

INSTITUTE FOR PLASMA RESEARCH
NEAR INDIRA BRIDGE, BHAT, GANDHINAGAR 382 428
GUJARAT STATE

Phone: 079 23962021, 23962023 Fax: 079 23962277

TENDER NOTICE DATED 18-8-2010

Itemwise sealed tenders are invited in from reputed and eligible parties for the following.

Sr. No	Tender Notice No.	Item	Qty.	Due Date & Time for		Tender Fee	EMD (Rs.)
				Submission of tender	Opening of tender		
1.	IPR/TN/PUR/016/10-11	Programmable Automation Controller (PAC)/ Programmable Logic Controller (PLC) with Engineering & Operator Station	1 No.	29-9-2010 by 1.00 p.m.	29-9-2010 2.30 p.m.	500.00	35000.00
2.	IPR/TN/PUR/017/10-11 (TWO PART TENDER)	Design, fabrication, installation and commissioning of 80K Helium Gas Supply System	1 No.	30-9-2010 by 1.00 p.m.	30-9-2010 2.30 p.m.	1000.00	200000.00

Tender documents are available on IPR Website : www.ipr.res.in/purchasetenders.html. Tenderers meeting the eligibility criteria mentioned in the tender documents may, at their option, download the tender documents from the website and submit their offer along with prescribed **Tender Fee (non refundable) and EMD** in the form of Demand Draft from any nationalized/scheduled bank drawn in favour of **Institute for Plasma Research** and payable at **Ahmedabad** as per the details given in the tender documents. In case party desires to collect the tender documents by post, they may contact the Purchase Officer along with prescribed tender fee. Tender documents will be issued upto **17-9-2010**. Representative who is going to attend the tender opening should carry an authorization letter from the organization for participation in the tender opening failing which he will not be allowed to attend the tender opening.

TENDER NOTICE No.IPR/TN/PUR/016/10-11 DATED 18-08-2010

For Programmable Automation Controller (PAC)/ Programmable Logic Controller (PLC) with Engineering & Operator Station (System design, supply, installation, testing & commissioning of PC based Automation System) and Software License for 2000 I/O's – 1 Unit

NOTE:

1. Full details and specifications of the items and general instructions to be followed regarding submission of tenders are indicated in the tender documents.
2. **Proof for fulfillment of eligibility criteria mentioned hereunder should be submitted along with the tender. If the tender is submitted without valid documents, we shall not consider your offer. Tenders received without proof of eligibility criteria will be rejected.**
3. Tender documents can also be obtained by submitting a written request to the Purchase Officer together with prescribed tender fee, provided that the eligibility criteria is fulfilled. Last date for issue of Tender documents is 17-9-2010.
4. While requesting for Tender Documents, such request shall indicate the **“REQUEST FOR TENDER DOCUMENTS AGAINST TENDER NOTICE NO.IPR/TN/PUR/016/10-11 DATED 18-08-2010”**.
5. The tender fee of Rs.500/- (non refundable) should be made in the form of **DEMAND DRAFT from any nationalized/scheduled bank drawn in favour of Institute for Plasma Research and payable at Ahmedabad.** Vendor's name and tender number shall be indicated on the reverse side of the Demand Draft.
6. **DD should not be prior dated to the date of advertisement. Separate request letter and separate Demand Draft shall be sent for each tender.**
7. Those who use the downloaded tender documents from IPR Website may submit the prescribed Tender Fee keeping in a separate envelope along with the tender.
8. **Tenders received without the prescribed tender fee will be rejected.**
9. No request for the extension of due date will be considered.
10. Late/Delayed offers will not be accepted.
11. Tenders in a sealed envelope superscribing the envelope with the above tender no., date, due date and brief description of tendered item along with EMD for Rs.35,000/- by way of Demand Draft from a nationalized/scheduled bank drawn in favour of **Institute for Plasma Research** and payable at **Ahmedabad** should be submitted to the **Purchase Officer** at the above address by 1.00 p.m. on **29th September, 2010.** Tenders received upto 1.00 p.m. on 29-9-2010 will be opened on the same day at **2.30 p.m.** in the presence of attending tenderers.

12. In the event of any date indicated above is a declared Holiday, the next working day shall become operative for the respective purpose mentioned herein.
13. IPR will not be responsible for any delay/loss of documents in transit.
14. Tenders received without the details asked for including proof of eligibility for participating in the tender may not be considered.
15. Tenderers should furnish/enclose full technical details/literature, delivery period and confirm the terms and conditions attached with the tender.
16. **Those who do not meet with the eligibility criteria need not submit Tender.**
17. **Those who are quoting on behalf of their foreign Principals should submit a Proforma Invoice of Foreign Principals in foreign currency.**
18. The Director, IPR reserves the right to accept or reject any offer in full or part thereof without assigning any reason thereof.
19. **Quotations received without EMD will not be considered.**
20. **AUTHORITY LETTER**
 - a. **The representative who is going to attend the tender opening should carry an authorization letter from the organization for participation in the tender opening failing which he will not be allowed to participate in the tender opening.**
 - b. **The tenderers representative, who reaches the venue of the tender opening late, i.e. after the starting time specified for opening of the tenders, may not be allowed to take part in the tender opening. It should be noted that only one representative of each tenderer will be permitted to participate in the tender opening.**

ELIGIBILITY CRITERIA: The vendor (i) should be a manufacturer or authorized dealer/distributor of PAC/PLC (in case of authorized dealer/distributor, attach valid Dealership/Distributorship certificate) and (ii) should have executed similar nature of system for any government organization, R&D institute or to reputed organizations (attach copy of purchase orders).

NOTE: Issue of tender documents does not mean that a vendor is qualified to submit tenders. IPR's decision to consider as to whether a vendor has met with the eligibility criteria is final.

