 80° E)
Vacuum	Maximum 0.001 bar abs
Working pressure for version without cavities	Maximum 12.0 bar
Options	Limit switches Inductive proximity switch. Electrical contact switch. Pneumatic switch. Solenoid valve Additional manual operation Oil and grease free version

				Bidder's Compliance (Yes/No)
			Qty: As per requirement	
9.	**23.**	**39.**	**Pilot Operated with integrated quick exhaust Solenoid Valve**	

Description	Specifications
Fluids	Air, inert gas, water, oil
Temperature range	-20 to +90°C
sealing	NBR (nitrile /Buna-n)
Body	Brass
Core and Plug nut	SS
Core spring	SS
Disc-core upper	PA (nylon)
Disc core lower	NBR
Poppet	CR (chloroprene/neoprene)
Seat	Brass
Shading coil	Copper
Coil insulation class	F
Connector	Spade plug (pg 11p) or as per design
Connector specification	ISO 4400
Electrical safety	IEC 335
Standard voltages	24V DC
Ambient temperature range	-20 to +75 °C
Protection	Molded IP65
Qty	As per requirement

9.	**23.**	**40.**	**Thermocouple Cable Specification**	

Description	Specifications
Construction	Twisted & Multi pair
Voltage Grade	Up to 1.1KV
Conductor	TC
Type of Conductor	K
Conductor Size	2- pair (or as per requirement) Selection of AWG should match to TC sensor
Conductor Stranding	Single stand
Core Insulation	PTFE-PTFE
Screening	Aluminum foil with Mesh Braided
Inner/Outer sheath	Teflon
Rip Cord	For easy removal of sheath
Armoring	G. I
Color	Yellow (+), Red (-)

				Bidder's Compliance (Yes/No)
			Color code: ANSI MC 96.1 Tolerance class: Class-1 Cable temperature Range: 0 ^{0}C to 1100^{0}C Qty: As per requirement	
9.	**23.**	**41.**	**Thermocouple K type Terminal Blocks**	

Description	Specifications
Type	TC Type "K"
Standard	IEC 60584, IEC 60947-7-1
Material	Wemid
Color	Dark beige
UL 94 flammability rating	V-0
Wire cross Section	2.5 mm2
No. of potentials	1
No. of clamping points per level	2
Level cross connection internally	No
End cover plate	Required
Rail	TS35
PE connection	No
Open sides	Right
Type of mounting	Snap-on
Connection direction	On side
Stripping length	10 mm
Type of connection	Screw connection
Twin wire end ferrule minimum	0.5 mm^2
Twin wire end ferrule maximum	1.5 mm^2
Power loss in accordance with IEC 60947-7-x	0.77w
Operating temperature range	-60 ^{0}C to 130 ^{0}C
Quantity	Minimum 200 Nos., maximum as per requirement

9.	**24.**	**0.**	Quality Assurance plan: Instrumentation and Control Systems	

Quality Assurance plan for Instrumentation and Control System									
S. No	**Component/Stage**	**Characteristic sought for**	**Type of check**	**Extent of check**	**Reference Std./ Acceptance norms**	**Acceptance norms**	**Test performed by**	**Processing agency (Vendor)**	**Verifying agency (SDSC-SHAR)**
PLC & SCADA									
1	PLC & Modules	as per the tender specification	Visual, Functional	100%	OEM supplied Data sheet & test certificates	as per specification	Manufacturer / Vendor	Perform	witness & review
2	Remote I/O	as per the tender specification	Visual, Functional	100%	Configuration drawings, Datasheets. Communication with PLC.	as per specification	Manufacturer / Vendor	Perform	witness & review
3	24V DC power supply	as per the tender specification	visual, line & load regulation, ripple measurement	100%	OEM supplied Data sheet & test certificates	as per specified tolerance.	Manufacturer / Vendor	perform	witness & review
4	MMI(Client)	as per the tender specification	Visual, Functional	100%	Approved specifications. Genuine licenses	as per specification	Manufacturer / Vendor	Perform	witness & review
5	Network Switches	as per the tender specification	port isolation, functional check, configurational, Visual, connectivity, Vendor QC certificate	100%	OEM supplied Data sheet & test certificates	as per specification	Manufacturer / Vendor	perform	witness & review
Field instruments									
1	Transmitter (Temperature, Pressure, Level, Vacuum, Flow, %RH+ Temp, etc.,)	as per the tender specification	visual, calibration & functional checks	100%	OEM supplied Data sheet & test certificates	as per specified accuracy	Manufacturer / Vendor	perform	witness & review

Quality Assurance plan for Instrumentation and Control System									
S. No	**Component/Stage**	**Characteristic sought for**	**Type of check**	**Extent of check**	**Reference Std./ Acceptance norms**	**Acceptance norms**	**Test performed by**	**Processing agency (Vendor)**	**Verifying agency (SDSC-SHAR)**
2	Proximity sensors, Pressure Switches etc.,	as per the tender specification	Visual & functional checks	100%	OEM supplied Data sheet & test certificates	as per specified accuracy	Manufacturer / Vendor	perform	witness & review
3	Thermocouple sensors Type “K”	as per the tender specification	Visual & functional checks	100%	OEM supplied Data sheet & test certificates	as per specified accuracy	Manufacturer / Vendor	perform	witness & review
4	Encoder	as per the tender specification	Resolution, Calibration & functional	100%	OEM supplied Data sheet & test certificates	as per specification	Manufacturer / Vendor	perform	witness & review
5	Control valve	as per the tender specification	Visual, Calibration & functional	100%	OEM supplied Data sheet & test certificates	as per specification	Manufacturer / Vendor	perform	witness & review
Panels, JBs, & Miscellaneous items									
1	Panels & JBs	Physical Inspection	Visual	100%	GA drawing	as per specification	Manufacturer / Vendor	Verification	witness & review
2	Relay board	as per the tender specification	visual & functional	50%	OEM supplied Data sheet & test certificates	as per specification	Manufacturer / Vendor	perform	witness & review
3	Isolators	as per the tender specification	Functional check	50%	OEM supplied Data sheet & test certificate	as per specification	Manufacturer / Vendor	perform	witness & review
4	Flanged Valve	as per the tender specification	Functional check	50%	OEM supplied Data sheet & test certificate	as per specification	Manufacturer / Vendor	perform	witness & review
5	Pilot operated & quick exhaust solenoid valves	as per the tender specification	Functional check	100%	OEM supplied Data sheet & test certificate	as per specification	Manufacturer / Vendor	perform	witness & review

				Bidder's Compliance (Yes/No)
10.	**0.**	**0.**	**POWER SUPPLY FOR HOT AIR AUTOCLAVE PLANT**	
			All the electrical subsystems and auxiliary equipment of the entire autoclave like control equipment, fan motor drive, vacuum pumps, cooling and pressurization systems etc., shall be designed to operate on the available mains power supply of 3 phase, 4 wire AC, 415 V ± 10% and 50 Hz± 3%.	
11.	**0.**	**0.**	**ELECTRICAL SYSTEMS FOR HOT AIR AUTOCLAVE PLANT**	
			Supplier's scope for electrical systems includes – a. Supply of electrical panel as per under stated specification. Interfacing of control panel, power panel with heater banks, fan drive system and cooling system motors for water pump, cooling tower etc., with necessary cabling including supply of all cables along with stainless steel cable trays.	
11.	**1.**	**0.**	**HMI Control station-** **(As mentioned in Instrumentation scope)**	
11.	**1.**	**1.**	HMI control station is a local operating panel near autoclave for autoclave door operation, rail bogie forward /reverse movement in two speeds and rail bridge up /down operation.	
11.	**1.**	**2.**	HMI shall have operation selection, visual indication, emergency OFF with required interlocks. Configuration and necessary interlocks for all these operations shall be incorporated in the control circuit which are detailed in instrumentation and control system in Section C- Clause 10&11 and its sub-clauses.	
11.	**1.**	**3.**	Control circuit shall be hard wired using contactor logic with necessary interface with proximity switches/safety devices/pressure switches/solenoid valves for door closing/opening, rail bogie and rail bridge operations.	
11.	**1.**	**4.**	All switch gear elements like contactors, over load relays, MCB etc., shall be mounted in Switch gear panel located in control room, interfaced with HMI local operating panel with necessary control wiring.	
11.	**1.**	**5.**	Emergency button with key, hardwired only to trip circuit breaker feeding power to door, rail bogie and lighting system switchgears shall be provided in HMI panel.	
11.	**1.**	**6.**	This Emergency button shall not trip the incoming circuit breaker.	
11.	**1.**	**7.**	Rail bogie forward/reverse shall be interlocked with front and rear end proximity switches to stop automatically after reaching final in/out positions.	

				Bidder's Compliance (Yes/No)
11.	**1.**	**8.**	Refer Section C-/Clause 9 and its sub-clauses for details of instrumentation and control system.	
11.	**2.**	**0.**	Switch Gear panel (SGP) - Essential design requirements and proposed panel configuration	
			Essential Design requirement:	
11.	**2.**	**1.**	**Panel Make: Rittal/President**	
11.	**2.**	**2.**	Electrical panel (i-MCC) builder must be a Valid license partner certificate / system integrator certificate & endorsement letter from OEM (Switchgear and automation products. Siemens/ABB)	
11.	**2.**	**3.**	**Construction:** a. Enclosure – Indoor, Floor mounting, single front operated free standing compartmentalized panel. b. Fixed mounted design with front door c. Thickness of frame, mounting plates, Doors, Covers & Patricians – As per OEM Design. d. Gland plate – 3.0 mm (minimum) Thickness CRCA. e. Lifting arrangements - Suitable Lifting Arrangement shall be provided for the panel on the Top on all four sides f. Base frame – As per the OEM design. g. Grouting bolt – M12 (minimum) or as per the standard practice. h. Hinges – As per the OEM design. i. Gasket – Neoprene rubber or better. j. Degree of protection – IP 42 in accordance with IEC60529. **k.** Internal Separation – Form 4b as per IEC 61439-2, Section 8.101 l. Shrouding – As per standard (to be provided inside the panel, in front of power components and power terminals).	
11.	**2.**	**4.**	**Dimension of panel** a. Height (excluding base frame): Up to 2200 mm b. Depth (single-fronted): From 500 mm to 1200 mm c. However, OEM design tolerances are accepted. d. Panel shall have a provision for future horizontal expansion. Length of all the panels shall be limited to 14m.	
11.	**2.**	**5.**	**Door:** a. Door lock for all cable and bus bar chambers – Lever type and key lockable b. Must be equipped with locks that are resistant to internal	

				Bidder's Compliance (Yes/No)
			arcing faults. c. Door Opening angle – Minimum of 125^0 d. Earth connectivity between cubicle door and main frame of the panel shall be established positively. e. Door hinges must be easily changed to adapt to the specified escape route.	
11.	**2.**	**6.**	**Compartment:** a. All the feeders are to be planned with sufficient place for maintenance. b. Marshalling chamber to be planned in the panel as per the user requirement. c. Grouping of feeders also may be required for making a ring topology. The same will be decided during detailed engineering.	
11.	**2.**	**7.**	**Surface preparation / powder coating** - All the exposed steel surfaces/structural steel shall be painted as per following: - a. Surface Preparation: Cleaning by wire brush or power tools to remove any loose dirt or mill scales from the surface. Sand blasting shall be carried to clean the inner and outer surface before painting operation or pre-treatment. This is applicable only wherever CRCA sheets were used for the fabrication. A separate list to be submitted for the same. b. Panel structure (frames, cubicle, doors, etc) to undergo for Nine tank process for surface treatment – necessary certificate and process flow chart need to be produced along with tender submission. c. Base frame – Galvanized, Matt black or as per OEM Design. d. Mounting plate – Silver shade or approved by department. e. SGP shall be with SIEMENS grey powder coating RAL-7032 as per 7 tank processes.	
11.	**2.**	**8.**	Intelligent MCC panel, bus bar chamber needs to be provided with panel lamps (LED) along with door limit switches	
11.	**2.**	**9.**	**Wiring** a. Control circuit – Minimum size: 1.5 Sq.mm with copper FRLS PVC insulated. b. All Digital Inputs – Minimum size: 1.0 /0.5 Sq.mm. c. Power circuit – Minimum size: 4 Sq.mm. d. Ferrules – double cross ferrules **e.** Power supply to / from panel: f. 3 Ph, 4 Wire, 415 V AC ± 10 %, 50 Hz ± 3 %	

				Bidder's Compliance (Yes/No)
11.	**2.**	**10.**	**Busbar** a. Material: Copper as per the latest IS. b. Busbar Size: To be specified in the submitted G.A drawing. c. The bus bar should be designed to withstand fault level of 50kA RMS and 105kA peak for phase and neutral bus bars for one (1) second. Type test certificate issued by CPRI in this regard shall be submitted. d. The busbar must be identified in accord with the following markings: e. Line conductor: L1, L2, L3. f. PE/PEN conductor: Green / Yellow. g. N conductor: N h. The busbar shall be provided with maintenance free screw connections. i. Support: Suitable bus bar insulator to be planned for the bus bar support.	
11.	**2.**	**11.**	**Terminal blocks:** a. It shall be of 650/1100 V grade of the stud type and shrouded. b. Insulating barriers shall be provided between adjacent terminals. c. All the terminals are grouped with respect to the following: d. 24V DC power distribution. e. 230V AC UPS power distribution. f. 230V AC NON-UPS power distribution. g. 415V AC power distribution h. Command (ON, OFF) i. Status (ON, OFF, TRIP, Running, Healthy) j. Spare terminals k. More than one termination to be avoided in one terminal block (i.e., not more than one in and one out is allowed). l. Short linked terminals are to be used for terminal multiplication of Phase and neutral / positive and negative. m. All the future interlocks to be provided with permanent short link. n. Power terminals blocks suitable for connecting ring type end termination. o. All the terminals need to be provided with group markers. p. Make: M/s Connectwell / Wago / Elmex / phoenix.	
11.	**2.**	**12.**	**Proposed Panel Configuration:**	
11.	**2.**	**13.**	Switch gear panel consists – Incoming Air Circuit Breaker (ACB), thyristor power controllers, VFD for fan motor and cooling pumps, switch gears for door operation and rail bogie	

				Bidder's Compliance (Yes/No)
			operation, vacuum pumps, compressors, water pumps etc.as per the design of the equipment.	
11.	**2.**	**14.**	One (1) no. of i-MCC panel need to be supply for the entire system as per this tender. **Note:** Party shall furnish panel dimensions, switch gear ratings, panel layout for purchaser's approval. Length of the panel shall not exceed 14m including panel AC. SGP shall be single integrated panel with a panel ACs attached at the both the ends with proper ducting for sufficient cooling of entire panel to maintain standard conditions inside the panel. Both the ACs shall be of same rating. Detailed design of panel AC shall be submitted for purchaser's review and approval.	
11.	**2.**	**15.**	**Marshalling compartment:** Marshalling compartment shall be provided for interfacing the communication devices with PLC/SCADA. This compartment will facilitate to provide the data required from i-MCC to PLC/SCADA and vice versa.	
11.	**2.**	**16.**	**Panel shall have the provision for *bottom-cable entry*.**	
11.	**2.**	**17.**	**Control Voltage inside the Electric Panel:** a. 1 Ph, 3 Wire, 230 V AC for all contactors, relays & indications lamps (if any) **b.** 24 V DC supply for soft starter auxiliary and other switchgears (if required) c. 1 Ph, 3 Wire, 230 V AC UPS supply for all intelligent modules, control unit of VVVF drive and other elements (which will be finalized during detailed engineering), relays & indications lamps (if any)	
11.	**2.**	**18.**	**Selector switch** a. i-MCC mode or PLC (Remote) mode to be selected using this selector switch. b. It shall be used for selecting the main and redundant feeder. c. Selector switch shall be of three positions, maintained, key way type. d. Key shall be removable in all three positions. e. Position-1: i-MCC Mode; Position-2: Maintenance Mode-No Operation; Position-3: PLC (Remote mode). f. i-MCC Mode: Operation from Operator Panel or Remote Terminal, PLC Mode: Operation from PLC via communication or Remote Terminal. g. Position-1: Main chain; Position-2: Maintenance; Position-3: Redundant chain – in case of main/redundant selection. h. It shall be provided for individual feeder. i. It shall be used wherever applicable as per the control logic	

