

**TECHNICAL BID PROFORMA**

Item Name: Control system for High pressure combustor rig

## 1.0 Bidder Eligibility Criteria:

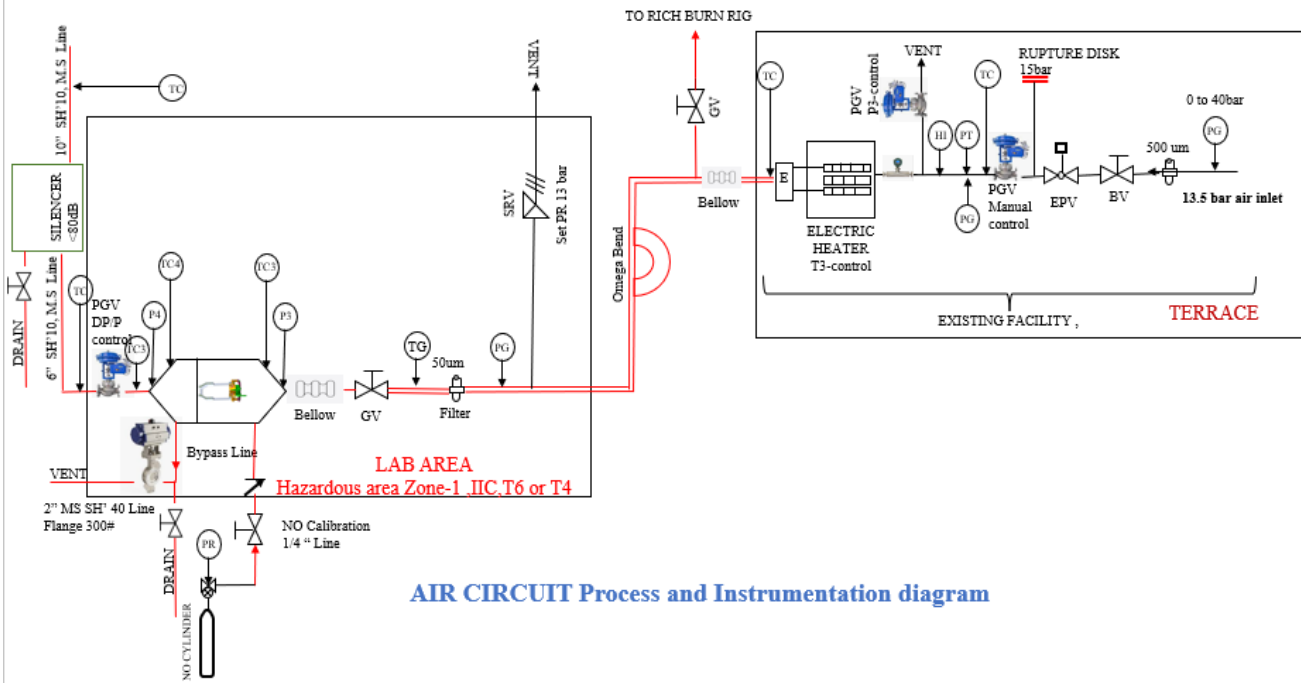
| I   | Bidder Eligibility Criteria-I<br>(Public Procurement – Preference to Make in India)  | Class I /<br>Class II          | Local<br>Content<br>value     | Reference,<br>Page No.     |
|-----|--|--------------------------------|-------------------------------|----------------------------|
| I   | Only 'Class-I local suppliers' and 'Class-II local suppliers', as defined under DIPP, MoCI Order No. P-45021/2/2017-PP (BE II) dated 16 <sup>th</sup> September 2020 and other subsequent orders issued therein.   |                                |                               |                            |
| 2.0 | <b>Bidder Eligibility Criteria-II</b>  | <b>Compliance<br/>(Yes/No)</b> | <b>Reference<br/>Page No.</b> | <b>Remarks, If<br/>any</b> |
| 1   | The bidder/OEM should have supplied at least 3 similar items to IITs, NITs, IISERs, CSIR Labs or other Govt. organizations in the last 5 years, PO copies or installation certificates along with contact details of end user need to be submitted as the proof of supply. IIT Madras reserves its right to verify the claims submitted by the bidder and the feedback from the previous customers will be part of technical evaluation. |                                |                               |                            |
| 2   | The bidder should have 48 lakhs turnover in any one of the last 3 Financial Year.  |                                |                               |                            |

## 3.0 Technical Compliance:

| S.No                       | Specification   | Complaied<br>/Not<br>Complied | Reference Page<br>.No |
|----------------------------|---|-------------------------------|-----------------------|
|                            | Existing valve, must be connected with the PLC/microcontroller        |                               |                       |
|                            | Existing electropneumatic Open/Close valve<br>Signal type: 0 to 24V   |                               |                       |
| <b>PGV-manual control:</b> |   |                               |                       |
|                            | Existing valve, this has to be connected with the PLC/microcontroller |                               |                       |
|                            | Type: Globe valve   |                               |                       |
|                            | Size & Rating: 4" valve with 300#                                     |                               |                       |
|                            | Actuation: electropneumatic with 10 bar air and 4 to 20mA control     |                               |                       |
|                            | Humidity Sensor:  |                               |                       |