INSTRUCTIONS TO BIDDERS AND TERMS AND CONDITIONS

1. The quotation and any order resulting from this tender/enquiry shall be governed by our Conditions of contract and supplier quoting this tender shall be deemed to have read and understood the same in toto.
2. Where counter terms and conditions have been offered by the supplier, the same shall not be deemed to have been accepted by us, unless our specific written acceptance thereof is obtained.
3. **Tender Fee: Tenders received without the prescribed Tender Fee will be rejected.**
4. **Clarifications:**
Any technical and commercial questions, information, clarifications, etc. that may be required pertaining to this Tender/enquiry may be obtained from the Purchaser before submitting the tender.
 - 4.1 Bids shall be complete in all respects and shall include properly filled in prices, other specifications, schedules, relevant drawings and catalogues as necessary alongwith the bid covering letter, all in duplicate.
5. **Quotation:** Your quotation superscribing our tender/enquiry No., date, due date and short description of item should be submitted to the Purchase Officer, IPR in a sealed envelope on or before the due date. Late and delayed quotations will not be considered. IPR will not be responsible for postal delays or any other delays in receipt of quotation. Envelopes received without Tender number, date, due date and short description of item may be rejected. The quoted prices should be firm for a period of 120 days from due date for placing order. IPR is not bound to accept lowest rate/s. IPR reserves the right to place order on one or more parties irrespective of whether he is lowest or not. The scope of supply includes insurance by the Contractor/Supplier.
6. **Specifications:** Material should be offered strictly conforming to our specifications/drawings. Deviation, if any, should be clearly indicated by the supplier in their quotation. The supplier should also indicate the Make/Type number of the materials offered and catalogues, technical literature and samples, wherever necessary should accompany the quotation.
7. **Terms of prices:** Quotation should be submitted on door delivery basis without extra charge wherever possible. For quotations on Ex-Works, Ex-godown basis the approximate packing and forwarding charges should be indicated by the supplier. In the case of local suppliers, the material is to be delivered at our stores free of charge. Unit rate/s should be valid throughout the validity of purchase order/contract period for addition/deletion purposes. Break-up of price should be furnished. The quoted price should not be subject to price escalation for whatsoever reasons. The quoted price shall be firm, fixed and non-revisable during the validity/extended validity of purchase order/contract.
 - 7.1 Prices are required to be quoted according to the units indicated in the tender form. When quotations are given in terms of units other than those specified in the tender form, relationship between the two sets of units must be furnished.
 - 7.2 Wherever options are specified in the tender documents, IPR reserves the right to accept any option/s irrespective of whether all the vendors have quoted for all the options or not. The decision of IPR in this regard will be final.

8. Tender should be free from Correction and Erasures. Corrections, if any, must be attested. All amounts shall be indicated both in words as well as in figures. Where there is difference between amounts quoted in words and figures, amount quoted in words shall prevail.
9. IPR shall be under no obligation to accept the lowest or any tender and reserves the right of acceptance of the whole or any part of the tender or portion of the quantity offered and the tenderers shall supply the same at the rates quoted.
10. **Sales Tax etc.:** We have no "C" or "D" form. The percentage of Sales Tax/VAT, surcharge, if applicable, and other levies legally leviable and intended to be claimed should be clearly indicated in the tender. Where this is not done, no claim on these accounts would be admissible later.
- 10.1 **VAT Registration:** You may submit a copy of VAT Registration certificate along with your quotation (if applicable).
- 10.2. **Service Tax:** Wherever Service tax is applicable, it should be mentioned clearly. You may indicate percentage of Service Tax in your quotation.
- 10.3 **Excise Duty:** As per Notification No.10/97-CE (Central Excise) dated 1-3-1997, the Purchaser is entitled for availing Excise Duty exemption at present. Excise Duty Exemption Certificate, wherever applicable, and as per rules will be issued at the appropriate time. Hence Excise Duty should not be included in the BID. However, prevailing percentage of Excise Duty may be indicated.
- 10.4 **Customs Duty:** The purchaser is entitled for Customs Duty exemption under Notification No.51/96-Custom dated 23-7-1996 and can place order directly on foreign manufacturers. Necessary Customs Duty Exemption Certificate, wherever applicable, and as per the rules will be issued at appropriate time. Hence, Customs Duty should not be included in the BID. However, prevailing percentage of Customs Duty may be indicated.

Wherever, against a requirement, both indigenous as well as imported offers are received, the offers for imported stores will be evaluated on the basis of the total landed cost after loading the custom duty and other levies as may be applicable from time to time for taking purchase decision.

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

- a) Photocopy of the Agency Agreement between the Principals and the Indian Agent showing the percentage or the quantum of agency commission payable and a Letter of Authority from the Principals authorizing the Indian Agents to submit the tender on their behalf.
- b) The type and nature of after sales services to be rendered by the Indian Agent

The Indian Agents are allowed to quote on behalf of only one foreign Principal/ Supplier against this tender.

- 10.5 TDS/WCT will be deducted as per Income tax Rules.
- 10.6 **Octroi:** Octroi is not applicable in our case.