				Bidder's Compliance (Yes/No)
			as approved by the department. j. It shall be supplied with 2NO+2NC contacts.	
11.	**2.**	**19.**	Multifunction meter a. Measuring input for voltage: 3 AC, VL-L, VL-N, Cat III. b. Aux. Voltage: Up to 240 V AC, 50 Hz. c. Measuring input for current: xxx / 5A. d. Measuring values with min., max., values with date and time. e. Harmonic voltage and current measurement: Up to 31st f. It shall have a recording function with adjustable option. g. It shall be provided with event recording function with selectable option. h. Communication interface: PROFINET/Ethernet protocol i. Connector: PROFINET/Ethernet connector to be supplied. j. This communication module shall enable the operation of ACB via remote mode operation as a redundancy requirement. k. Digital Inputs & outputs: Minimum 2 nos. & expandable up to 4 inputs and 2 outputs. l. Operating voltage for digital inputs and outputs: 24 V DC. m. Accuracy: Class - 0.2S n. Type: Digital, True RMS o. Display: LCD. p. Make: M/s SIEMENS-PAC-4200 /ABB –equivalent of 4200. q. Location and Quantity: i-MCC panel incomer and compressor panels. (Total 3 sets)	
11.	**2.**	**20.**	**Current Transformer** a. It shall be complied with the requirements of relevant latest amended IS. b. CT Ratio: xxx / 5A. c. Accuracy: Class 1. d. Type: Resin Cast/ABS Moulded type. e. Qty: as mentioned in the proposed configuration. f. Make: AE, Kappa, Kalpa, Intras, paras or any other make with the approval of the department.	
11.	**2.**	**21.**	**Control Transformer** a. Voltage rating: 415 V (input) / 230 V (output). b. VA rating: Based on sizing calculation during detailed engineering. c. Both the input and output of the transformer to be provided with suitable rated MCBs. d. The output of this transformer to be linked to the common	

				Bidder's Compliance (Yes/No)
			non-UPS control supply bus bar. e. Make: AE, Kappa, Kalpa, Intras, paras any other make with the approval of the department. f. Sizing of the control transformer shall be submitted for purchaser's review and approval.	
11.	**2.**	**22.**	Earth Leakage relays: a. Microprocessor based relay with display shall be provided. b. Display: LCD. c. Indication: Set value and measured value shall be indicated. d. It shall be supplied along with CBCT of suitable size dia. and its calibration certificate. e. Current Range: 300 mA – 12000 mA f. No. of steps: 18 Nos. g. Tripping time: 0.0 S – 5 Sec. h. CBCT type: Resin cast. i. Contact rating: 5A, 250V AC j. No. of change over contact: 2 Nos. k. Make: Prok DVs l. Qty: To be provided for the i-MCC incomer and Heater bank feeders.	
11.	**2.**	**23.**	**Moulded case circuit breaker (MCCB)** a. No. of poles: 3/4 according to list of feeders given. b. Type: Plug-in type with necessary base and other accessories. c. Operating mechanism: Manual. d. Front operated, door coupled mechanism. e. Door sealing frame need to be supplied in order to maintain the panel IP rating. f. Releases: 230 V shunt release with changeover contact for outgoings. g. No. of change over contacts: Based on the control circuit requirement. h. No. of alarm contact: Based on the control circuit requirement. i. All the MCCBs shall be provided with built-in IDMTL type adjustable overload, short circuit, ground fault and instantaneous protection using latest microprocessor-based releases along with LCD display. j. All the MCCBs to be supplied with phase barriers and splitters both input and output side. k. The release shall offer minimum 50% to 100% (or wider range) settable overload and Icu = Ics = 50 kA @ 415 V AC. **l.** All the MCCBs shall have a communication feature. Same	

				Bidder's Compliance (Yes/No)
			to be used for sharing the status (ON, OFF & TRIP) of MCCB to the centralized automation system via PROFINET/Ethernet communication. m. All the MCCBs data to be interlinked with common display unit. n. Display: LCD o. **Make:**M/s SIEMENS	
11.	**2.**	**24.**	**MCCB Protection Release:** Microprocessor-based Trip Unit shall have a. All the MCCBs shall be provided with built-in IDMTL type adjustable overload, short circuit, ground fault and instantaneous protection - LSIG. b. All the MCCBs to be supplied with phase barriers and splitters both input and output side. c. All the supplied MCCBs shall have a communication module. d. The release shall offer minimum 50% to 100% (or wider range) settable overload. e. Display: LCD. f. Phase current measurements. g. Ground fault current measurement. h. Indication of fault type. i. High / low threshold limits alarms with respect to current. j. Trip, alarm and operating histories. k. Counters for Trip, alarm, operation. l. Contact wear. m. Load profile and thermal image.	
11.	**2.**	**25.**	**Surge protection:** a. Surge Protection Devices (SPDs) shall be provided & connected in incomer feeder cubicle for all the i-MCC panel. b. Class: B+C/I+II (according to IEC61643). c. Line to Neutral: 40 kA (10/350 µSec) – Qty: 3 Nos. **d.** Neutral to Earth: 100 kA (10/350 µSec) – Qty: 1 No. e. **HRC Fuse: 100 A (Qty: 3 Nos.)**	
11.	**3.**	**0.**	**Control and Power communication cables**	
11.	**3.**	**1.**	a. Cross-linked Polyethylene Insulated PVC Sheathed LT Power Cables working voltage up to and including 1100 Volts as per the IS 7098 (Part-1) shall be considered for the supply. b. Current Rating of the Power cable towards the motor are to be taken care 1.5 times the Rated current of cleared Electrical Motor and heater Rating. c. Current Rating of the MCC Incomer Power to be taken care	

			1.5 times the Rated current of all the cleared Electrical Motor Rating + Heater Rating + control transformer + Other auxiliary systems to be considered. d. All the Cables towards motors are to be considered for 4 cores only all cables are in the scope of supplier. Material of conductor is copper only. e. All the cable shall be provided with the double cross tag for ease identification. f. Make: M/s LAPP, M/s HAVELLS, M/s FINOLEX, M/s GLOASTER. Any other make with the approval of department g. All power and control cables shall be supplied, laid and terminated by supplier for functioning of autoclave. h. Electrical panel will be kept in electrical panel room. The party shall consider power and control cable for incoming and for all outgoing equipment. The cable shall be of copper conductor only and armored. Necessary length shall be considered by taking the building in to consideration. 30m may be considered for incoming cable. i. Compressor power shall be tapped from PCC (Power control center) available in the electrical panel room. j. However necessary power cables are to be supplied, laid and terminated for compressors by supplier. Other compressor loads like circulation pumps, air dryers and cooling tower fans from the compressor panel with necessary switchgear and protections. k. Incoming cable to the i-MCC panel from PCC panel of facility is in the scope of supplier. Approximate distance is 30m l. Equipment layout shall be considered for cable supply with minor variation shall be considered for cable schedule. m. While preparing the cable schedule sufficient margin in size and no. of cores shall be planned to have high reliability and future requirement. n. Cables for power and control wiring shall be armored with minimum insulation voltage of 650 V/1100 V with proper current ratings. o. Flexible cable shall be used for rail bogie system to facilitate movement. p. Cables shall be XLPE insulation as per IS: 7098 or suitable standards of country of origin. q. Cables shall be routed in trenches/cable trays with proper isolation between power and control cables to eliminate EMI effect. Entire cable tray needs to be covered. r. Proper cable-drag-chain system preferably of IGUS/Lapp make shall be provided for rail bogie movement. s. All Cables are to be laid in a Stainless-Steel Tray with cover including fixing materials.	

<table>
<tr><th></th><th></th><th></th><th></th><th>Bidder's Compliance (Yes/No)</th></tr>
<tr><td></td><td></td><td></td><td>t. Control cables shall be of minimum 1.5 Sq.mm.
u. VFD control unit shall be wired with 0.5 Sq.mm cable.
v. Power and control cable selection and schedule with respect to rating, No. of cores, and insulation shall be provided for purchaser's approval.
w. Ferruling: To and from furring shall be followed for the total circuit for easy identification of wiring. All switchgear shall be provided with suitable legend plate.
x. Cable Glanding: All Power cables and control cable are to be provided with double compression glands of reputed make. Selected glands shall be approved by department.
y. Communication Cables: All communication cables required for interfacing between PLC and I-MCC panels/filed devices etc. are in the scope of supplier. Cable are to be supplied, laid and terminated as per the approved configuration. Redundant communication cable shall be provided between I-MCC panel PLC.</td><td></td></tr>
<tr><td>11.</td><td>3.</td><td>2.</td><td><u>Power contactors</u>: Power contactors shall be selected one grade above the rating of the heaters or fan. Power/Control circuit shall not consist of any fuses other than VFD and Thyristor-based feeders. In place of fuses, MCBs MPCB, MCCBs shall be used. ON/OFF/Trip status of MCB/MPCBs, MCCB shall be provided and linked to SCADA for status monitoring.</td><td></td></tr>
<tr><td>11.</td><td>3.</td><td>3.</td><td><u>Incomer Air Circuit Breaker</u>
Push button and selector switch for operation of ACB and indication lamps to indicate the position and condition of ACB shall be provided on the panel door.
Specification for ACB
<table>
<tr><td>Operation</td><td>Electrically operated, Draw out version</td></tr>
<tr><td>No. of Poles</td><td>4</td></tr>
<tr><td>Rated operating voltage</td><td>Up to 690 V</td></tr>
<tr><td>Rated Current</td><td>Shall be submitted by vendor for approval</td></tr>
<tr><td>Rated Insulation voltage</td><td>1000 V</td></tr>
<tr><td>Utilization Category</td><td>B</td></tr>
<tr><td>Main Conducting paths</td><td>12 kV</td></tr>
<tr><td>Auxiliary Circuits</td><td>4 kV</td></tr>
<tr><td>Control Circuits</td><td>2.5 kV</td></tr>
<tr><td>Closing Solenoid</td><td>For local /remote Electrical ON</td></tr>
</table></td><td></td></tr>
</table>

<table>
<tr><td></td><td></td><td></td><td></td><td>Bidder's Compliance (Yes/No)</td></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>Shunt Release</td><td>Operating Voltage 240 V AC</td></tr>
<tr><td>Closing Release</td><td>Operating Voltage 240 V AC</td></tr>
<tr><td>Locking Device</td><td>1. In OFF position
2. For hand operated lever</td></tr>
<tr><td>Sealing (cap) device</td><td>For Electrical ON button</td></tr>
<tr><td>Operation Counter</td><td></td></tr>
<tr><td rowspan="6">Micro switches</td><td>For electrical indication about position of breaker</td></tr>
<tr><td>Door Interlock</td></tr>
<tr><td>Door racking interlock</td></tr>
<tr><td>Locking in disconnected position</td></tr>
<tr><td>Communication: Suitable to PLC</td></tr>
</table>
</td><td></td></tr>
<tr><td>11.</td><td>3.</td><td>4.</td><td><u>Incomer Air Circuit Breaker protection release</u>
a. Overload – Phase and Neutral, Instantaneous Short Circuit, Earth Fault protection with variable current and time delay setting shall be provided (LSIG)
b. Current (Current unbalance) and Load monitoring shall be provided as additional protection.
c. Overload indication, display of cause for trip through LED shall be provided.
d. It shall have a trip and event recording.
e. Provision for self – diagnostic, self – powered protection test shall be provided.
f. Set time and date shall be maintained irrespective of power supply.
g. It should communicate with the PLC/SCADA and all current and Voltage parameters shall be linked to SCADA.
Make: Siemens/ABB</td><td></td></tr>
<tr><td>11.</td><td>4.</td><td>0.</td><td>Thyristor Power controllers</td><td></td></tr>
<tr><td>11.</td><td>4.</td><td>1.</td><td>Individual heater bank is controlled with thyristor controllers with individual power contactor, interlocked with minimum speed of fan motor VFD, drive health, air flow switch to detect actual air flow (preferably) etc.</td><td></td></tr>
<tr><td>11.</td><td>4.</td><td>2.</td><td>Details of thyristor configuration-three leg, mode of control (phase firing / burst firing), power ratings etc., shall be submitted before implementation for purchaser's approval.</td><td></td></tr>
</table>

<table>
<tr><td></td><td></td><td></td><td></td><td>Bidder's Compliance (Yes/No)</td></tr>
<tr><td>11.</td><td>4.</td><td>3.</td><td>Control mode shall be preferably full wave switch (TAKT) in order to be suitable for loads with thermal inertia and avoid harmonics.</td><td></td></tr>
<tr><td>11.</td><td>4.</td><td>4.</td><td>Thyristor controllers shall be of AEG make Thyro-P or equivalent model of Euro-therm model of latest version with a profi-net communication to PLC port and compatible with SCADA/PLC along with devices like semiconductor fuses etc.</td><td></td></tr>
<tr><td>11.</td><td>4.</td><td>5.</td><td>Thyristor controller status (controller healthy, firing, current, voltage etc.) shall be interfaced with PLC for necessary interlocking.</td><td></td></tr>
<tr><td>11.</td><td>4.</td><td>6.</td><td>Control input (4 to 20 max /0- 5 V configurable) shall be from PLC analog output module as per Temperature control command loop.</td><td></td></tr>
<tr><td>11.</td><td>4.</td><td>7.</td><td>Door mounted advanced display unit shall be provided in the SGP with a suitable cutout and communication arrangement with thyristor unit to indicate power, current, voltage, Fault indications etc. Bar chart, line chart, numeral values, data logger may be provided on the display unit</td><td></td></tr>
<tr><td>11.</td><td>4.</td><td>8.</td><td>Thyristor control shall be supplied with 25 % extra load cushion with circuit load monitoring provision.</td><td></td></tr>
<tr><td>11.</td><td>4.</td><td>9.</td><td>Thyristor control shall accept control command both via terminal (4 – 20 mA) as well as communication.</td><td></td></tr>
<tr><td>11.</td><td>4.</td><td>10.</td><td>Thyristor control shall have a provision for finding out the minimum heater failure.</td><td></td></tr>
<tr><td>11.</td><td>4.</td><td>11.</td><td>Details of Thyristor Power controllers
<table>
<tr><td>Semiconductor fuses</td><td>Suitable rated semiconductor fuses shall be used for protection of Thyristor</td></tr>
<tr><td>Connection Voltage</td><td>3 x 500 V AC +10% - 15%</td></tr>
<tr><td>Auxiliary Voltage</td><td>240 V AC</td></tr>
<tr><td>Control Type</td><td>Current, (I, I2), Voltage (V, V2), Power (P)</td></tr>
<tr><td>Set point inputs</td><td>Configurable analog inputs</td></tr>
<tr><td>Digital Inputs</td><td>Min. 5 Nos.</td></tr>
<tr><td>Digital Outputs</td><td>Min. 3 Nos.</td></tr>
<tr><td>Analog Inputs</td><td>Min. 2 Nos.</td></tr>
<tr><td>Analog Outputs</td><td>Min. 2 Nos.</td></tr>
<tr><td>Potential Free Change Over Points</td><td>Min. 2 Nos. @ 5 A, 240 V AC</td></tr>
</table></td><td></td></tr>
</table>

				Bidder's Compliance (Yes/No)
			<table><tr><td>Fault indicators</td><td></td></tr><tr><td>Rating of Thyristor unit</td><td>25 % extra current rating shall be selected than the rated current of individual heater bank capacity.</td></tr><tr><td colspan="2">**Qty:** 4 Working Thyristors to be mounted in panel and one spare (1 No. spare for replacement in case of any issue)</td></tr><tr><td colspan="2">**Note:** 2 sets of semiconductor fuses are to be provided as commissioning spares.</td></tr></table>	
11.	**5.**	**0.**	**Heater banks**	
11.	**5.**	**1.**	**Heater shall be divided into (minimum four) banks** for smooth rising and maintaining required temperature inside autoclave.	
11.	**5.**	**2.**	All banks shall be controlled through thyristor controllers powered individually from power contactor arrangement interlocked with minimum fan rpm etc.	
11.	**5.**	**3.**	Peak heating load (36 Tons of Steel& 4 tons of NBR rubber at 8bar pressure is heated to 150^{o}C @ 1.5^{o}C per minute) should be met by 75% capacity of the heater elements. Spare capacity shall be uniformly distributed.	
11.	**5.**	**4.**	Heater type, voltage and power ratings, heater bank arrangement inside autoclave, design calculations for arriving heater capacity etc., shall be furnished for purchaser's approval.	
11.	**5.**	**5.**	Proper accessibility shall be provided for replacement of defective heaters and cables in case of need.	
11.	**5.**	**6.**	All interlocks like closing of autoclave door, fan motor rpm etc., shall be incorporated for safe operation of heater banks.	
11.	**5.**	**7.**	Maximum Demand shall be controlled as per the requirement and suitable provision shall be provided in Thyristor.	
11.	**5.**	**8.**	**Interlocking with Pull chord (Man-in -Vessel alarm) system**: Heater and Blower operation shall be interlocked with pull chord system.	
11.	**6.**	**0.**	**Electric Motors**	
11.	**6.**	**1.**	Electrical motors shall be provided for fan, door operation, rail bogie movement, cooling system pumps – cooling water pump for autoclave, cooling tower water circulation pump, etc.	