11. **Delivery Date:** The supplier must indicate the firm delivery date by which the materials will be despatched/delivered by them from the date of our order.
12. **Inspection:** Materials on its arrival at IPR will be inspected by Stores In-charge, and his decision in the matter will be final.
13. **EARNEST MONEY DEPOSIT (EMD):**
The Bidder shall submit interest free Earnest Money Deposit (EMD) for Rs.35,000/- (Rupees Thirty five thousand only) by way of Demand Draft from a nationalized/scheduled bank issued in favour of "**Institute for Plasma Research**" and payable at **Ahmedabad**. **Tender received without EMD will be rejected at the discretion of IPR.**
- 13.1 **EMD of unsuccessful Bidder will be returned after finalizing the Contract/placing Purchase order.**
- 13.2 **The EMD shall be forfeited in case the selected Bidder does not start the work within the time limit specified or fail to complete the work within the stipulated delivery period or fail to comply with any of the terms and conditions in the purchase order/contract.**
- 13.3 **Exemption from payment of EMD:** Firms who are registered with DGS&D and NSIC are exempted from payment of EMD subject to submission of valid registration certificate with the bid. **Tenders received without the valid registration certificate will be rejected.**
14. **Payment:** 80% of the invoice value against delivery and balance 20% within 30 days from the date of acceptance and on receipt of invoice.
- 14.1 Wherever, advance payment is involved, it will be paid only against submission of Bank Guarantee from a Nationalised Bank. Bank Guarantees should be furnished as per IPR format.
15. No correspondence will be entertained within 30 days from the date of receipt of material and bills, whichever is later.
16. Quotation should be valid at least for 120 days from the date of opening of the tender.
17. Delivery periods be clearly indicated against each item separately.
18. **Guarantee:** The Stores/material/goods/equipment offered by the bidder should be guaranteed for a minimum period of twelve months from the date of acceptance, against defective materials, design, workmanship, operation or manufacture. For defects noticed during the Guarantee period, replacement/ rectification should be arranged free of cost within a reasonable period of such notification. In cases where our specifications call for a guarantee period more than 12 months specifically, then such a period shall apply.
19. **Security Deposit:** The successful Bidder will have to furnish to the Purchaser an interest free security deposit for 10% (Ten percent) of the order value in the form of Bank Guarantee of an equivalent amount from a nationalised/scheduled Bank within 15 days from the date of LOI/Purchase order and the said Guarantee should be valid till the goods are accepted by IPR. The Security deposit shall be forfeited in case the selected Bidder does not start the work within the time limit specified or fail to complete the work within the stipulated delivery period or fail to comply with any of the terms and conditions in the purchase order/contract.

20. **Liquidated Damages:** In addition to forfeiting Security Deposit, Liquidated Damages for the delay shall be 1/2% (half percent) of the total order value for the delay of each week in the scheduled time of supply or the scheduled date of final completion for the work as the case may be, subject to a maximum of 5% (five percent) of total order value. Liquidated Damages will be recovered from the payment due to the supplier.
21. **Performance Bank Guarantee:** The Contractor/Supplier will have to furnish to the Purchaser (IPR) an interest free performance bank guarantee for 10% (Ten percent) of the order value/ contract value by Demand Draft or by way of providing a Bank Guarantee from a Nationalised/Scheduled Bank valid for a period of 12 months/guarantee period mentioned in the order from the date of installation/acceptance for satisfactory performance of the work carried out by the Contractor.
22. The Contractor/Supplier shall at all times indemnify the purchaser against all claims which may be made in respect of the stores/material/goods/equipment for infringement of any right protected by Patent Registration of design or Trade Mark and shall take all risk of accidents or damage, which may cause failure of supply from whatever cause arising and the entire responsibility for sufficiency of all means used by him for the fulfillment of the contract.
23. **BAR/PERT Charts:**
To be provided as per the requirement of Purchaser.
24. **Sub-Contract:** All sub-contractors are required to be appraised and approved by the Purchaser before placement of orders by the Vendor.
25. **Jurisdiction:** The contract/Purchase order shall be governed by the Laws of India for the time being in force. The Courts of Ahmedabad only shall have jurisdiction to deal with and decide any legal or dispute arising out of this contract.
26. **Settlement of disputes:** Any disputes or difference arising out of or in connection with the Contract/Purchase order shall be to the extent possible settled amicably between the parties.

If amicable settlement cannot be reached then all disputed issues shall be settled by arbitration.
27. **Arbitration:** In the event of any dispute or difference arising under this Contract, the matter shall be referred to the Arbitrators one each nominated by the Purchaser and Contractor from their respective organisations. In case the said Arbitrators are not able to settle the dispute by themselves, the matter shall be referred to the Arbitrator mutually nominated by the Purchaser and the Contractor and whose decision will be final and binding on both the parties. The venue of arbitration will be IPR. Subject to as aforesaid the Arbitration Act, 1996 and the rules thereunder and any statutory modification thereof for the time being in force shall be deemed to apply to the Arbitration proceedings under this Contract.
28. **Permits and Licences:** The Contractor shall secure and pay for all permits and licence which he may require to comply with in respect of all laws, ordinances and regulations of the Government or Public Authorities in connection with the performance of his obligations under the Contract. The successful contractor shall be responsible for all damages and shall indemnify and save the Purchaser harmless from and against all claims for damages and liability which may arise due to his failure to comply with what is stated above.

29. **Training:** The successful tenderer shall, if required by the Purchaser, provide facilities for the practical training of Purchaser's engineering or technical personnel for their active association on the manufacturing process throughout the manufacturing period of the Contract/stores, number of such personnel to be mutually agreed upon.
30. **Operation/Instruction Manual:** Where operation/instruction manual is essential to enable the Purchaser to put the stores to proper use, the successful tenderer shall furnish such operation/instruction manual along with the stores.
31. **Test Certificate:** Wherever required, test certificates should be sent along with the despatch documents.
32. **Secrecy:**
- 32.1 All information, drawings, designs and specifications imparted to the bidder/successful contractor shall, at all times, remain the absolute property of the Purchaser, the bidder/successful contractor shall not use them for purposes other than for which they are provided for and shall treat all these documents as confidential. These shall not be reproduced in whole or in part for any other purpose.
- 32.2 The contractor shall use his best endeavours to ensure that such information are not divulged to third parties except where needed for the performance of the contract by the successful bidder with the prior consent of the Purchaser. In such cases, the successful contractor shall ensure and obtain similar obligation of confidence, from third parties in question.
33. **Indemnity:** The Contractor shall warrant and be deemed to have warranted that all stores supplied against this contract are free and clean of infringement of any Patent, copy right or trade mark and shall at all times indemnify the Purchaser against all claims which may be made in respect of the stores for infringement of any right protected by patent. Registration of design or Trade Mark and shall all risk of accidents of damage which may cause a failure of the supply from whatever cause arising and the entire responsibility for the sufficiency of all the means used by him for the fulfilment of the contract.
34. **Counter terms and conditions of Suppliers:** Where counter terms and conditions printed or cyclostyled conditions have been offered by the supplier, the same shall not be deemed to have been accepted by the Purchaser unless specific written acceptance thereof is obtained.
35. **Installation/commissioning/site works:** Wherever these activities are part of scope of work/specifications, Vendor should carryout out the same without any extra cost to IPR.
36. **Free Issue Material (FIM) (If specified in the tender documents):** Successful tenderer will have to furnish in the form a Bank Guarantee or in any other form as called for by the Purchaser towards adequate security for the materials/property provided/issued by the Purchaser as Free Issue Material (FIM) for the due execution of the contract. Successful bidder shall submit Bank Guarantee from a nationalized bank and arrange insurance for the cost of FIM at his expenses.
37. Late/delayed tenders will not be accepted. Incomplete tenders may be rejected at the discretion of IPR.