				Bidder's Compliance (Yes/No)
11.	**6.**	**2.**	Design calculations for all electric motors shall be furnished for purchaser's approval.	
11.	**6.**	**3.**	Motors shall be 3 phase induction motors with Embedded thermistor with interfacing of winding temperature protection relay for proper tripping. Dual speed motors shall be selected other than fan motor if such requirement comes with the approval of the purchaser.	
11.	**6.**	**4.**	Fan motor shall be invertor duty type, compatible with VFD drives along with insulation protection against high frequency components, harmonics, bearing currents etc. Fan motor shall be controlled through suitable VFD drive for air flow control, interlocked with cooling system. At operating pressure (5.5bar) and temperature (125^0) the fan motor shall run at rated speed to maintain the special variation uniformly.	
11.	**6.**	**5.**	Blower shall not draw more than 80% rated current at design pressure of 8 bar and Temperature 150^0 C at rated speed.	
11.	**6.**	**6.**	RTD (Resistance Temperature Detector) shall be provided to Blower motor winding (2 Nos) for continuous temperature monitoring. The RTD output shall be linked to AI module of PLC and temperature shall be displayed in the SCADA screen.	
11.	**6.**	**7.**	**Motor Makes:** Siemens, ABB, Marathon, Bharat-Bijilee, Grundfos or any other make with the approval of department.	
11.	**7.**	**0.**	**Documents to be submitted design review and clearance:** a. No. of motors, Power of motor, Frame size, make, duty, type and No. of poles, Insulation, Ambient temperature, applicable IS for construction, bearing, accessories, terminal position from drive end, drawing Nos. b. Torque and speed curves, thermal withstand time curve, efficiency and power factor with respect to loading of the motor, speed and time with respect to current and complete G.A of motor, terminal box / boxes by mentioning the approved drawing reference and nos. etc. c. Electrical power and control diagram need to submitted for review and approval d. Sizing of control transformer, Air Conditioning unit, power supply unit etc. for approval. e. Inspection and Testing Plan for review and approval. f. Commissioning Plan for review and approval g. All the test certificates, panel test reports and other relevant test reports / certificates.	

				Bidder's Compliance (Yes/No)
11.	**8.**	**0.**	**Variable Frequency drive (VFD) and Intelligent Motor Management (i-MCC)**	
			General Technical details of VFD:	
11.	**8.**	**1.**	**VVVF drive Power Module:** a. The power (kW) rating of VVVF drive shall be one step higher than the electrical power (kW) rating of the motor selected. b. Refer list of for the feeder/motor which are driven by VVVF drive. c. Three positions-maintained selector switches shall be provided for the selection of VVVF drive. d. Based on the selector switch position, the control unit may give the command to the respective VVVF drive. e. The selected drive shall be indicated by means of indication lamp. f. VVVF drive shall have a high level of torque, speed, position and functionality accuracy. g. Drive shall have a minimum of 3 signal traceability function.	
11.	**8.**	**2.**	**VVVF drive technical features:** a. Short current rise time shall be very fast. b. It shall have a high over load factor. c. Flexible and simple control technology. d. Closed loop control function. e. It shall have binary input and output. f. Configurable relay outputs. g. It shall be provided with analogue input and outputs based on the user requirement	
11.	**8.**	**3.**	**VVVF communication:** a. Protocol: PROFINET/Ethernet. b. Data rate: 100 Mbit/s in full duplex mode. c. Redundancy: *Media redundancy and System redundancy*. d. Topology: Ring e. Connector: PROFINET/Ethernet connector to be supplied as per the requirement with 100 % spare. f. Make: M/s SIEMENS g. Earthing of the VVVD is to be connected to the Instrumentation earth. Insulated copper of 2R x 1C x 10 sq.mm at both the ends of the panel. h. Insulated copper conductor G.I armoured cable of 1C x 10 sq.mm need to be supplied with 250 meters along with the panel.	
11.	**8.**	**4.**	**VVVF drive Control Unit**	

				Bidder's Compliance (Yes/No)
11.	**8.**	**5.**	**Control unit – Suitable for system redundancy.** a. In case of common control unit, stand by unit shall be provided. b. Three positions-maintained selector switches shall be provided for the selection of VVVF Drive control unit. c. Based on the selector switch position, the control unit may give the command to the respective VVVF drive. d. The selected control unit shall be indicated by means of indication lamp. e. VVVF drive shall have DI / DOs with the status LED indication preferably. f. All the control unit auxiliary supply needs to be routed through the appropriate rated MCB. g. 20% additional DI / DOs with respect to the used/assigned terminals for future usage. h. All the control units need to be supplied with memory module and card.	
11.	**8.**	**6.**	Input and Output Choke: Suitable input and output chokes are to be provided for controlling the harmonics.	
11.	**8.**	**7.**	**Input and Output Filter:** Suitable input and output filters are to be provided for better performance.	
11.	**8.**	**8.**	**VFD for Blower (fan) motor** a. The speed control for fan motor and desired air flow rate shall be achieved through VFD. b. VFD shall be provided with profinet (PN) communication provision and all operations of VFD will be carried out through the PN communication with PLC/SCADA. c. In Addition to the above VFD shall be provided with provision of speed control command (4-20mA/1-5V) from PLC analog output module. d. Programmable digital output from VFD (drive health etc.) shall be interlocked with heating system. e. Analog output for speed from VFD after reaching preset speed, shall be interlocked in PLC with Heating system. f. VFD shall be of SIEMENS/ ABB make and necessary drive software shall be supplied along with VFD. Two numbers of VFDs shall be provided (main and redundant). VFD shall be provided with Profinet communication facility and Intelligent operator panel. One step higher rating than the VVVF drive capacity output contactors shall be provided and interlocked properly to route the power to fan motor. Independent MCCBs and SDF units shall be provided for each VFD with	

				Bidder's Compliance (Yes/No)
			semiconductor fuses. Semiconductor fuses shall be provided with status monitoring switches and shall be linked to PLC/SCADA. g. Each feeder shall be provided with MCCB of suitable rating as Incomer to VFD followed by semiconductor fuses. h. Fan Motor VFD selection (between main and redundant) shall be by simple selector switch so that all power and controls shall change smoothly without any issue. i. Necessary interlocks shall be provided between Fan VFDs. j. Power flow diagram: Bus bar—Semiconductor fuse Unit – Power contactor – VFD –Power contactor –suitable choke /filter –Fan motor. k. Two parallel lines with main and redundant concept shall be planned to feed fan motor with proper inter locking mechanism. All semiconductor fuses shall have status monitoring provision and interlocked with main system.	
11.	**8.**	**9.**	**VFDs for cooling system pump motors**	
11.	**8.**	**10.**	**Main Cooling Pumps :(2 Nos)** a. VFD shall be provided for cooling system motors to achieve rapid and normal cooling rate operated at main (50 Hz) and preset lower frequencies respectively. b. Each feeder shall be provided with MCCB of suitable rating as Incomer to VFD followed by semiconductor fuses. c. Semiconductor fuses shall be provided with status monitoring switches and shall be linked to PLC/SCADA. All operations shall be carried out through PLC/SCADA.	
11.	**8.**	**11.**	**Pre-cooling Pump Motor: Qty:01** a. VFD shall be provided for pre-cooling system motor to achieve pre- cooling rate operated at main (50 Hz) and preset lower frequencies respectively. b. There shall be provision in contactor logic arrangement to run the pre-coolant motors at main frequency in case of VFD failure. c. Necessary program logic shall be made in PLC to make smooth change over from VFD to conventional starter mechanism (DOL/Star-delta). d. VFD system for cooling system shall be provided in SGP. All operations shall be linked to main autoclave SCADA.	
11.	**8.**	**12.**	**DOL-Star/Delta Based feeders: Intelligent motor Management system (i-MCC)/ Other than VFD feeders)**	

				Bidder's Compliance (Yes/No)
			Intelligent Module: a. All the intelligent motor management module needs to be selected to suit for the intended application. b. All the modules shall be supplied with PROFINET/Ethernet communication protocol. c. Connector: PROFINET/Ethernet connector to be supplied for all the ports. d. All need to be interlinked to the remotely located PLC. e. The entire feeder shall have a provision to measure current and voltage measurement. f. All the intelligent Module need to be supplied with door mounting operator panel (big size). g. All the current measuring modules are to be supplied only with straight through CT only. h. Health status of the module and the trip log during the power up the period need to be communicated to centralized automation system based on the demand by sending a request. i. Necessary support (both hardware and software if any) for building the logic in the centralized automation system is in the scope of supplier during commissioning. j. To retrieve the data records from the module – if any software or license needed – the same to be considered for the supply along with the panel. k. Auxiliary supply to the intelligent motor management module need to be extended from UPS supply with independent control MCB other than the control MCB used for the control circuit. However, supply of UPS is not in the scope of bidder. l. Independent Control MCB shall be planned for control circuit, auxiliary supply to intelligent motor management module and shunt trip release. m. Earthing of the intelligent modules to be connected to the Instrumentation earth. Insulated copper of 2R x 1C x 10 sq.mm at both the ends of the panel.Make: M/s SIEMENS	
11.	**8.**	**13.**	**Intelligent Module communication**: a. Protocol: PROFINET/Ethernet. b. Data rate: 100 Mbit/s in full duplex mode. c. Redundancy: Media redundancy and System redundancy. d. Topology: Ring e. Connector: PROFINET/Ethernet connector to be supplied as per the requirement with 100 % spare.	
11.	**8.**	**14.**	**Other technical details of i-MCC Feeder:** a. It shall be taken care of type-2 co-ordination with fuse-less	

			feeder (i.e., with TP MPCB) as the selection criteria with auxiliary for ON, OFF, TRIP and shunt release. b. The MPCB shall have a capability to take care of over load as well as short circuit protection. c. Intelligent-motor management module of with PROFINET/Ethernet communication port to be planned, the same need to be interlinked to the remotely located PLC. d. Independent Control MCB shall be planned for control circuit and auxiliary supply to *intelligent* motor management module and shunt trip release independently. e. Auxiliary supply to the *intelligent* motor management module needs to be extended from UPS supply. f. Make of the Motor Management systems shall be of SIEMENS g. Motors not fed by VFD, shall have i-MCC to control and acquire data of the motors through SIMOCODE modules of SIEMENS make and interfaced to PLC and SCADA via profinet communication. h. **Software:**Relevant VFD and i-MCC and Thyristor licensed software shall be provided for programming. GSD files /CD s are to be provided for hard ware configuration in PLC. i. Push buttons to switch on fan, compressors, vacuum pumps, water pumps, etc., from SGP shall also be provided with an interlocking/mode arrangement from control panel. j. All the motors current values which are not operated through VFD shall be monitored and recorded by incorporating a suitable intelligent motor management system (i-MCC, SIMOCODE, SIEMENS make) and interfaced with PLC via Profinet communication. k. Local control panel (LCP) shall be provided at front door of SGP for i-MCC feeders and Intelligent Operator Panel (IOP) for VFD operated feeders and Local operator panel(Digital) for Thyristor with door mounting kits. l. SGP shall be single integrated panel with a panel ACs attached at the both the ends with proper ducting for sufficient cooling of entire panel to maintain standard conditions inside the panel. Both the ACs shall be of same rating. Detailed design of panel AC shall be submitted for purchaser's review and approval. m. All the communication devices of SGP shall be needs to be powered with dedicated UPS bus. However, the UPS power to be routed to individual component via a suitable rated MCBs. All MCBs shall have status monitoring provision like ON/OF/Trip and wired up to PLC for monitoring and interlocking.	
11.	**9.**	**0.**	**HARMONIC DISTORTION CONTROL:** THD shall be maintained less than 5 % by using choke at the input side of	

				Bidder's Compliance (Yes/No)
			VFD and suitable chokes/filters to eliminate harmonic from 2nd to 50th harmonic component if required for harmonic distortion likely to be created by Thyristor controllers.	
11.	**10.**	**0.**	**PROGRAMMING TOOL**	
			a. Suitable software needs to be supplied along with VVVF Drive, Thyristors and intelligent modules. b. Supplied software shall have a valid license for its operation. c. Thyristor configuration software need to be supplied with valid license for programming the device. d. This software is to be loaded on the laptop. e. Software shall be of latest version software with valid premium/professional license to be supplied. Qty: 1 Nos. f. Necessary communication cable suitable for support either USB or RJ45 of the laptop need to be supplied. g. VVVF Drive, intelligent Module and Thyristor communication cable suitable for support either USB or RJ45 of the laptop need to be supplied. - 2sets each are required. h. Licensed and latest version of SIRIUS Soft Starter ES (TIA Portal), MS Office, MS Vision, Read & write, merge, convertible PDF are to be loaded. i. GSD files are to be provided for VVVF drives, Simocode Units Thyristors to make interface with the PLC/SCADA. j. Programming device specifications: Suitable programming device (laptop) need to be supplied along with the necessary hard carrying case.	
11.	**11.**	**0.**	**LOTO devices:**	
11.	**11.**	**1.**	**LOTO (Lock Out Tag Out)** a. All the switchgears (MCB/MCCB and ACB) need to be supplied along with relevant LOTO devices (i.e., Lock Out and Tag Out). b. Qty: as per BOM c. Supply of both Lock and Key as well as suitable tag for the same. d. Supply of the following magnetic type display board (each four (4) nos. per i-MCC panel) in addition to the tags used for the locks. The board shall have a provision to hang. • Under Maintenance; • Under Breakdown. • Under Testing. • Under observation. e. All the LOTO devices (both lock and key) are need to be kept inside the box (LOTO Master box) as approved by the	

				Bidder's Compliance (Yes/No)
			department. f. Necessary supporting stand need to be supplied for storing the magnetic type display board.	
11.	**11.**	**2.**	**Insulation Rubber Mat** a. Class 'A', 3.3 kV ac (Rms), 2.0mm ±10 % thickness as per IS 15652/2006 rubber mats of suitable length as equal to the length of panel (multiples of 5 m) to be supplied and provided in-front of the all the supplied panels as per the direction of department. Width of the rubber mat is 1m (maximum). b. Every meter of mat should be marked with respective class symbol, Lot No. or Batch number and Manufacturer's identity or Brand name. c. Necessary test certificate needs to be supplied along with the rubber mat	
11.	**11.**	**3.**	**Autoclave Lighting:** Autoclave shall be provided with LED lights to have sufficient illumination. Lights shall withstand for a Temperature of 200°C and pressure of 11.0bar g. Necessary Certificates are to be submitted for approval of department.	
11.	**12.**	**0.**	**Documents to be submitted design review and clearance**	
11.	**12.**	**1.**	No. of motors, Power of motor, Frame size, make, duty, type and No. of poles, Insulation, Ambient temp, applicable IS for construction, bearing, accessories, terminal position from drive end, drawing Nos.	
11.	**12.**	**2.**	Torque and speed curves, thermal withstand time curve, efficiency and power factor with respect to loading of the motor, speed and time with respect to current and complete G.A of motor, terminal box / boxes by mentioning the approved drawing reference and nos. etc.	
11.	**12.**	**3.**	Electrical power and control diagram need to submitted for review and approval.	
11.	**12.**	**4.**	Sizing of control transformer, Air Conditioning unit, power supply unit etc. for approval.	
11.	**12.**	**5.**	Flame proof electrical equipment test reports along with approved drawings (Either by CIMFR / ERTL (E) or any authorized approving authority) with respect to all the Annexure and amendment if available need to be submitted for review and acceptance of all FLP items.	
11.	**12.**	**6.**	Inspection and Testing Plan for review and approval.	
11.	**12.**	**7.**	Commissioning Plan for review and approval.	

				Bidder's Compliance (Yes/No)
11.	**12.**	**8.**	All the test certificates, panel test reports and other relevant test reports / certificates.	
11.	**13.**	**0.**	**Tests to qualify i-MCC:**	
11.	**13.**	**1.**	**The following are the tests to be conducted during Factory acceptance test.** **a.** High voltage test as per the relevant standard. **b.** Insulation resistance measurement for bus-bar and other power and control circuits before and after high voltage test. **c.** Functional checks like ON, OFF and TRIP will be ensured before powering the i-MCC panel. **d.** Healthiness of shunt trip coil and its control circuit will be ensured for its correct and recommended functionality. **e.** Incomer switch gear need to be tested in all modes of operation. **f.** Communicable capability for all the switchgear (MCCB), intelligent module, VVVF Drive, MF Meters, Thyristors are to be demonstrated for its functionality as per the department requirement. **g.** Performance check of all the in-built safety systems like overload tripping, short circuit tripping, earth fault tripping, etc. shall be carried out and relevant faults needs to be acknowledged either from the trip unit or from the communicable software or from both. **h.** Necessary hardware needs to be arranged for carrying out the demonstration of communication capability of individual system / sub-system / components as per the requirement.	
11.	**13.**	**2.**	**The following are the test proposed during site acceptance test at site.** **a.** All the feeders need to be tested as per the tender configuration and functionality. **b.** Similarly, for VVVF Drive feeder, intelligent module and Thyristor, functionality to be ensured for both status and command as exercised based on the department requirement **c.** Any relevant qualification test as per the procedure followed during testing of MCC panels at SDSC SHAR. **d.** Test results are to be submitted in the form of report both in soft / hard bound to department within 15 days from the date of completion of the test at site.	
11.	**14.**	**0.**	**List of feeders:** The list of indicative feeders is given below. It may be increased depends upon system requirement and design. Additional requirement shall be accommodated by supplier without any	

				Bidder's Compliance (Yes/No)
			extra cost. Ratings are to be decided based on the mechanical systems design:	

Feeder Description	No. of Feeders	Feeder Type	Preferable Incomer
Incomer Note: LSIG protection and ELR is required.	1		ACB
Conveyor Motor	1 No.	i-MCC	MPCB/ MCCB+OLR
Door Swing Motor	1 No.	i-MCC	MPCB/ MCCB+OLR
Door Turn Motor	1 No.	i-MCC	MPCB/ MCCB+OLR
Blower Motor feeder	1 No.	VFD	MCCB followed by Semiconductor fuses.
Stand by feeder for Blower Motor	1 No	VFD	MCCB followed by Semiconductor fuses.
Cooling Tower Circulation Pump Motor -1	1 No	i-MCC	MPCB/MCCB+OLR
Cooling Tower Circulation Pump Motor -2	1 No.	i-MCC	MPCB/MCCB+OLR
Cooling Tower Fan-1	1 No	i-MCC	MPCB/MCCB+OLR
Cooling Tower Fan-2	1 No.	i-MCC	MPCB/MCCB+OLR
Auto clave Main Cooling Pump Motor-1	1 No	VFD	MCCB followed by Semiconductor fuses.

							Bidder's Compliance (Yes/No)
			Auto clave Main Cooling Pump Motor-2	1 No.	VFD	MCCB followed by Semiconductor fuses.	
			Auto clave pre -Cooling Pump Motor	1 No	VFD	MCCB followed by Semiconductor fuses.	
			Blower motor Winding and Vacuum Pump Cooling pump motor-1	1 No.	i-MCC	MPCB/ MCCB+OLR	
			Blower motor Winding and Vacuum Pump Cooling pump motor-2	1 No	i-MCC	MPCB/ MCCB+OLR	
			Drain Pump motor	1 No.	i-MCC	MPCB/ MCCB+OLR	
			Vacuum Pump Motor-1	1 No	i-MCC	MPCB / MCCB+OLR	
			Vacuum Pump Motor-2	1 No.	i-MCC	MPCB/ MCCB+OLR	
			Control Air Compressor motor	1 No	i-MCC	MPCB/ MCCB+OLR	
			Heater Bank with Thyristors Note: ELR is required.	4 No.	i-MCC	FP MCCB	
			Spare i-MCC feeders of rating 15kW	2 No's	i-MCC	MPCB/ MCCB+OLR	
			Items required for Air compressors and Air dryers				
			Multi-function meter along with 1 set (3 Nos.) of VCTs Rating:400/5A Note:	2 sets	For Air compressors current and Voltage measure	Profinet Communication and expansion DI/DO	

<table>
<tr><td></td><td></td><td></td><td></td><td>Bidder’s Compliance (Yes/No)</td></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>Will be installed in PCC panel of dept. for monitoring the compressor feeder parameters.</td><td></td><td></td><td>module required.</td></tr>
<tr><td>i-MCC Modules along with Basic Unit and VCT module
Rating: As per motor ratings
Note: To be installed in the compressor panels for current and voltage parameters.</td><td>4 Sets</td><td>For Air dryer and circulation pumps of compresso r.
Current and voltage measurem ent.</td><td></td></tr>
<tr><td>Thyristor As per design</td><td>1set</td><td>As a spare Item</td><td></td></tr>
<tr><td colspan="4">Note: In case of star/ delta starter for higher rating motors, MPCB shall be replaced with suitable MCCB with OLR.</td></tr>
</table>
</td><td></td></tr>
<tr><td>11.</td><td>15.</td><td>0.</td><td colspan="2">Quality Assurance Plan-Electrical systems</td></tr>
</table>

QUALITY ASSURANCE PLAN FOR ELECTRICAL SYSTEMS								
S. No.	**Component**	**Characteristics**	**Type of Check**	**Quantum of check**	**Reference Document & Acceptance Norms**	**Format of Records**	**Inspection Scope**	
							Supplier	**Customer**
PANEL								
1	**Panel**	Panel Dimensions.	Measure	100%	Drawing	Certificate	Perform	Witness
		Bus Bar dimensions	Measure	100%	Drawing	Certificate	Perform	Witness
		Creep age distance	Measure	100%	Drawing	Certificate	Perform	Witness
		IR Values of panel	Measure	100%	Relevant IS	Certificate	Perform	Witness
		Eye Bolts	Visual	100%	Drawing	Certificate	Verify	Verify
		No load test	Measure	100%	Relevant IS	Certificate	Perform	Witness
		HV test	Measure	100%	Relevant IS	Certificate	Perform	Witness
		Connections	Check	100%	Drawing	Certificate	perform	witness
PANEL ACCESSORIES								
2	Control Transformer/CT	Visual check	Visual	100%	Drawing	Certificate	Perform	Verify
		Rating	Visual	100%	Drawing	Certificate	Perform	Verify
		Routine Tests	Electrical	100%	Drawing	Certificate	Records	Verify
3	Thermostat and Space heater	Visual	Visual	100%	Drawing	Record	Record	Verify
		Rating and type	Electrical	100%	Drawing	Record	Record	Witness
4	Meters	Visual check	Visual	100%	PO	Record	Record	Verify
		Rating &Type	visual	100%	PO	Record	Record	Verify

QUALITY ASSURANCE PLAN FOR ELECTRICAL SYSTEMS								
S. No.	**Component**	**Characteristics**	**Type of Check**	**Quantum of check**	**Reference Document & Acceptance Norms**	**Format of Records**	**Inspection Scope**	
							Supplier	**Customer**
		Routine Tests	Electric test	100%	PO/IS	Test Certificate	Verify	Verify
Equipment								
5	VVVF drives	Visual check	Visual	100%	PO	Record	Record	Verify
		Rating &Type	visual	100%	PO	Record	Record	Verify
		Routine Tests	Electric test	100%	PO/IS	Test Certificate	Verify	Verify
		Functional Test	Electric	100%	PO/Drawing	Test report	Perform	Witness
6	Simocode Modules	Visual check	Visual	100%	PO	Record	Record	Verify
		Rating &Type	visual	100%	PO	Record	Record	Verify
		Routine Tests	Electric test	100%	PO/IS	Test Certificate	Verify	Verify
		Functional Test	Electric	100%	PO/Drawing	Test report	Perform	Witness
7	Thyristors	Visual check	Visual	100%	PO	Record	Record	Verify
		Rating &Type	visual	100%	PO	Record	Record	Verify
		Routine Tests	Electric test	100%	PO/IS	Test Certificate	Verify	Verify
8	ELR	Visual check	Visual	100%	PO	Record	Record	Verify
		Rating &Type	visual	100%	PO	Record	Record	Verify
		Routine Tests	Electric test	100%	PO/IS	Test Certificate	Verify	Verify
		Functional Test	Electric	100%	PO/Drawing	Test report	Perform	Witness
9	MCCB	Visual check	Visual	100%	PO	Record	Record	Verify
		Rating &Type	visual	100%	PO	Record	Record	Verify
		Routine Tests	Electric test	100%	PO/IS	Test Certificate	Verify	Verify

QUALITY ASSURANCE PLAN FOR ELECTRICAL SYSTEMS								
S. No.	**Component**	**Characteristics**	**Type of Check**	**Quantum of check**	**Reference Document & Acceptance Norms**	**Format of Records**	**Inspection Scope**	
							Supplier	**Customer**
		Functional Test	Electric	100%	PO/Drawing	Test report	Perform	Witness
10	Cables	Visual check	Visual	100%	PO	Record	Record	Verify
		Rating &Type	visual	100%	PO	Record	Record	Verify
		Routine Tests	Electric test	100%	PO/IS	Test Certificate	Verify	Verify
		IR Test	Electric	100%	PO/Drawing	Test report	Perform	Witness
11	Communication	Configuration	Visual	100%	Drawing	Test Certificate	Perform	Verify
		Termination	Visual	100%	Drawing	Test Certificate	Perform	Verify
		Functional Checks	Electric	100%	PO/Drawing	Test report	Perform	Witness

<table>
<tr><td></td><td></td><td></td><td></td><td>Bidder's Compliance (Yes/No)</td></tr>
<tr><td>12.</td><td>0.</td><td>0.</td><td>Civil works</td><td></td></tr>
<tr><td>12.</td><td>1.</td><td>0.</td><td>Party's scope includes submission of details of foundation design and layout drawings for the autoclave & its auxiliary equipment with smooth interface.</td><td></td></tr>
<tr><td>12.</td><td>2.</td><td>0.</td><td>Necessary inputs with respect to site and soil conditions will be provides by purchaser, during detailed engineering.</td><td></td></tr>
<tr><td>12.</td><td>3.</td><td>0.</td><td>Specific requirements of civil works if any, particularly with respect to size and weight of the autoclave shall be intimated by the party in advance.</td><td></td></tr>
<tr><td>12.</td><td>4.</td><td>0.</td><td>On completion of the foundation design and layout drawings, same shall be furnished for a review and clearance by purchaser.</td><td></td></tr>
<tr><td>12.</td><td>5.</td><td>0.</td><td>Civil work related to the foundation of autoclave and other auxiliary equipment as per the finalized foundation design & equipment layout drawings submitted by the party.</td><td></td></tr>
<tr><td>13.</td><td>0.</td><td>0.</td><td>Spares</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Commissioning spares are in the scope of the Vendor.</td><td></td></tr>
<tr><td>13.</td><td>1.</td><td>0.</td><td>Sub-system/ Category wise spares list with detailed specifications and supplier details for Hot Air Autoclave plant shall be submitted to the Purchaser.</td><td></td></tr>
<tr><td>13.</td><td>2.</td><td>0.</td><td>Following listed essential spares for Hot Air Autoclave Plant normal trouble-free operation after warranty along with list of spares along with spares mentioned in Instrumentation Control Section-C/Clause-9 shall be supplied by the Vendor.
<table>
<tr><td></td><td>Description</td><td>Quantity</td></tr>
<tr><td>1</td><td colspan="2">All commissioning spares in addition to the mentioned list</td></tr>
<tr><td>2</td><td colspan="2">All recommended list of essential spares for bought-out items in addition to the mentioned list</td></tr>
<tr><td colspan="3">Mechanical Equipment Spares</td></tr>
<tr><td>3</td><td>Rupture disc same as the one fitted to autoclave</td><td>2 Nos. (of same lot used for vessel at commissioning)</td></tr>
<tr><td>4</td><td>Safety Relief valves (spares for SRV-1 & SRV-1) same type fit on the Autoclave</td><td>1 No. SRV set at 6.05 bar g and 1 No. SRV set at 9.35 bar g</td></tr>
<tr><td>5</td><td>Blind flanges for SRV and burst disc ports</td><td>1 No. for each SRV port
1 No. for Burst Disc Port</td></tr>
<tr><td>6</td><td>Compound pressure & vacuum gauge liquid filled (-1 to 9.0 bar)</td><td>4 Nos.</td></tr>
<tr><td>7</td><td>Autoclave door seals</td><td>Door Seal-2 Nos.
Blower Flange Seal-2 Nos.</td></tr>
<tr><td>8</td><td>Repair kit for control valves</td><td>2 Nos for each valve</td></tr>
</table></td><td></td></tr>
</table>

						Bidder's Compliance (Yes/No)
			9	Seal Kit for Rail Bridge operating mechanism	2 Sets	
			10	O-Ring kit for Door operating mechanism	2 Sets	
			11	Oil Seals kit for Door operating mechanism	2 Sets	
			12	Synthetic grease for Door operating mechanism	5 Kg	
				Air Compressor Spares		
			13	Oil filter	2 Nos.	
			14	Suction air filter element	2 Nos.	
			15	Moisture separator	2 Nos.	
			16	NRVs	2 Nos.	
			17	Lubrication oil	20 Liters	
			18	Y type strainer	2 Nos.	
			19	O ring kit	2 Nos.	
			20	Gasket kit	1 Nos.	
			21	Suction valve assembly first stage	2 Nos.	
			22	Suction valve assembly second stage	2 Nos.	
			23	Discharge valve assembly first stage	2 Nos.	
			24	Discharge valve assembly second stage	2 Nos.	
			25	"V" belts	2 Sets	
			26	Drive coupling	1 Set	
			27	Spiders	3 Nos.	
			28	Safety relief valve LP	1 No.	
			29	Safety relief valve HP	1 No.	
			30	Rubber hoses	2 Sets	
			31	Ball valves outlet	2 Nos.	
			32	Ball valves water line	2 Nos.	
			33	Valve service kits	2 Nos.	
			34	Auto drain valves	2 Nos.	
			35	Compressor repair kit	1 No.	
				Cooling Water Pumps		
			36	Mechanical seals / seal kit	4 Nos.	
			37	Pump bearings	4 Nos.	
			38	Rotor shafts	2 Nos.	
			39	Impeller & casing rings	2 sets	
			40	Inlet & outlet valves	2 each	
				Vacuum Pumps		
			41	O-ring kit	2 sets	
			42	Oil filter	2 nos.	
			43	Exhaust filter	2 sets	
			44	Inlet filter	2 nos.	

<table>
<tr><th></th><th></th><th></th><th></th><th>Bidder's Compliance (Yes/No)</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>45</td><td>Bearings kit</td><td>2 sets</td></tr>
<tr><td>46</td><td>Oil mist separator</td><td>2 nos.</td></tr>
<tr><td>47</td><td>Coupling</td><td>1 nos.</td></tr>
<tr><td>48</td><td>Coupling sleeve or spider</td><td>3 nos.</td></tr>
<tr><td>49</td><td>Vacuum pump repair / service kit</td><td>1 nos.</td></tr>
<tr><td>50</td><td>Safety relief valve</td><td>2 sets</td></tr>
<tr><td colspan="3">Electrical System Spares</td></tr>
<tr><td>51</td><td>Thyristor for switching off the heating elements.</td><td>1 No.</td></tr>
<tr><td>52</td><td>Heater's elements for heating system</td><td>5 Nos.</td></tr>
<tr><td>53</td><td>Indicator bulbs for the control panel</td><td>15 Nos</td></tr>
<tr><td>54</td><td>Switches for the control panel</td><td>4 Nos</td></tr>
<tr><td>55</td><td>Assorted gaskets</td><td>2 sets</td></tr>
<tr><td>56</td><td>Cooling system expansion joints</td><td>1 set</td></tr>
<tr><td>57</td><td>VFD for pre-cooling motor drive loaded with drive program</td><td>1 No.</td></tr>
<tr><td>58</td><td>Switchgear</td><td>one for each type</td></tr>
<tr><td>59</td><td>Semiconductor fuse of different ratings and each rating</td><td>1 set (Contains 3 Nos.)</td></tr>
<tr><td>60</td><td>Multi-meter and Insulation tester</td><td>2 Nos. each</td></tr>
<tr><td>61</td><td>Special tools</td><td>1 set</td></tr>
<tr><td>62</td><td>i-MCC communication module and basic units</td><td>2 Nos.</td></tr>
<tr><td>63</td><td>i-MCC Voltage and current module (for each rating)</td><td>1set</td></tr>
<tr><td></td><td colspan="2">Note:
1. List includes any other essential spare for trouble free operation with purchaser's approval.
2. Refer Section C -Clause 9 for spares of Instrumentation & Control systems</td></tr>
</table>
</td><td></td></tr>
<tr><td>14.</td><td>0.</td><td>0.</td><td colspan="2">Makes for Bought-Out Items and Material of Construction</td><td></td></tr>
<tr><td>14.</td><td>1.</td><td>0.</td><td colspan="2">a. Makes for the bought-out items are specified for each sub-system in Section-C.
b. Any make selection for bought-out items of Hot Air Autoclave Plant shall be with the approval of the purchaser only.</td><td></td></tr>
<tr><td>14.</td><td>2.</td><td>0.</td><td colspan="2">a. Materials to be used for equipment/item of each sub-system of Hot Air Autoclave Plant are specified in Section-C.
b. Material selection for fabrication of any equipment/item of Hot Air Autoclave Plant shall be with the approval of the purchaser only.</td><td></td></tr>
</table>

				Bidder's Compliance (Yes/No)
15.	**0.**	**0.**	**TECHNICAL DOCUMENTS / DRAWINGS SUBMITTED FOR APPROVAL**	
			The Vendor shall execute the works in compliance with the provisions of contract, good engineering practices and code requirements. Vendor shall submit the design details of Autoclave and other subsystems with drawings to meet the technical specifications	
15.	**1.**	**0.**	**Design Review:**	
			a. Vendor shall submit general arrangement drawings to scale, design& assembly drawings with detailed bill of materials, design & fabrication drawings, P&I diagrams indicating all details, power & control drawings, design reports with detailed calculation supporting the specifications of sub-systems and selection of bought-out items of Hot Air Autoclave Plant, fabrication methodology, detailed quality assurance plan (QAP), surface preparation & painting scheme, transportation plan, erection, testing & commissioning methodology to the purchaser for preliminary review. b. Documents & drawings to be submitted by the Vendor for review and approval, shall be as per Section-C clauses. c. Detailed QAPs, fabrication methodology, transportation plan, surface preparation & painting scheme, erection, testing& commissioning plan, submitted by the Vendor shall be in-line/complying with the indicative QAPs, methodologies and schemes for all sub-systems as per Section-C clauses. d. Documents & drawings revised after incorporating suggestions from preliminary review of the purchaser shall be submitted for final approval of the purchaser before proceeding further. Wherever third-party approval is required as per Section-C for drawings & documents, final approval of the purchaser shall be taken only after the approval of the third party. Third party shall approve the documents & drawings only after preliminary review by the purchaser.	
15.	**2.**	**0.**	**Finalized documents:** Approved documents, reports design and fabrication drawings, finalized list & details of bought-out items, detailed approved QAPs with clear indications of revisions/ amendments with approval from TPI and verified by Purchaser	
15.	**2.**	**1.**	**Before Start of Fabrication/Procurement:** Bidder shall submit the following documents in compliance with RFP for clearance and go ahead with fabrication and procurement only after obtaining clearance from SDSC SHAR.	