38. **IPR is not bound to accept the lowest tender. IPR reserves the right to select any vendor at its sole discretion.**
39. **Result of the tenders:** Unsuccessful tenderers will not be informed of the result of their tenders.
40. The Director, IPR reserves the right to accept or reject any quotation/tenders fully or partly without assigning any reason.
41. IPR reserves the right to place order on a single party or to split the order at its sole discretion.

We agree to the above terms and conditions.

Place:

Signature of Bidder with seal

Date:

Note: A copy of our terms and conditions duly signed should accompany your quotation.

1.0 Specifications for Programmable Automation Controller (PAC) / Programmable Logic Controller (PLC).

The PAC/PLC shall have the following **Modules**:

- a) Process Supervisor (Processor) – Redundant.
- b) 110 numbers of Analog input Channels (Differential) module(s) with TC input Terminal unit.
- c) 200 numbers of Analog input Channels (Differential) module(s) with mV input Terminal unit.
- d) 30 numbers of Analog input Channels (Differential) module(s) with mA input Terminal unit.
- e) 20 numbers of Analog output Channels module(s) with mA (current) output Terminal unit.
- f) 10 numbers of Analog output Channels module(s) with VDC output Terminal unit.
- g) 30 numbers of digital input Channels module(s) of Contact type with terminal unit.
- h) 30 numbers of digital output Channels module(s) with Terminal unit.

1.1 System Configuration Requirement:

- a) Engineering Cum Operator Station
- b) Pentium-4 Core 2 Quad 3.33 GHz/4 GB RAM/500GB HDD/DVD-RW/ 20" TFT/ Optical Mouse/ Qwerty Membrane Type Keyboard/ WIN XP workstation.
- c) **Associated Full fledges Development tools** (All the original copies of software development tools have to be provided along with the system).
- d) Other Accessories: Control panel to house I/O sub units, processor and networking cards (standalone).

2.0 Detailed specifications for Processor.

2.1 Base unit:

The Base Unit should support the I/O Controller Modules. These modules plug onto Terminal Units, which provide the wiring interface between the plant or machine and the I/O modules. It should provide intercommunication between the I/O modules and the processor with the use of a passive internal module I/O bus running the full width of the base. Each module position is tracked separately for additional security during live replacement of I/O modules.

2.2 Physical Parameters of Processor:

Bus size	32 bit
System clock	66 MHz
Removable Flash card size	32M bytes
Maximum database size	210 KB or better
Sequence memory Programme data	105 KB or better

2.3 Communications:

Ethernet: It should support Ethernet LIN (ELIN) protocol that provides secure peer-to-peer communications between bases and to other Ethernet devices over 10/100 Ethernet from each processor.

Serial (RS422/485): Simultaneously it should support Modbus-TCP Master or Slave to other Modbus- TCP devices. Modbus-serial Master or Slave communications are optionally supported.

Third party devices such as PLCs supporting Modbus can be readily integrated into the ELIN based architecture by direct connection to T2550 control units. The Modbus communications allows a T2550 to be used as a gateway providing access to database elements in any ELIN node.

3.0 Detailed specifications of I/O modules.

Maximum update speed or scan rate of all the I/O cards (AI, AO, DI and DO): 100mS

3.1 Analog input module:

- i. No of channels 4, 8, 16 ...
- ii. Input types TC, mV, mA.
- iii. mV range -150mV to +150mV at input impedance >100M Ω
- iv. mA range -22mA to +22mA with 5 Ω burden in the Terminal Unit
- v. Resolution Better than 0.001% of range
- vi. Initial input accuracy Electrical Input Factory Calibrated to better than 0.1% of reading
- vii. System Isolation Reinforced, 260V ac or better
- viii. Channel isolation Functional, 260V ac or better separating Ch1 and Ch2 from Ch3 and Ch4
- ix. Series Mode Rejection. 60dB (50Hz to 60Hz, 1mA r.m.s)
- x. Common Mode Rejection 120dB (50Hz to 5kHz, 50V r.m.s)
- xi. Current consumption 100mA max

TC Input specification

- xii. Linearization types J, K, L, R, B, N, T, S, C, PL2, linear, Sq Root, plus custom
- xiii. CJC System Measured by RTD fitted on Terminal Unit
- xiv. CJC Accuracy $\pm 0.5^{\circ}\text{C}$, over -10°C to $+70^{\circ}\text{C}$
- xv. CJC Rejection Better than 30:1
- xvi. Initial accuracy $\pm 1^{\circ}\text{C}$ or $\pm 0.2\%$ of reading whichever is greater (standard thermocouples)

3.2 Analog output module:

Each output should independently be configured for current or voltage mode. The module should be optionally fitted with disconnects to allow isolation of an individual output to allow work on the individual loop to continue safely.