				Bidder's Compliance (Yes/No)
15.	**2.**	**2.**	Detailed engineering documents including drawings of all sub-systems shall be submitted for utility assessment and purchaser's approval.	
15.	**2.**	**3.**	Technical brochure for bought out items shall be furnished for purchaser's clearance.	
15.	**2.**	**4.**	Welding scheme of the vessel and nozzles shall be provided to the purchaser for approval.	
15.	**2.**	**5.**	Details of material selection shall be furnished to the purchaser for approval.	
15.	**2.**	**6.**	Schedule of drawings and documents for review, approval by the purchaser and information with submission date.	
15.	**2.**	**7.**	Detailed equipment list and bill of materials.	
15.	**2.**	**8.**	Dimensioned to-scale equipment layout drawing showing all equipment, accessories, relevant external dimensions, mounting details and provision for electrical connections to be made by the purchaser, overall space and head room requirements with details of handling during erection, operation and maintenance of all the equipment and accessories.	
15.	**2.**	**9.**	Foundation load distribution drawings with static loads, unbalanced forces and moments if any, pocket details etc.	
15.	**2.**	**10.**	Approved Fabrication methodology for each and every item/ equipment of Hot Air Autoclave Plant.	
15.	**2.**	**11.**	Quality assurance plan (QAP): Detailed QAP in line with the indicative QAP in each clause of Section-C shall list down various stages of inspection and inspection agency namely vendor quality Control agency & 3rd party inspection agency involving clearance of all the major activities which also includes, fabrication, weld inspection, Hydro test certification for Vessel and Heat exchanger. The 3rd party certification shall also include subsequent surface preparation and painting clearance. Elaborate Quality Assurance Plan (QAP) is to be prepared and furnished for review & approval of the purchaser.	
15.	**2.**	**12.**	**Pre-Inspection meeting** minutes before every stage inspection. Based on the approved minutes, documents, inspection plan to be for submitted/verified/ approved by vendor/purchaser/third party shall be verified before proceeding for inspection and after the inspection.	
15.	**3.**	**0.**	**Final documents after completion of fabrication**: Bidder shall submit the 5 copies of design, fabrication drawings & reports, as built drawings, heat treatment curves, FAT reports, operation and	

				Bidder's Compliance (Yes/No)
			maintenance manuals etc. well before the dispatch of the equipment. The manual shall be in sufficient detail for step-by-step instructions to enable others to inspect erect, commission, maintain, dismantle, repair, re-assemble and adjust all parts of the equipment. Each manual shall also include a complete set of approved as built drawings together with Performance / rating curves / charts of the equipment, maintenance schedule and test Certificates wherever applicable.	
15.	**4.**	**0.**	Approved scheme inspection records of surface preparation & painting of equipment of Hot Air Autoclave Plant.	
15.	**5.**	**0.**	**List of documents to be submitted**: Vendor shall submit 5 hard copies of the following documents	
15.	**5.**	**1.**	Operator's manual (mechanical, instrumentation and electrical) of the Autoclave and its sub systems along with all service equipment.	
15.	**5.**	**2.**	Detailed engineering, dimensional drawings of all systems with bill of materials, specifications of the Autoclave sub-systems along with all service equipment.	
15.	**5.**	**3.**	Final copies of documents submitted in design phase, fabrication, inspection & testing phases along with as built drawings.	
15.	**5.**	**4.**	Programming and user manual for control system	
15.	**5.**	**5.**	Maintenance manual for the mechanical systems of Autoclave plant along with all service equipment.	
15.	**5.**	**6.**	Maintenance manual for the control system of the autoclave, with circuit diagrams.	
15.	**5.**	**7.**	Maintenance manual for the control system of the service equipment (Air compressors, Cooling water pumps, Vacuum pumps, Air Dryer, Air Receiver & Vacuum Receiver), with circuit diagrams.	
15.	**5.**	**8.**	Manuals of PC, PLC and other equipment from the original equipment manufacturers. Copy of PLC program is required along with I/O list and addresses.	
15.	**5.**	**9.**	P&I diagram detailed with bill of materials, specifications, vendors name and identifications numbers.	
15.	**5.**	**10.**	Category wise spares list including details and specifications of all standard bought out items/components with vendor identification numbers, manuals for all systems of Hot air autoclave plant.	

				Bidder's Compliance (Yes/No)
15.	**5.**	**11.**	Manual, program back up copy and drive software for VFDs and thyristor controller.	
15.	**5.**	**12.**	Routine Test certificate for Motors	
15.	**5.**	**13.**	Test certificate for Switch gear panel.	
15.	**5.**	**14.**	Warranty and test certificates.	
15.	**5.**	**15.**	Inspection reports including third party inspection as per code requirements.	
15.	**5.**	**16**	Full set of as built drawings (system configuration, GA, as built wiring, cable layout, equipment layout etc.), mounting diagrams of all sub-systems.	
15.	**5.**	**17**	In addition to hard copies of the above documents, vendor shall hand over soft copies in CD ROMs containing all drawings, design documents, all circuit diagrams, sub system details, plans and procedures, operation & maintenance manuals etc. in a compatible form to AUTOCAD and windows latest OS.	
15.	**2.**	**18**	Any other relevant document not listed above.	
16.	**0.**	**0.**	**INSPECTION AND TESTING**	
16.	**1.**	**0.**	The vendor shall identify various stages of inspection and quality control of the Hot Air Autoclave Plant including sub systems, components and bought out items etc., and inform the same to SDSC, SHAR in advance. The approved QAP shall be followed during course of Manufacture, Erection & Testing.	
16.	**2.**	**0.**	**Pre-Inspection Meeting:** Before every inspection a meeting shall be convened with all necessary inputs, documents, plan of inspection before every inspection stage in detail for enabling effective inspection at each and every stage.	
16.	**3.**	**0.**	Purchaser reserves the right to inspect all phases of Bidder's operations through its representatives and/or third- party inspection agency approved by the Purchaser. Therefore, it is the responsibility of the Bidder to provide the necessary support for the inspection agency and get the works inspected at all stages of work as identified in quality assurance plan.	
16.	**4.**	**0.**	The presence or absence of a Purchaser's representative does not relieve the Bidder of the responsibility for quality control in all phases of the work. In the event that any of the work being done by the Bidder or any Sub-Bidder is found by Purchaser's representatives to be unsatisfactory or not in accordance with the drawings, procedures, specifications, and standards the Bidder	

				Bidder's Compliance (Yes/No)
			shall, upon verbal notice of such discrepancy or deficiency, take immediate steps to revise the work in a manner to conform to the relevant drawings, procedures and specifications.	
16.	**5.**	**0.**	The Bidder shall carry out required supervision and inspection as per Quality Assurance Plan and furnish all assistance required by the Purchaser in carrying out inspection work during this phase.	
16.	**6.**	**0.**	The authorized inspectors of the purchaser shall have access to the premises of the Bidder and its sub-contractors at all reasonable times. All the equipment, instruments, tools that are necessary for the inspection shall be provided by the Bidder on demand by purchaser's own inspectors or a third Bidder authorized by purchaser. Inspection by purchaser's own inspectors or by third Bidder authorized by purchaser shall not absolve the responsibility of the Bidder from proper performance of the machine and from the guarantee/warranty clauses stipulated in the contract.	
16.	**7.**	**0.**	Factory acceptance Test (FAT)**:**	
16.	**7.**	**1.**	FAT plan shall be submitted by the party for approval before execution.	
16.	**7.**	**2.**	Pressure vessel, heat exchanger and surface preparation & painting of internal and external surfaces of the vessel post hydro test shall be completely inspected and tested by third party such as M/s. LLOYDS, M/s. DNV, M/s. BV, M/s. TGS or any other reputed agency with the prior approval of purchaser.	
16.	**7.**	**3.**	The arrangements and charges for 3rd party inspection shall be in the scope of supplier.	
16.	**7.**	**4.**	The autoclave shall be subjected to inspection at the supplier's site, in the presence of purchaser's representatives according to mutually agreed inspection plan to verify all the constructional and functional parameters such as material test certificates, DP, UT and radiography reports, dimensional and thickness inspection, hydro test of the vessel, details of bought out items and spares, details of electrical, instrumentation and control systems.	
16.	**7.**	**5.**	The party shall carryout all the functional tests as per test plan approved by purchaser before dispatch in the presence of third party.	

				Bidder's Compliance (Yes/No)
16.	**7.**	**6.**	Raw Material Inspection shall be carried out at the manufacturer's site for compliance of the raw materials to the specified standards.	
16.	**7.**	**7.**	Bought out components shall be inspected either at manufacturer's site or at the Bidder's premises for compliance with the specifications.	
16.	**8.**	**0.**	**Hydro Test**	
16.	**8.**	**1.**	Hydro test of the autoclave vessel, Air receiver, Vacuum Receiver and heat exchanger shall be carried out as per ASME Section VIII Division I with respect to the design pressure of the vessel at the supplier's site. Clean potable water/DM water/RO water with chlorine content less than 50ppm shall be used.	
16.	**8.**	**2.**	Hydro testing of all the pipe lines including pneumatic, water and vacuum lines shall be at SDSC SHAR. Clean potable water/DM water/RO water with chlorine content less than 50ppm shall be supplied by the purchaser for the test at SDSC-SHAR.	
16.	**9.**	**0.**	**Pre - delivery Inspection:** Vendor shall inform the SDSC SHAR the readiness for pre-delivery inspection. Pre - Inspection meeting shall be convened at least 21 days in advance to check the readiness for Pre-Delivery Inspection. All necessary test results / inspection reports / certificates as per the approved detailed QAP and any other test results mutually agreed by SDSC SHAR and vendor shall be made available to the Purchaser after conducting tests as mentioned above in pre-dispatch inspection for obtaining the dispatch clearance.	
16.	**10.**	**0.**	Site Acceptance Test (SAT):	
16.	**10.**	**1.**	SAT plan shall be submitted by the party for approval before execution.	
16.	**10.**	**2.**	The party shall carryout all the functional tests as per mutually agreed plan after installation of the autoclave plant along with complete auxiliary equipment at SDSC, SHAR. The party shall ensure full functional readiness of the plant in all respects.	
16.	**10.**	**3.**	The party shall carry out pneumatic testing of the vessel involving design temperature and pressure or as per mutually agreed test plan.	
16.	**10.**	**4.**	The transfer of title to the purchaser will take place only after satisfactory erection, testing, commissioning and performance testing of complete autoclave plant by supplier and acceptance by SHAR.	

				Bidder's Compliance (Yes/No)
16.	**10.**	**5.**	Acceptance tests like HV test and IR test etc., and functional checks of electrical equipment like measurement of Voltage, Current etc., and panels shall be carried out before dispatch of Autoclave.	
16.	**10.**	**6.**	All the instrumentation and control system should be tested at vendor's site prior to delivery of the item to SHAR.	
16.	**10.**	**7.**	After delivery of items to site, the installation works shall be taken up after obtaining site clearance from Purchaser.	
16.	**10.**	**8.**	During the warrantee period, the bidder has to arrange for periodical maintenance once in every four months and unlimited breakdown calls and replacement of failed/ malfunctioning components without any additional cost.	
16.	**11.**	**0.**	**DELIVERY AND STORAGE**	
16.	**11.**	**1.**	Dispatch Instructions given in the Contract shall be strictly followed. Failure to comply with the instructions may result in delay in payment apart from imposing any other charges as may be deemed to fit.	
16.	**11.**	**2.**	The Vendor shall be responsible for transporting all the equipment to site, unloading and storage. No equipment shall be delivered without obtaining dispatch clearance from Purchaser. All the equipment shall be properly packed to avoid any damage during transportation / handling / storage.	
16.	**11.**	**3.**	Party shall undertake the responsibility of the equipment and its components during transportation to Sriharikota and during erection, testing and commissioning of the same at suitable location identified by SDSC, SHAR and until handing over the machine to SDSC, SHAR after its acceptance. SDSC, SHAR will provide sheltered area for storage of the machine and its components. Vendor shall take proper care while storing the equipment and shall provide watch and ward at his own cost.	
17.	**0.**	**0.**	**ERECTION, TESTING & COMMISSIONING**	
17.	**1.**	**0.**	Vendor's staff shall include adequate number of competent erection engineers with proven experience on similar works to supervise the erection works and sufficient skilled, unskilled and semiskilled labor to ensure completion of work in time.	
17.	**2.**	**0.**	The services of EOT Crane, Material handling equipment viz. 3,5 &12-ton forklift, scissor lift, pallet truck etc. available with purchaser; these will be provided on chargeable basis subjected to availability & approval. However, Bidder shall convey the list of material handling equipment needed for the above purpose. If	

				Bidder's Compliance (Yes/No)
			the required material handling equipment is found unavailable, the Bidder shall have to arrange the same by its own.	
17.	**3.**	**0.**	Any damage caused by Vendor during erection to building shall be made good at no extra cost to Purchaser.	
17.	**4.**	**0.**	Purchaser will make ready the foundations, trenches and provision of water supply to a place identified near the building as per the details furnished by the Bidder.	
17.	**5.**	**0.**	During erection, Purchaser's engineer will visit site from time to time with or without Bidder's engineer to establish conformity of the work with specification. Any deviations, deficiencies or evidence of unsatisfactory workmanship shall be corrected as instructed by Purchaser.	
17.	**6.**	**0.**	**Details of the equipment to be installed at site:**	
17.	**6.**	**1.**	Autoclave vessel with accessories	
17.	**6.**	**2.**	Pressurization system including air compressors, Air receiver and Air dryer connected to tapping points on Autoclave.	
17.	**6.**	**3.**	Cooling water circulation system along with cooling water pumps and cooling tower	
17.	**6.**	**4.**	Heating system.	
17.	**6.**	**5.**	Vacuum system including vacuum pumps and Vacuum reservoir connected to tapping points on Autoclave.	
17.	**6.**	**6.**	Control panel & instrumentation systems and SCADA based control Data acquisition system.	
17.	**7.**	**0.**	**Electrical panels and wiring**: Bidder shall carry out work in a true professional manner and strictly adhere to the approved drawings. Any damage caused by Bidder during erection to new or existing building shall be made good at no extra cost to Purchaser.	
17.	**8.**	**0.**	Bidder shall submit detailed documentation of fabrication and installation works to be carried out at on-site and off-site towards realization of the Hot Air Autoclave plant.	
17.	**9.**	**0.**	**Setting out, levelling and grouting of equipment:**	
17.	**9.**	**1.**	Bidder shall check the civil works where the system is to be erected in advance for their correctness / conformity to the approved drawings for erection of system with respect to the adequacy of their lines, levels, pockets, openings, cut outs etc. and shall notify Purchaser of any major deviation and additional requirement.	