- i. No of channels 2, 4, 8...
- ii. Current output -0.1 to 20.5mA; 10V dc max compliance with total burden less than 500 Ω
- iii. Voltage output 0 to 10V dc; 20mA max compliance with total load greater than 500 ohms
-0.5 to 10.5 V dc; 20mA max compliance with total load greater than 1500 Ω

iv.	Channel isolation	Functional, 260V ac or better
v.	Current consumption	120mA max
vi.	Resolution	Better than 1 part in 10,000 (15 bit typical)
vii.	System isolation	Reinforced, 260V ac or better

3.3 Digital input module:

This digital input module(s) should accept logic inputs.

i.	No of channels	8, 16...
ii.	Input functions	On/Off. pulse and de-bounce inputs with input invert
iii.	System isolation	Reinforced, 260V ac or better
iv.	Channel isolation	50V ac functional isolation between 4 pairs of channels
v.	Current consumption	100mA max
vi.	Contact closure	
	ON state:	Input resistance threshold 100 Ω (<1k Ω typical)
	OFF state:	Input resistance threshold 10k Ω (>7k Ω typical)
vii.	Wetting current	4mA typical
viii.	Wetting voltage	>9V, 12V typical, measured open-circuit
ix.	'Logic' Variant	
x.	Logic inputs	
	ON state:	Input Voltage threshold 10.8V dc, 30V max
	OFF state:	Input Voltage threshold 5.0V dc non-overlapping
xi.	Input impedance	5k Ω approx (>2mA drive required for 'ON')

3.4 Digital output module:

The digital output module should provide logic outputs, which are typically used for control, alarms or events outputs.

Each channel a 24V output with 0.75A capability (subject of a maximum of 4A total per module) which can be used for driving solenoids, relays, lamps, fans, thyristor units, single phase Solid State Relays (SSRs) or some three phase SSRs.

i.	No of channels	8, 16...
ii.	Voltage supply (external)	supply 18 to 30V dc to plant devices Vs
iii.	Leakage current off state	<0.1mA
iv.	Channel maximum	0.75A/channel
v.	Module maximum	4A total (500mA/channel, all channels ON)

- vi. Output voltage >Voltage supply (Vs) less 3V
- vii. System isolation Reinforced, 260V ac or better
- viii. Channel isolation Channels share a common connection
- ix. Current consumption 500mW max.

IPR will provide:

- **Loop control strategy (Sequences, Interlocks and alarms) document will be provided by IPR. This document also contains P & ID for developing the SCADA screens.**
- **The number of interlocks in the application will be 30 (tentative). This total number of interlocks will be finalized at the time of software development.**

4.0 Application Software development (software deliverables).

Vendor will provide final deliver as per following scope.

- 4.1 Vendor should develop the application program (PLC Programming & SCADA) and HMI for the System according to the operating sequences, this is provided by the IPR.
- 4.2 Application software for monitoring, controlling and analysis.
- 4.3 User manual for complete application.
- 4.4 Software design document for complete application.
- 4.5 Source codes for complete application.
- 4.6 Executable Set-up of the software with source code on CD / DVD.
- 4.6 Demonstration and training of software application at IPR or at vendor location.
- 4.7 Supply, Installation & Testing of the whole system (Hardware and software) at IPR is also the part of the work.

5.0 Test procedure and Acceptance criteria:

- 5.1 Vendor should have experience in developing application program for reputed process industries or for any other R & D Institutes like BARC, ISRO, IPR, etc.
- 5.2 All the I/O cards and Base units will be tested at vendor site with a test program. IPR Representatives and/or IPR authorized experts should be present at the time of the test.

The complete system will be accepted only after all the cards respond in pre-defined manner.

5.3 Pre – dispatch clearance will be given from IPR based on the acceptance of those test Results.

5.4 Similar tests will be carried out at IPR after installation and commissioning of the system. Final acceptance of the system will be given after successful completion of all those tasks.

5.5 The test consists of execution of the developed application software according to the **loop control strategy** document (Sequences, Interlocks and alarms). Final testing of the software will be carried out by vendor at IPR on hardware setup at the time of installation. The software should support all the features and requirement mentioned in **loop control strategy** document (Sequences, Interlocks and alarms).

Note: Accessories required for the system will be supplied by the vendor.

6.0 Training:

Training should be given to at least two persons for developing control programs, developing SCADA Screens and trouble shooting.

7.0 Warranty/Guarantee:

7.1 The Vendor has to provide a free support and maintenance for a period of one year.

7.2 Vendor should also support minor up-gradation in the software if required for any reported bug or feature enhancement.

LOOP CONTROL STRATEGY: DEVELOPMENT OF INTERLOCKS AND ALARMS

The complete operation of the MERCURY-TBM loop consists of 5 sequences of operations

Sequence 1:

- ❖ Loading the mercury into the loop from dump tank using gas (nitrogen) pressurizing system.

Sequence 2:

- ❖ Circulation of the water in the Heat exchanger & also in the Electromagnet by using pump (with required flow rate, pressure & temperature).

Sequence 3:

- ❖ Circulation of the mercury in the loop by using mechanical pump.

Sequence 4:

- ❖ Switch ON the power to the heaters, which are embedded in the TBM walls and also switch ON the power to the Electromagnet.

Sequence 5:

- ❖ Switch OFF the power to the heaters, which are embedded in the TBM walls and breeders and also switch OFF the power to the Electromagnet. Dumping the mercury into the dump tank (after successful completion of the experiment).

Sequence 6:

- ❖ Emergency stop due to any accidents in Experimental area (like mercury leakage or over limit of mercury vapour in the Experimental area).

SEQUENCE 1: Loading the mercury into the loop from dump tank using gas (Nitrogen) pressurizing system.