				Bidder's Compliance (Yes/No)
17.	**9.**	**2.**	Bidder shall mark precisely the center lines and datum reference on civil works where the system is to be erected with reference to benchmark given by Civil Bidder. Any minor adjustment necessary to structure (on which system is to be erected) for making them plumb and level shall be carried out by Bidder at his cost.	
17.	**9.**	**3.**	All the grout for system shall be carried out using non-shrinkable grout. Surfaces receiving grout shall be prepared to receive grout. All block outs for pipes (puddle pipes), sleeves etc. shall be grouted by using cement concrete of the same grade as that of the parent structure. All associated civil works such as cutting of re-bar, chipping or dressing of foundation or widening openings in RCC work and brick work, drilling holes in concrete work or brick work shall be carried out by Bidder as part of the scope of contract.	
17.	**10.**	**0.**	**Records**	
17.	**10.**	**1.**	Bidder shall maintain records pertaining to the quality of erection work in a format approved by Purchaser. Whenever erection work is complete, Bidder shall offer erected system for inspection to Purchaser's engineer who along with Bidder's engineer will sign such records on acceptance.	
17.	**10.**	**2.**	The complete construction of system right from component level till the complete system assembly performance tested including sub – assembly shall be properly documented with drawing, raw material, Test certificate etc.	
17.	**10.**	**3.**	There shall be time to time submission of information /clearance / approval by the purchaser and all comments shall be duly incorporated.	
17.	**10.**	**4.**	All such drawing will become part of SYSTEM MASTER FILE which shall also contain as built drawing, final erection, testing & commissioning report done at site.	
17.	**10.**	**5.**	5 copies of SYSTEM MASTER FILE shall be supplied.	
17.	**11.**	**0.**	**Erection**	
17.	**11.**	**1.**	Bidder shall carry out the works in accordance with the specific instructions given on the approved drawings, method statements, manufacturer's drawings / documents or as directed by Purchaser. Equipment shall be erected in neat workmen like manner so that they are level, plumb, and square and properly aligned and oriented. Tolerances shall be as established in manufactures drawings or as stipulated by Purchaser. No	

				Bidder's Compliance (Yes/No)
			equipment shall be grouted or bolted down to the foundation, until its alignment is checked and found acceptable by Purchaser.	
17.	**11.**	**2.**	Bidder shall provide all supervision, labor, tools, system, cranes, slings, wire-rope, D-shackle etc., equipment, scaffolding, rigging material and incidental material such as bolts, wedges, anchors, concrete inserts, grout material etc. required to complete the works.	
17.	**11.**	**3.**	Bidder shall also provide at his own cost all such consumables like oxygen - acetylene gas welding rods, grinding wheels, temporary supports, shims etc. required to complete work. However, free electricity shall be provided by the purchaser free of cost.	
17.	**11.**	**4.**	Bidder shall take utmost care while handling instruments, delicate equipment, panels etc., and protect all such equipment on erection.	
18.	**0.**	**0.**	**SURFACE PREPARATION AND PAINTING**	
18.	**1.**	**0.**	Surface Preparation & Painting of all equipment of Hot Air Autoclave plant shall be as per the scheme verified by the Third Party and approved by the Vendor.	
18.	**2.**	**0.**	The entire surface of all the fabricated materials is to be blast cleaned to near white metal quality specification of Steel Structures Painting Council (SSPC) standard or Sa 2½ of SIS 055900. The surface shall be completely free from contamination by oil, grease, dirt or other matter. The surface profile after blasting should be between 37 to 65 microns and should be of jagged in nature. Surface should be free from dirt/sand just before application of primer paint.	
18.	**3.**	**0.**	All parts inaccessible after assembly shall be painted before the assembly. Inner surfaces of box Sections shall be painted before closing them.	
18.	**4.**	**0.**	Autoclave and its auxiliary equipment shall be painted as per standard practice to mutually agreed shade/shades. Grade of paints for respective components shall withstand maximum exposed temperature.	
18.	**5.**	**0.**	Painting scheme for external surface: Immediately after sand blasting, one coat of zinc rich epoxy primer shall be applied to a Dry Film Thickness (DFT) of 75 microns. An intermediate coat of 80 micron (DFT) of polyurethane/epoxy painting shall be given. A final coat of polyurethane enamel paint of 40 microns DFT shall be given.	

				Bidder's Compliance (Yes/No)
18.	**6.**	**0.**	Painting scheme for internal surface: Immediately after sand blasting, one coat of zinc rich epoxy primer shall be applied to a Dry Film Thickness (DFT) of 75 microns should with stand temperature of 300^0C. Two coats of heat resistant paint of thickness 15-20 microns (DFT) shall be given.	
18.	**7.**	**0.**	Any intermediate cleaning required between successive coats of paint is to be carried out as per the recommendation of paint manufacturers.	
18.	**8.**	**0.**	All paint and primer shall be of standard quality and procured from approved manufacturers. The contractor shall arrange necessary instrument to measure DFT by the purchaser.	

SECTION D
ANNEXURES

ANNEXURE-I

SCHEDULE OF PRICE

S. No	Description	UOM	VALUE IN (Rs.)
1	Design, Procurement of Materials and sub-systems, Manufacturing, Inspection & Testing at Vendor's Site for **Autoclave Vessel with door & dished ends, Job feeding system, Air circulation system and Heating system** of Hot Air Autoclave Plant along with Third Party Inspection and supply of spares as per the Tender Specification Document and design BOQ	Composite	
2	Design, Procurement of Materials and sub-systems, Manufacturing, Inspection & Testing at Vendor's Site for **Pressurization & De-pressurization system, Cooling system, Vacuum system and Safety systems** of Hot Air Autoclave Plant along with Third Party Inspection and supply of spares as per the Tender Specification Document and design BOQ	Composite	
3	Design, Procurement of Materials and sub-systems, Manufacturing, Inspection & Testing at Vendor's Site for **Instrumentation & Control system, Power and Electrical Systems** of Hot Air Autoclave Plant along with Third Party Inspection and supply of spares as per the Tender Specification Document and design BOQ	Composite	
4	Transportation Charges	Lump sum	
5	Erection, On-site Testing & Commissioning charges at SDSC-SHAR	Lump sum	
6	Applicable Taxes	5%	
7	**Non - Comprehensive AMC** for 3 years after the completion of warranty period	Per year	
8	Applicable tax for **Non - Comprehensive AMC** for 3 years after the completion of warranty period		
9	**Total Value**		

Note:

1. Total value as per S. No 9 will be considered for Bid evaluation.
2. Refer Section-A/Clause-7.1 for applicable GST

(SIGNATURE OF VENDOR)

ANNEXURE-II

EXCEPTIONS AND DEVIATIONS

In line with Proposal Document, Bidder may stipulate Exceptions and deviations to the Proposal conditions if considered unavoidable.

SL. NO	Reference in Specification		Dept. Spécification	Offered Spécification	DEVIATION
	PAGE NO	CLAUSE NO			

NOTE :

Only deviations are to be written in this Annexure.

Any deviations taken by the Bidder to the stipulations of the Proposal document shall be brought out strictly as per this format and enclosed along with the bid.

Any deviations not brought out as per this format and written elsewhere in the Proposal document shall not be recognized and the same is treated as null and void.

Any willful attempt by the Bidder to camouflage the deviations by giving them in the covering letter or in any other documents that are enclosed may render the Bid itself non-responsive.

(SIGNATURE OF BIDDER)

ANNEXURE-III

PRE-QUALIFICATION CRITERIA

S. No.	Criteria	Bidder's Compliance
1	Bidder's with following qualification criteria as stated in Case-1 or Case-2 or Case-3 shall participate in bidding process	
	Case-1	
1.1	**Bidder:** Hot Air Autoclave manufacturer, with ASME U- stamp certification and with minimum 3 years of experience in the field of Autoclave manufacturing can participate in the bidding. **Bidder Qualification Criteria:** 1. Technical Qualification Criteria: Hot Air Autoclave manufacturer should have executed a similar project on Hot Air Autoclave with size of minimum usable diameter 3.5 m and length 5.0 m with operating conditions not less than 5.0 bar design pressure and design temperature 125^0C as per ASME Sec VIII or equivalent, to Government or any reputed organization. 2. Financial Qualification Criteria: a. Similar orders executed: Hot Air Autoclave manufacturer should have executed, One similar work not less than ₹1500 Lakhs or Two similar works each not less than ₹800 Lakhs or Three similar works each not less than ₹600 Lakhs. a. Avg. annual turnover: Hot Air Autoclave manufacturer's average annual financial turnover shall be not less than ₹2000Lakhs during last three Financial years ending with 31st March 2024. b. Solvency certificate: Hot Air Autoclave manufacturer should possess a current Solvency Certificate from Nationalized Bank for an amount of not less than ₹900Lakhs, issued on or after 01st April, 2024.	
	Case-2	
1.2	**Bidder:** Pressure Vessel manufacturers, in collaboration with Hot Air Autoclave technology provider can participate in the bidding. Pressure Vessel manufacturer shall be the Prime bidder for the project and should lead the project. Pressure Vessel Manufacturer shall submit a signed agreement/Collaboration MoU for the project specifying the details of scope of collaboration with Hot Air Autoclave technology provider in detail at the time of bidding.	

S. No.	Criteria	Bidder's Compliance
	Bidder Qualification Criteria: 1. Technical Qualification Criteria: a. Pressure Vessel manufacturer should have ASME U-stamp certification and should have minimum 3 years of experience and should have executed fabrication and supply of pressure vessel of size of minimum diameter 4.5 m & length 8.0 m, with design pressure of 5.0 bar, as per ASME Sec VIII or equivalent, to Government or any reputed organization. b. Hot Air Autoclave Technology provider should have minimum 3 years of experience and should have worked on executed projects for Hot Air Autoclave realization with minimum diameter 3.5 m and length 5.0 m with operating conditions not less than 5.0 bar design pressure and design temperature 125^0C as per ASME Sec VIII or equivalent, to Government or any reputed organization. 2. Financial Qualification Criteria: a. Similar orders executed: Pressure Vessel Manufacturer should have executed, One similar work not less than ₹1500 Lakhs or Two similar works each not less than ₹800 Lakhs or Three similar works each not less than ₹600 Lakhs. b. Avg. annual turnover: Pressure Vessel Manufacturer's average annual financial turnover shall be not less than ₹2000 Lakhs during last three Financial years ending with 31stMarch2024. c. Solvency certificate: Pressure Vessel Manufacturer should possess a current Solvency Certificate from Nationalized Bank for an amount of not less than ₹900Lakhs, issued on or after 01st April, 2024.	
	Case-3	
1.3	**Bidder:** Pressure Vessel manufacturers, in collaboration with either Thermal equipment manufacturer with design capability or with High-pressure Boiler manufacturer with design capability can participate in the bidding. Pressure Vessel manufacturer shall be the Prime bidder for the project and should lead the project. Pressure Vessel Manufacturer shall submit a signed agreement/Collaboration MoU for the project specifying the details of scope of collaboration with either Thermal equipment	

S. No.	Criteria	Bidder's Compliance
	manufacturer with design capability or with High-pressure Boiler manufacturer with design capability in detail at the time of bidding. **Bidder Qualification Criteria:** 1. Technical Qualification Criteria: a. Pressure Vessel manufacturer, should have ASME U-stamp certification and should have minimum 3 years of experience and should have executed fabrication and supply of pressure vessel of size of minimum diameter 4.5 m & length 8.0 m, with design pressure of 5.0 bar, as per ASME Sec VIII or equivalent, to Government or any reputed organization. b. Thermal equipment manufacturer with design capability or High-pressure Boiler manufacturer with design capability should have ASME U- stamp certification and should have minimum 3 years of experience and should have executed at least 1No. of project of value not less than ₹500 Lakhs or 2 Nos. of projects of value not less than ₹300 Lakhs or 3 Nos. of projects of value not less than ₹200 Lakhs to Government or any reputed organization. 2. Financial Qualification Criteria: a. Similar orders executed: Pressure Vessel Manufacturer should have executed, One similar work not less than ₹1500 Lakhs or Two similar works each not less than ₹800 Lakhs or Three similar works each not less than ₹600 Lakhs. b. Avg. annual turnover: Pressure Vessel Manufacturer's average annual financial turnover shall be not less than ₹2000 Lakhs during last three Financial years ending with 31st March2024. c. Solvency certificate: Pressure Vessel Manufacturer should possess a current Solvency Certificate from Nationalized Bank for an amount of not less than ₹900Lakhs, issued on or after 01st April, 2024.	
2.0	Electrical, Instrumentation & Control systems related activities may be sub-contracted to system integrator. If sub-contracted, the system integrator should have minimum 3 years of experience in the field of executing the large-scale automation projects including realization of Hot-standby PLC, server-client architecture with digital field instrument's like Profibus, Profinet along with intelligent motor control systems. Sub-	

S. No.	Criteria	Bidder's Compliance
	contractor/system integrator should be OEM authorized for Control system and should have executed at least 1No. of project of value not less than ₹75 Lakhs or 2 Nos. of projects of value not less than ₹40 Lakhs or 3 Nos. of projects of value not less than ₹30 Lakhs to Government or any reputed organization. Signed agreement/Collaboration MoU for the project specifying the details of scope of sub-contract with system integrator shall be submitted by the Prime bidder at the time of bidding.	
3.0	Documentary proofs, shall be submitted for the fulfillment of the qualification criteria. Work experience shall be supported with copies of the completion certificate / performance certificate and contact details from the client organization to whom similar kind of work is executed shall be furnished.	

(SIGNATURE OF BIDDER)

ANNEXURE-IV

BIDDER EVALUATION FORMAT

SDSC SHAR seeks response to the following questionnaire for assimilating data which would be used for evaluating the capability of the bidder for executing the referred work. Hence, the bidder is requested to provide only genuine data and any discrepancy found at a later point of time may result in rejection of the bidder from purchase process. Furnishing of data cannot be construed as automatic qualification for participation in the tender. Questionnaire should be signed by a responsible and authorized person of the Company / Agency.

S. No	Description		Bidder Response		
	Name of the company	:			
	Type of the Company (Proprietary/Pvt. Ltd/Public Ltd/Joint Venture/Consortium)	:			
	If Company is Consortium please provide the signed copy Consortium Agreement document.	:			
	Registration number & certificate	:			
	Name & Address of the Office of the Chief Executive of the Company	:			
	Contact person for this tender with name & address and contact number	:			
	Locations of the Branches of Company (if any)	:			
	From which year the Company is in operation	:			
	Current Annual turn-over of the company	:			
	IT returns for the last 3 years	:			
	The Profit & Loss Account details for the last 3 years which is duly audited and Submitted as part of the Annual Report.	:			
	In Rs. Lakhs only		**FY 2021-22**	**FY 2022-23**	**FY 2023-24**
	Total assets (i)	:			
	Current assets (ii)	:			
	Total liabilities (iii)	:			

<table>
<tr><th>S. No</th><th>Description</th><th></th><th colspan="3">Bidder Response</th></tr>
<tr><td></td><td>Current liabilities (iv)</td><td>:</td><td></td><td></td><td></td></tr>
<tr><td></td><td>Net Worth (i-iii)</td><td>:</td><td></td><td></td><td></td></tr>
<tr><td></td><td>Working capital (ii-iv)</td><td>:</td><td></td><td></td><td></td></tr>
<tr><td></td><td>Turnover ` in lakhs</td><td>:</td><td></td><td></td><td></td></tr>
<tr><td></td><td>Profit/Loss in Rs. lakhs</td><td>:</td><td></td><td></td><td></td></tr>
<tr><td></td><td>The major lines of business:</td><td>:</td><td colspan="3"></td></tr>
<tr><td></td><td>Details of availability of machinery and Testing equipment</td><td>:</td><td colspan="3"><table><tr><td>Machine Type</td><td>Qty</td><td>No. of Persons familiar to work</td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr></table></td></tr>
<tr><td></td><td>Manpower details
(Technician, Supervisor, QA, Inspection)</td><td>:</td><td colspan="3"><table><tr><td>Description</td><td>No. of Persons</td><td>Remarks</td></tr><tr><td>Admin& Acct</td><td></td><td></td></tr><tr><td>Design & Analysis</td><td></td><td></td></tr><tr><td>Workmen (floor)</td><td></td><td></td></tr><tr><td>Supervisor</td><td></td><td></td></tr></table></td></tr>
<tr><td></td><td>The major customers for whom similar works are provided (Enclose copies of the Purchase Orders)</td><td>:</td><td colspan="3"></td></tr>
<tr><td></td><td>Any customers feedback on the services which is in writing (Pl. enclose copies)</td><td>:</td><td colspan="3"></td></tr>
<tr><td></td><td>Shop floor area& Handling system availability</td><td></td><td colspan="3"></td></tr>
</table>

Details of similar type of latest projects, having an Autoclave size of minimum 3.5m diameter and 5.0 m length (or) Pressure Vessel of minimum 4.5m diameter and 8.0 m length to Government or any reputed organization which were completed:

Sl. No	Full postal address of the client with Contact Person	Description of the work	Value of the work (Rs. in Lakhs)	Completion Time as per PO	Actual period of completion	Reasons for delay
1						
2						

Note: In order to consider as valid experience, all the experience has to be supported with the completion certificate and purchase order

Details of similar type of project for Government or any reputed organization executed by the bidder:

Sl. No	Full postal address of the client with Contact Person	Description of the work	Value of the work (Rs. in Lakhs)

Note: copy of purchase orders shall be enclosed.

Signature of Authorized Person with Seal

ANNEXURE -V

COMPLIANCE STATEMENT

S.No.	DESCRIPTION	BIDDER'S COMPLIANCE (YES/NO)
1	The detailed scope of work and technical specifications is understood and price was quoted accordingly.	
2	All the general conditions of the contract are acceptable.	
3	In case of some general conditions of the contract are not acceptable, deviation statement is to be enclosed	
4	Techno-commercial bid is enclosed with the following a. General Arrangement Drawing of Hot Air Autoclave Plant with all sub-systems with Civil structure interface critical dimensions and overall dimensions. Weight of vessel with mountings, Volume of the vessel and useful space in autoclave, overall specifications of all the auxiliary equipment. b. Transportation plan along with Loading and Un-loading scheme from fabrication & testing unit to erection site of the purchaser. c. Details with scheme for erection like Vessel unloading & positioning on pedestals at purchaser's site.	
5	Indicate the acceptable Payment Terms Clause No. (2.1.0 or 2.2.0). In case of deviation, it is brought-out in the deviation statement.	
6	Indicate the Case No. as per the Annexure-III: Pre-Qualification Criteria, under which the bidder is participating in the bidding process.	
7	Indicate the Prime Bidder and Collaboration details	
8	Indicate if the Electrical, Instrumentation & Control systems related activities are being sub-contracted	
9	Delivery schedule is acceptable. If not, the deviation is brought-out in the deviation statement.	
10	Liquidate damages clause is acceptable. If not, the deviation is brought-out in the deviation statement	
11	Warranty clause is acceptable. If not, the deviation is brought-out in the deviation statement	
12	Un-priced copy of Annexure-I: Schedule of Price, payment schedule is enclosed along with the techno-commercial bid.	
13	Annexure-I: Schedule of Price is duly price filled and attached in Price bid	
14	Duly filled, Signed & Stamped Annexure-II: Exceptions & Deviations format is attached along with the techno-commercial bid.	
15	Duly filled, Signed & Stamped Annexure-III: Pre-Qualification Criteria format is attached along with the techno-commercial bid.	
16	Duly filled, Signed & Stamped Annexure-IV: Bidder Evaluation format is attached along with the techno-commercial bid.	

Signature of Vendor with Seal

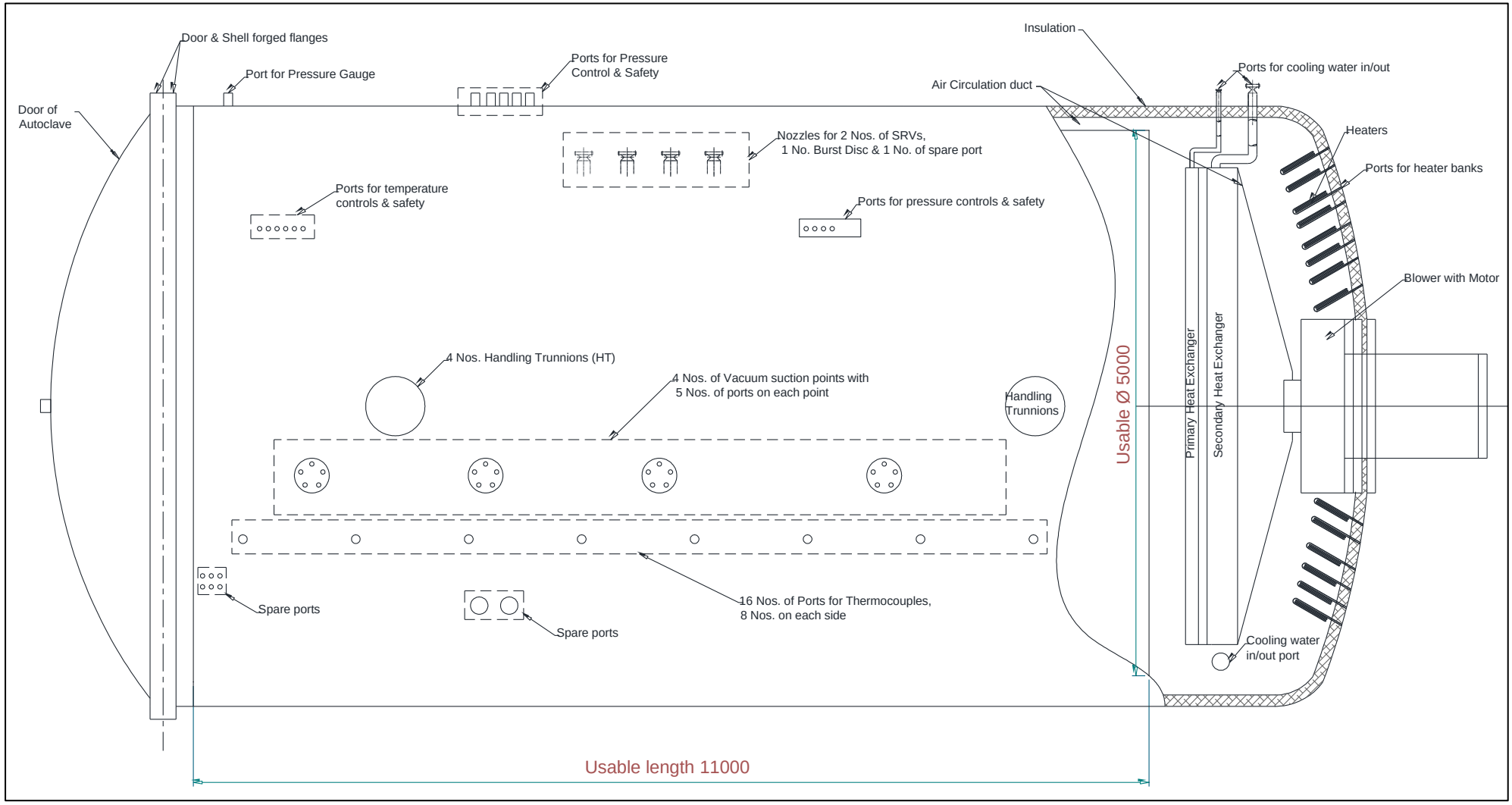
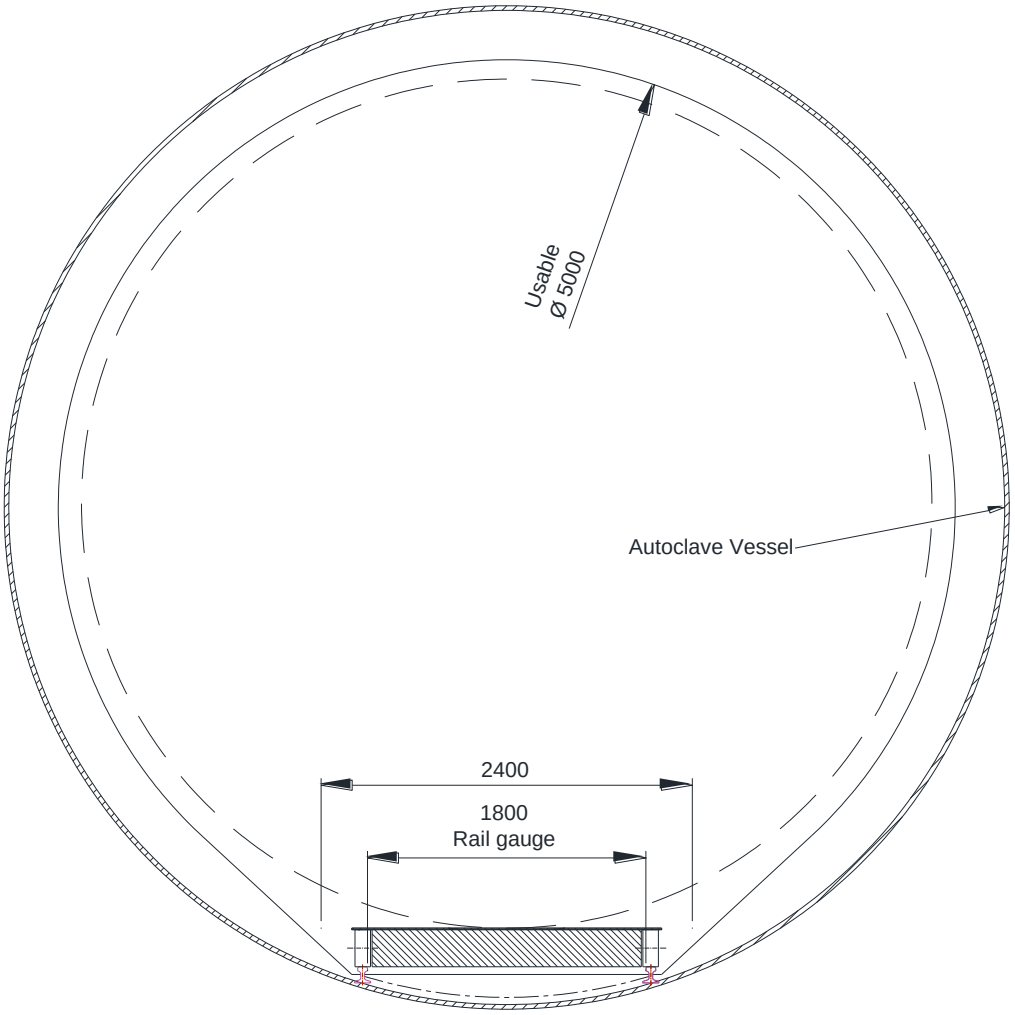