The **OFF** state of any valve indicates that the valve is closed and there is no flow of fluid through the valve. **ON** state indicates that, valve is open and the fluid can pass through the valve.

All valves are normally closed.

STEP 1:

- First open all the manual valves on the loop MV1, MV2, MV3, MV4, MV5, MV6, MV 7, and MV8.
- Check the pressure in the nitrogen banks (manually).
- Check the pressure in the Air compressor (manually).
- Set proper Pressure in PRV1 (manually).
- Set proper Pressure in PRV2 (manually).
- Set proper Pressure in PRV3 (manually).
- Set proper flow rate in MFC1_NB1 (Set by the operator).
- Set proper flow rate in MFC2_NB2 (Set by the operator).
- Read the level in the dump tank by using L1 & L2.
- If L1=**HIGH**
L2=**HIGH**
- Open pneumatic ball valve 1
 - COMPRESSOR = **ON**
 - SV1_PV1 = **ON**
- SV2_PV2 = **OFF**
- SV3_NB1 = **ON**
- SV4_NB2 = **OFF**
- SV5_DUMP = **OFF**
- SV6_TBM = **ON**
- SV7_PUMP = **ON**

The status of all the valves is set as indicated above until the mercury detector on the TBM and level sensors (L3, L4 and L5) in the Mechanical pump gives the logic high signal.

STEP 2:

After mercury detector on the TBM and level sensors (L3, L4 and L5) in the Mechanical pump gives the logic high signal, the following valve ON/OFF Status is to be set:

- Close Pneumatic ball valve 1
 - COMPRESSOR = ON
 - SV1_PV1 = OFF
 - SV2_PV2 = OFF
- SV3_NB1 = OFF
- SV4_NB2 = OFF
- SV5_DUMP = ON
- SV6_TBM = OFF
- SV7_PUMP = OFF

Interlocks:

- 1) If mercury detector on the TBM goes high, then close the solenoid valve (SV6) on the TBM.
- 2) If level sensors (L3, L4 and L5) on the mechanical pump go high, then close the solenoid valve (SV7) on the mechanical pump.
- 3) If level sensors (L3, L4 and L5) on the mechanical pump go high, then close solenoid valve (SV1) of PV1 on the dump tank
- 4) If level sensors (L3, L4 and L5) on the mechanical pump go high, then close solenoid valve (SV3) and MFC1 on the NB1
- 5) If pressure inside the dump is more than atmospheric Pressure (after loading the mercury into the loop), then open the solenoid valve (SV5) on the Dump tank.

Alarms:

- 1) If L1 goes low, then alarm has to be activated.
- 2) If the status of the digital input card does not match with the digital output card, then an alarm has to be raised.

- 3) If pressure in the dump tank exceeds more than atmospheric pressure (from PT1), then the valve SV5 on the dump tank has to be open otherwise alarm has to be activated.
- 4) If pressure in the loop increases more than **3 bar** (from PT6), then the valve SV7 on the mechanical pump has to be open otherwise alarm has to be activated.
- 5) If pressure in the loop decreases less than **3 bar** (from PT6), then the valve SV4 on the NB2 has to be open otherwise alarm has to be activated.

SEQUENCE2: Circulation of the water in the Heat exchanger & also in the Electromagnet by using pump (with required flow rate, pressure and temperature).

STEP 1:

- Open all the manual valves on the water pipe line.
- Switch **ON** the power to the water pump.
- SV1_PV1 = **OFF**
- SV2_PV2 = **OFF**
- SV3_NB1 = **OFF**
- SV4_NB2 = **OFF**
- SV5_DUMP = **OFF**
- SV6_TBM = **OFF**
- SV7_PUMP = **OFF**

Interlocks:

- 1) If water flow rate (FT1) in the heat exchanger line is not at required value, then operate the flow control valve on the heat exchanger.
- 2) If water flow rate (FT2) in the electromagnet is not at required value, then operate the flow control valve on the electromagnet

Alarms:

- 1) If the water temperature (heat exchanger) goes more or lesser than the allowable limit, then alarm has to be raised.
- 2) If the water pressure (heat exchanger) goes more or lesser than the allowable limit, then alarm has to be raised.
- 3) If the water flow rate (heat exchanger) goes more or lesser than the allowable limit, then alarm has to be raised.
- 4) If the water temperature (electromagnet) goes more or lesser than the allowable limit, then alarm has to be raised.
- 5) If the water pressure (electromagnet) goes more or lesser than the allowable limit, then alarm has to be raised.
- 6) If the water flow rate (electromagnet) goes more or lesser than the allowable limit, then alarm has to be raised.

SEQUENCE 3: Circulation of the mercury in the loop by using mechanical pump.

STEP 1:

- Make sure that pneumatic valve 1 & pneumatic valve 2 is closed properly.
- Switch **ON** the mechanical pump.
- Set desired nitrogen flow rate in MFC 2_NB2 (set by the operator).
- SV1_PV1 = **OFF**
- SV2_PV2 = **OFF**
- SV3_NB1 = **OFF**
- SV4_NB2 = **ON**
- SV5_DUMP = **OFF**
- SV6_TBM = **OFF**
- SV7_PUMP = **OFF**

Interlocks:

- 1) If Pressure in the mechanical pump (PT6) goes below the required pressure then close the solenoid valve (SV7) on the mechanical pump and open the solenoid valve (SV4) on the NB2.
- 2) If Pressure in the mechanical pump (PT6) goes above the required pressure then close the solenoid valve (SV4) on the NB2 and open the solenoid valve (SV7) on the mechanical pump.
- 3) If mercury flow rate (FT3) in the main mercury line is not at required value, then operate the flow control valve (fine changes in flow rate) on the loop.

Alarms:

- 1) If the status of the digital input card does not match with the digital output card, then an alarm has to be raised.
- 2) If pressure in the loop increases more than **3 bar** (from PT6), then the valve SV7 on the mechanical pump has to be open otherwise alarm has to be activated.
- 3) If pressure in the loop decreases less than **3 bar** (from PT6), then the valve SV4 on the NB2 has to be open otherwise alarm has to be activated.
- 4) If pressure in the dump tank exceeds more than atmospheric pressure (from PT1), then the valve SV5 on the pump has to be open otherwise alarm has to be activated.
- 5) If flow rate of mercury increases or decreases the allowable limit, then alarm has to be raised.
- 6) If the water temperature (heat exchanger) goes more or lesser than the allowable limit, then alarm has to be raised.
- 7) If the water pressure (heat exchanger) goes more or lesser than the allowable limit, then alarm has to be raised.
- 8) If the water flow rate (heat exchanger) goes more or lesser than the allowable limit, then alarm has to be raised.
- 9) If the water temperature (electromagnet) goes more or lesser than the allowable limit, then alarm has to be raised.

- 10) If the water pressure (electromagnet) goes more or lesser than the allowable limit, then alarm has to be raised.
- 11) If the water flow rate (electromagnet) goes more or lesser than the allowable limit, then alarm has to be raised.

SEQUENCE 4: Switch ON the power to the heaters, which are embedded in the TBM walls and also switch ON the power to the Electromagnet.

STEP 1:

- Make sure that solenoid valve (SV1) of pneumatic valve 1 & solenoid valve (SV2) of pneumatic valve 2 is closed properly or not.
- Switch **ON** the power to the all the heaters in the TBM walls.
- SV1_PV1 = **OFF**
- SV2_PV2 = **OFF**
- SV3_NB1 = **OFF**
- SV4_NB2 = **OFF**
- SV5_DUMP = **OFF**
- SV6_TBM = **OFF**
- SV7_PUMP = **OFF**

After achieving the desired temperature on the all the walls of the TBM, then switch **ON** the power to the Electromagnet.

STEP 2:

- Switch **ON** the power to the Electromagnet.
- SV1_PV1 = **OFF**
- SV2_PV2 = **OFF**
- SV3_NB1 = **OFF**
- SV4_NB2 = **OFF**
- SV5_DUMP = **OFF**
- SV6_TBM = **OFF**
- SV7_PUMP = **OFF**

Interlocks:

- 1) If water temperature in the heat exchanger (inlet) is not at required value then switch **OFF** the power to the all the heaters in the TBM walls.
- 2) If water flow rate in the heat exchanger (inlet) is not at required value then switch **OFF** the power to the all the heaters in the TBM walls.
- 3) If water pressure in the heat exchanger (inlet) is not at required value then switch **OFF** the power to the all the heaters in the TBM walls.
- 4) If mechanical pump is not working properly (like power failure to the mechanical pump) & then switch **OFF** the power to the all the heaters in the TBM walls.
- 5) If Thermocouple on First wall gives lesser or greater than the required temperature value, then control the power to the heater in the First wall.
- 6) If Thermocouple on First breeder gives lesser or greater than the required temperature value, then control the power to the heater in the First breeder.
- 7) If Thermocouple on second breeder gives lesser or greater than the required temperature value, then control the power to the heater in the second breeder.
- 8) If Thermocouple on third breeder gives lesser or greater than the required temperature value, then control the power to the heater in the third breeder.
- 9) If Thermocouple on top wall gives lesser or greater than the required temperature value, then control the power to the heater in the top wall.
- 10) If Thermocouple on bottom wall gives lesser or greater than the required temperature value, then control the power to the heater in the bottom wall.
- 11) If Thermocouple on right side wall gives lesser or greater than the required temperature value, then control the power to the heater in the right side wall.
- 12) If Thermocouple on left side wall gives lesser or greater than the required temperature value, then control the power to the heater in the left side wall.
- 13) Between the heaters of the different walls (If the temperature between the any 2 walls is more than the allowable limit, then switch off the power to the all the heaters).
- 14) If the temperature of the mercury exceeds more than the critical value, then switch **OFF** the power to all the heaters.

Alarms:

- 1) If the status of the digital input card does not match with the digital output card, then an alarm has to be raised.
- 2) If pressure in the loop increases more than **3 bar** (from PT6), then the valve SV7 on the mechanical pump has to be open otherwise alarm has to be activated.
- 3) If pressure in the loop decreases less than **3 bar** (from PT6), then the valve SV4 on the NB2 has to be open otherwise alarm has to be activated.
- 4) If pressure in the dump tank exceeds more than atmospheric pressure (from PT1), then the valve SV5 on the pump has to be open otherwise alarm has to be activated.
- 5) If the flow rate of the mercury decreases the desired value, then an alarm has to be activated.
- 6) **If the temperature in the each wall of the TBM should maintain pre-defined value, otherwise alarm has to be raised.**
- 7) If the water temperature (heat exchanger) goes more or lesser than the allowable limit, then alarm has to be raised.
- 8) If the water pressure (heat exchanger) goes more or lesser than the allowable limit, then alarm has to be raised.
- 9) If the water flow rate (heat exchanger) goes more or lesser than the allowable limit, then alarm has to be raised.
- 10) If the water temperature (electromagnet) goes more or lesser than the allowable limit, then alarm has to be raised.
- 11) If the water pressure (electromagnet) goes more or lesser than the allowable limit, then alarm has to be raised.
- 12) If the water flow rate (electromagnet) goes more or lesser than the allowable limit, then alarm has to be raised.
- 13) If the magnetic field will be less than Tesla, then an alarm has to be raised.
- 14) If the temperature of the mercury in the loop exceeds more than the critical value, then alarm has to be raised.

SEQUENCE 5: Switch OFF the power to the heaters, which are embedded in the TBM walls and breeders and also switch OFF the power to the Electromagnet. Dumping the mercury into the dump tank (after successful completion of the experiment).