Figure 1 General Arrangement Drawing of Autoclave Vessel



SCHEMATIC DETAILS OF AUTOCLVE VESSEL

Figure 2 Schematic view of Autoclave internal arrangement and user requirement

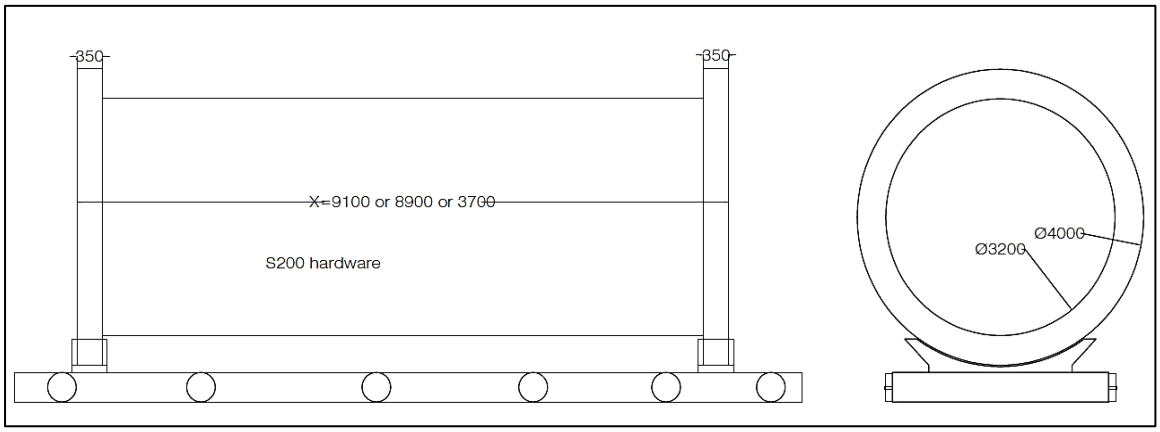


Figure 3 Loading scheme for any Job

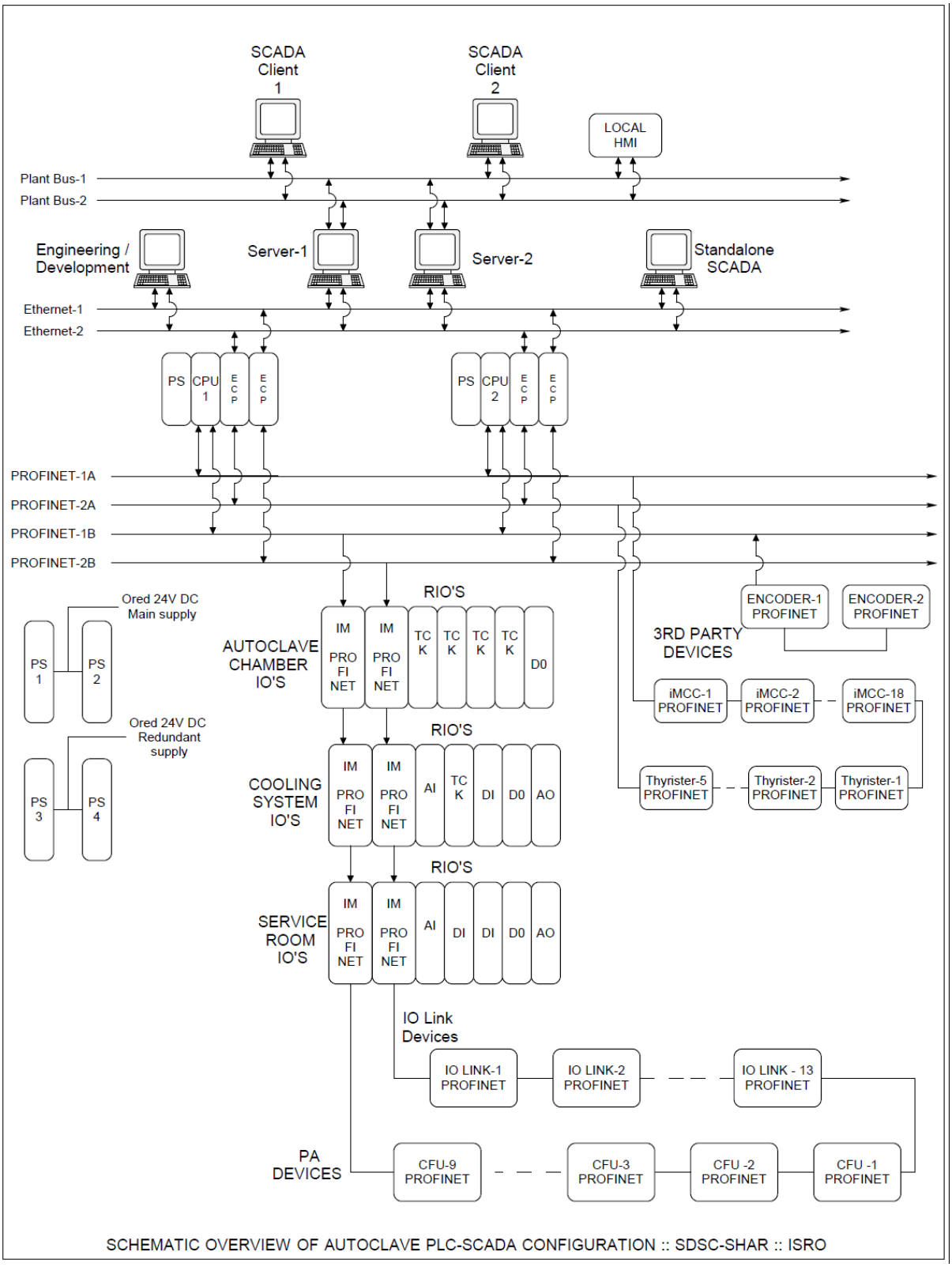
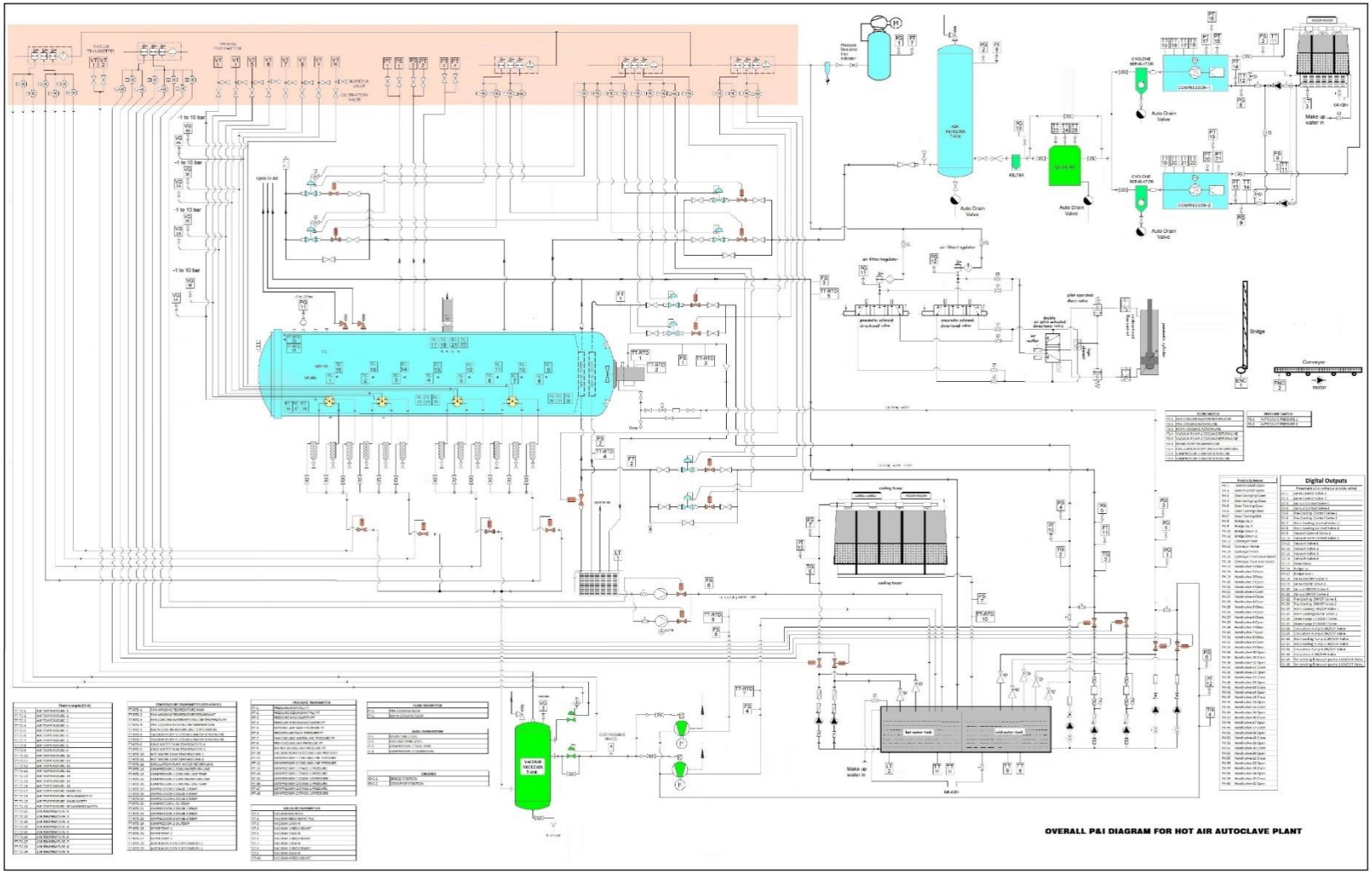
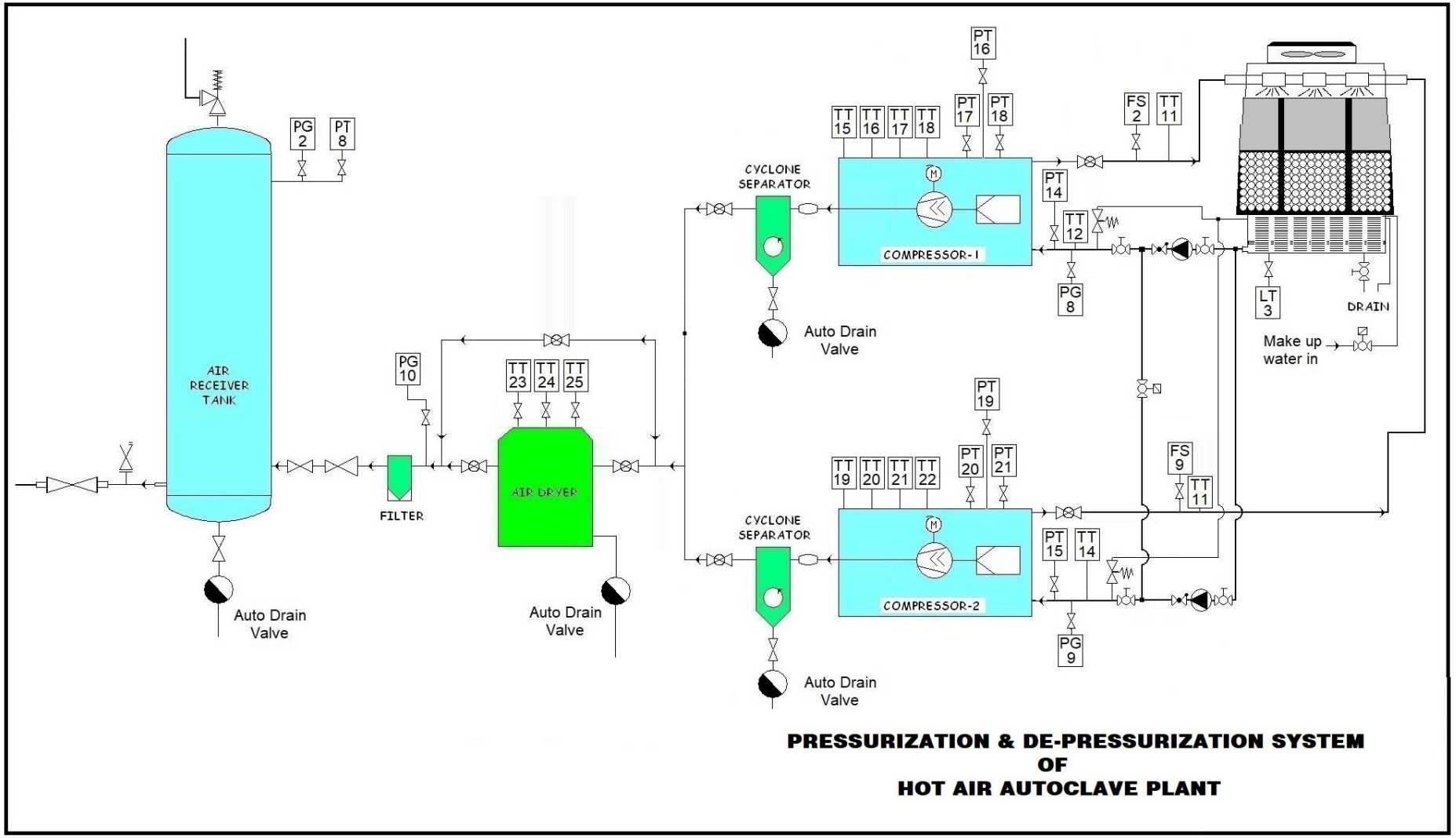
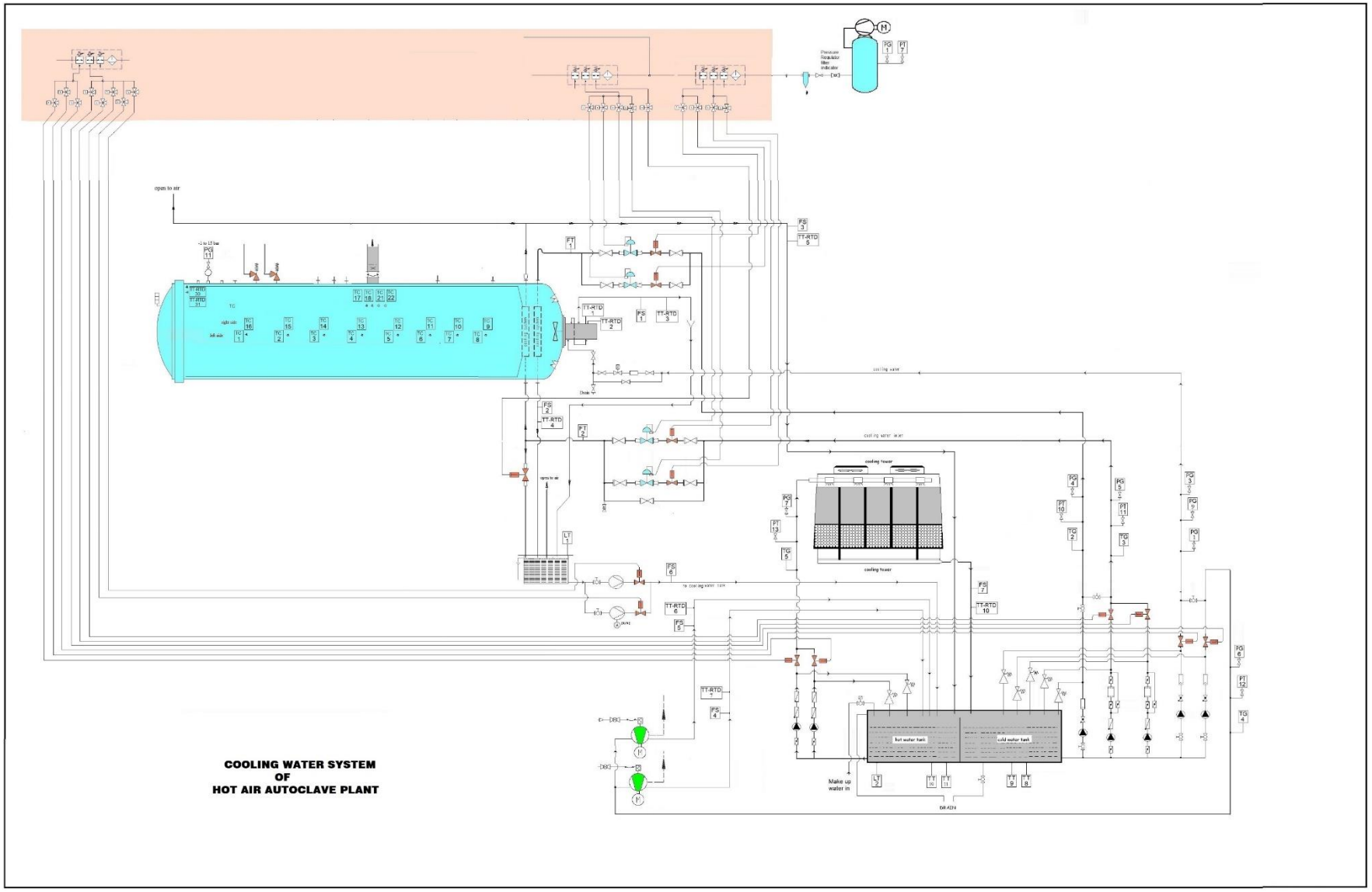


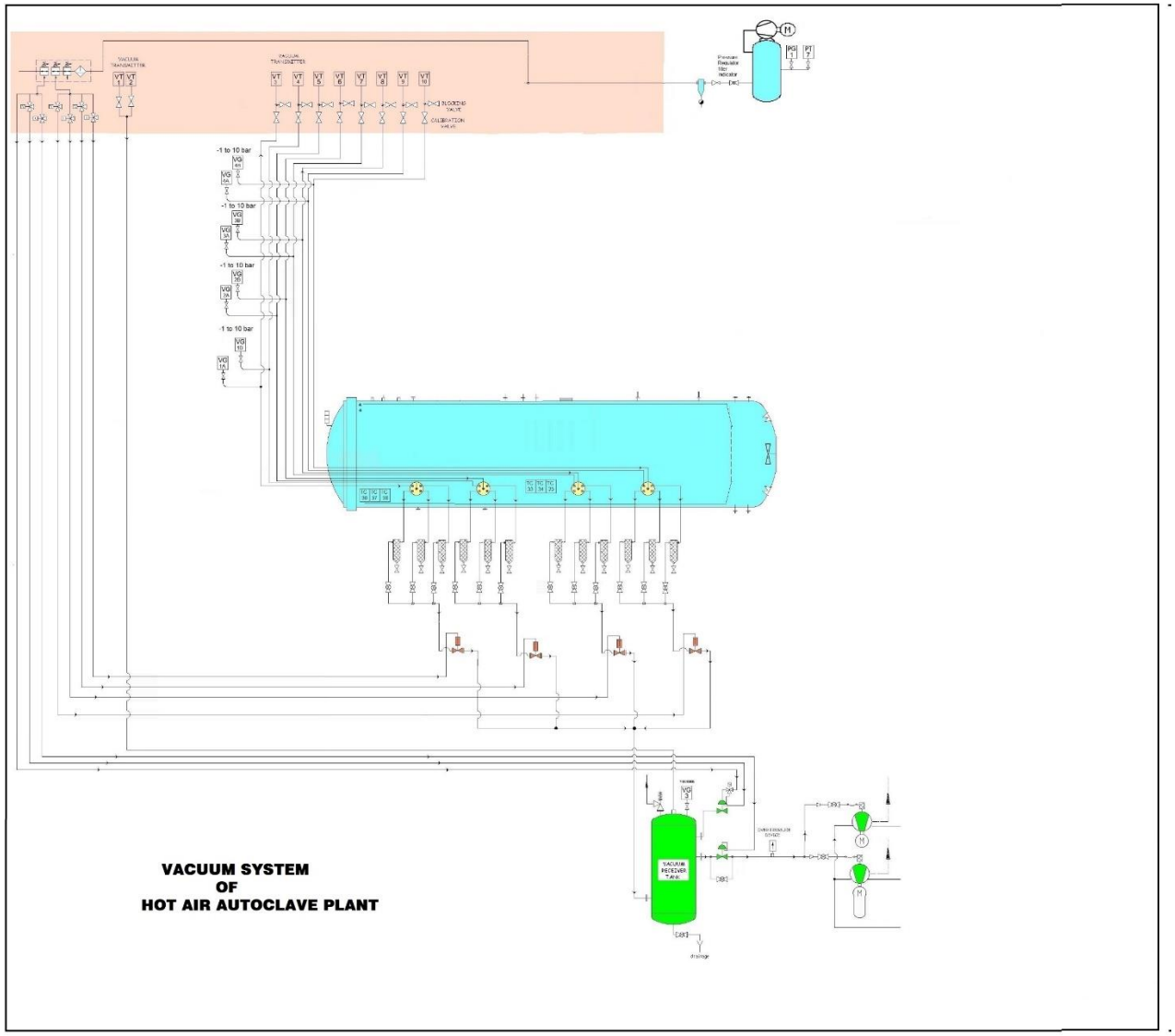
Figure 4Instrumentation & Control system conceptual architectural configuration

ANNEXURE-VII
P&I DIAGRAM FOR HOR AIR AUTOCLAVE PLANT

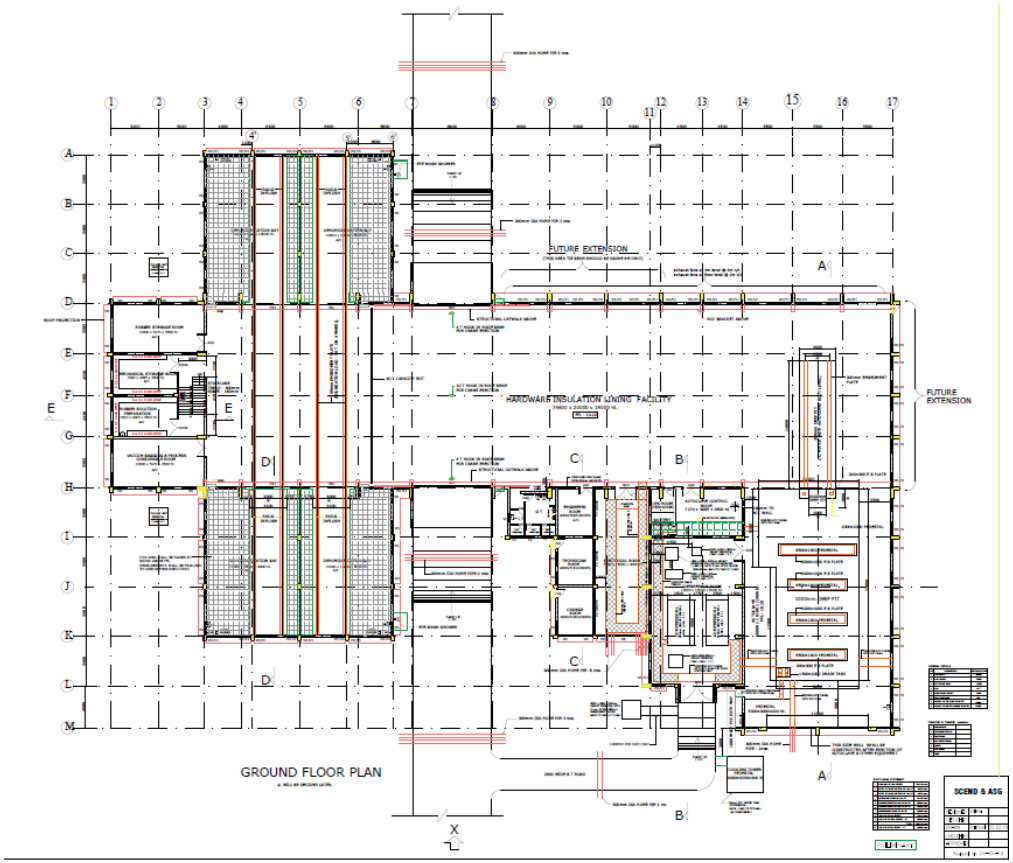



AIR RECEIVER TANK
PG 2
PT 8
Auto Drain Valve
FILTER
PG 10
AIR DRYER
TT 23
TT 24
TT 25
Auto Drain Valve
CYCLONE SEPARATOR
PT 16
TT 15
TT 16
TT 17
TT 18
PT 17
PT 18
COMPRESSOR-1
Auto Drain Valve
FS 2
TT 11
PT 14
TT 12
PG 8
LT 3
DRAIN
Make up water in
CYCLONE SEPARATOR
PT 19
TT 19
TT 20
TT 21
TT 22
PT 20
PT 21
COMPRESSOR-2
Auto Drain Valve
FS 9
TT 11
PT 15
TT 14
PG 9
PRESSURIZATION & DE-PRESSURIZATION SYSTEM
OF
HOT AIR AUTOCLAVE PLANT


COOLING WATER SYSTEM
OF
HOT AIR AUTOCLAVE PLANT
cooling tower
hot water tank
cold water tank
Make up water in


-1 to 10 bar
-1 to 10 bar
-1 to 10 bar
-1 to 10 bar
VACUUM SYSTEM
OF
HOT AIR AUTOCLAVE PLANT

ANNEXURE VIII



Overall Building Layout for erection of Hot Air Autoclave Plant