STEP1:

- Switch **OFF** the power to the electromagnet.
- Switch **OFF** the power to the heaters.
- SV1_PV1 = **OFF**
- SV2_PV2 = **OFF**
- SV3_NB1 = **OFF**
- SV4_NB2 = **OFF**
- SV5_DUMP = **OFF**
- SV6_TBM = **OFF**
- SV7_PUMP = **OFF**

After the mercury temperature comes into room temperature, then perform the STEP 2

STEP 2:

- Switch **OFF** the mechanical pump.
- Switch **OFF** the water motor.
- SV1_PV1 = **OFF**
- SV2_PV2 = **OFF**
- SV3_NB1 = **OFF**
- SV4_NB2 = **OFF**
- SV5_DUMP = **OFF**
- SV6_TBM = **OFF**
- SV7_PUMP = **OFF**

STEP 3

- Open Pneumatic ball valve 1 and Pneumatic ball valve 2
 - COMPRESSOR = **ON**
 - SV1_PV1 = **ON**

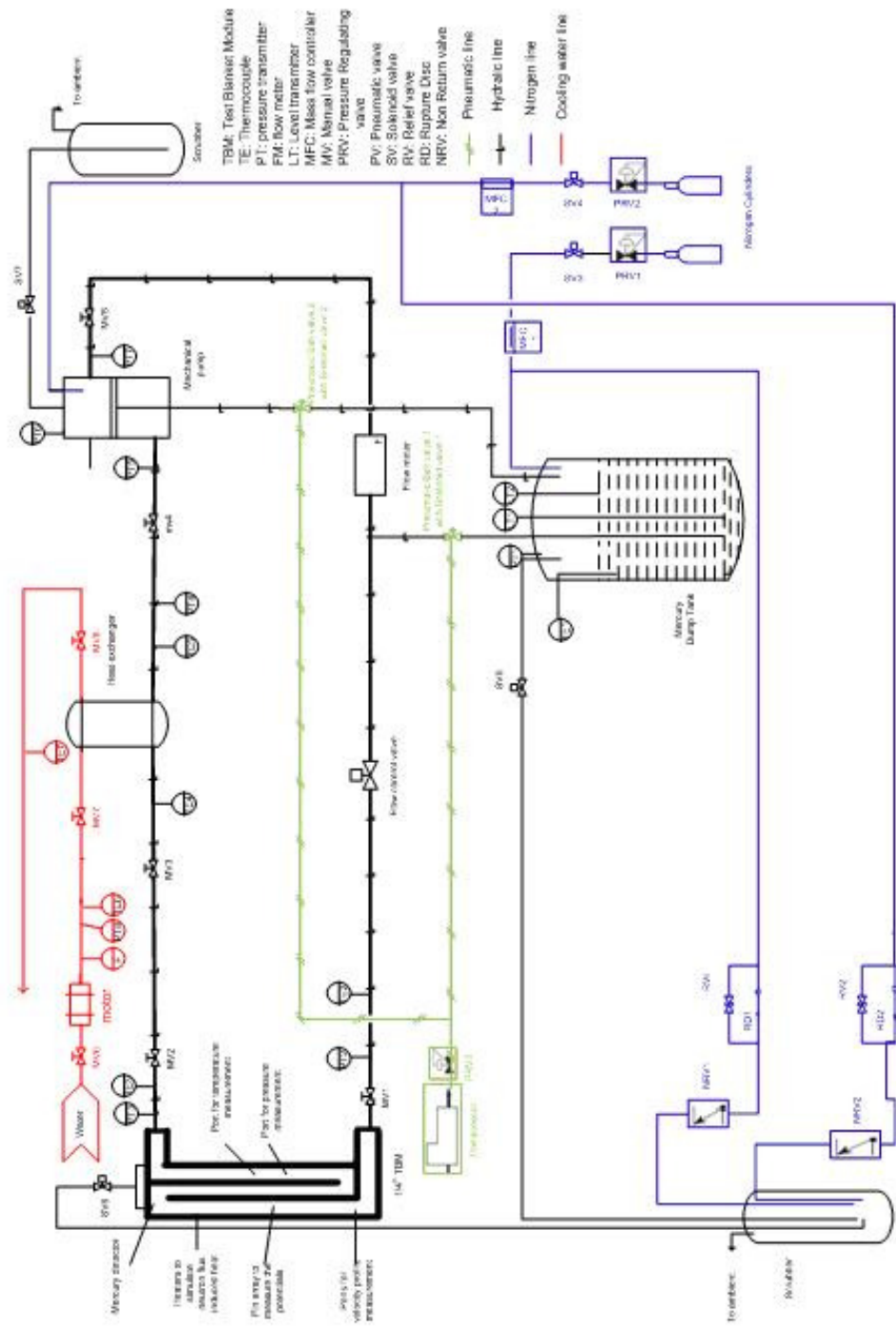
- SV2_PV2 = ON
- SV3_NB1 = OFF
- SV4_NB2 = ON
- SV5_DUMP = ON
- SV6_TBM = OFF
- SV7_PUMP = OFF

Alarms:

- 1) If the status of the digital input card does not match with the digital output card, then an alarm has to be raised.
- 2) L1=HIGH and L2=HIGH, otherwise alarm has to be activated.
- 3) If the status of the digital input card does not match with the digital output card, then an alarm has to be raised.

SEQUENCE 6: Emergency stop due to any accidents in Experimental area (like mercury leakage or over limit of mercury vapour in the Experimental area).

- SV1_PV1 = ON
- SV2_PV2 = ON
- SV3_NB1 = OFF
- SV4_NB2 = ON
- SV5_DUMP = ON
- SV6_TBM = OFF
- SV7_PUMP = OFF



Preliminary process flow sheet of Mercury - TBM Experiment