|                           |  |  |  |
|---------------------------|--|--|--|
|                           | Existing sensor, must be connected with the PLC/microcontroller                              |  |  |
|                           | Signal type: 4 to 20mA   |  |  |
| Pressure sensor:          |  |  |  |
|                           | Existing sensor, must be connected with the PLC/microcontroller                              |  |  |
|                           | Signal type: 4 to 20mA   |  |  |
| PGV-P3 control:           |  |  |  |
|                           | Make: L&T or Emerson   |  |  |
|                           | Type: Globe valve  |  |  |
|                           | Size & Rating: 4" valve with 300# ASME B16.5 flanges   |  |  |
|                           | MOC: Mild steel  |  |  |
|                           | Design pressure: 20 bar  |  |  |
|                           | Design Temperature: 60 C   |  |  |
|                           | Actuation: electropneumatic with 10 bar air and 4 to 20mA control                            |  |  |
|                           | Actuation resolution: control within 0.1% of the stem length                                 |  |  |
|                           | The pipeline must be slightly modified on the Cold side to add this valve and the vent line. |  |  |
|                           | To be connected with the PLC/Microcontroller   |  |  |
|                           | Normally closed position   |  |  |
| Air Mass flow meter:      |  |  |  |
|                           | Existing meter, must be connected with the PLC/microcontroller                               |  |  |
|                           | Type: Coriolis type mass flow meter  |  |  |
|                           | Range: 0 to 3kg/s  |  |  |
|                           | Signal type: 4 to 20mA   |  |  |
| Electric Heater:          |  |  |  |
|                           | Existing equipment, must be connected with the PLC/microcontroller                           |  |  |
|                           | Signal type: 4 to 20mA and no-potential contact  |  |  |
| Thermal expansion bellow: |  |  |  |
|                           | Make: Athulya/Eagle Burgmann   |  |  |
|                           | MOS: SS316   |  |  |
|                           | 4" Sh-40, 300#   |  |  |
|                           | 1.5 times working pressure   |  |  |
|                           | 1.5 times working temp   |  |  |
|                           | containments around the bellow region are required   |  |  |
| 50-micron filter:         |  |  |  |
|                           | Type: Basket type filter   |  |  |

|                           |  |  |  |
|---------------------------|--|--|--|
|                           | Mesh Size: 50 micron   |  |  |
|                           | MOC: Mild steel and the filtering element alone in SS316                                 |  |  |
|                           | Design pressure: 20 bar  |  |  |
|                           | Design Temperature: 400 C  |  |  |
|                           | Graphite filled spiral wound gasket  |  |  |
|                           | Safety relief valve:   |  |  |
|                           | Discharge time – 1.5 minutes   |  |  |
|                           | API 520  |  |  |
|                           | Discharge rate   |  |  |
|                           | Set pressure: 13 bar   |  |  |
|                           | Cast-steel   |  |  |
|                           | Flanged outlets  |  |  |
|                           | Design pressure 40 bar   |  |  |
| Manual Gate Valve:        |  |  |  |
|                           | Make: L&T or Emerson   |  |  |
|                           | Type: Manual Gate valve  |  |  |
|                           | Size & Rating: 4” valve with 300# ASME B16.5 flanges                                     |  |  |
|                           | MOC: Mild steel  |  |  |
|                           | Design pressure: 20 bar  |  |  |
|                           | Design Temperature: 400 C  |  |  |
| Thermal expansion bellow: |  |  |  |
|                           | Make: Athulya/Eagle Burgmann   |  |  |
|                           | MOS: SS316   |  |  |
|                           | 4” Sh-40, 300#   |  |  |
|                           | 1.5 times working pressure   |  |  |
|                           | 1.5 times working temp   |  |  |
|                           | containments around the bellow region are required                                       |  |  |
|                           |  |  |  |
| Test Rig:                 |  |  |  |
|                           | Already available, the Supplier should connect the inlet and exhaust pipe with the rig.  |  |  |
|                           | Pressure and thermocouples mentioned in the P&ID drawing has to be procured by supplier. |  |  |
|                           | The pressure and temperature sensors have to be connected with the PLC/Microcontroller.  |  |  |
|                           | Pressure measurement range 0 to 15 bar, with 0.1% of full-scale accuracy                 |  |  |
|                           | All temperature has to be measured by K-type thermocouples                               |  |  |



**AIR CIRCUIT Process and Instrumentation diagram**

|    |   |  |  |
|----|---|--|--|
| 7. | PGV-DP/P control:   |  |  |
|    | Make: L&T or Emerson  |  |  |
|    | Type: Globe valve   |  |  |
|    | Size & Rating: 4" valve with 300# ASMEB16.5 flanges               |  |  |
|    | MOC: SS316  |  |  |
|    | Design pressure: 20 bar   |  |  |
|    | Design Temperature: 550 C   |  |  |
|    | Actuation: electropneumatic with 10 bar air and 4 to 20mA control |  |  |
|    | Actuation resolution: control within 0.1% of the stem length      |  |  |
|    | To be connected with the PLC/Microcontroller                      |  |  |
|    | Normally Open position  |  |  |
| 8. | Butterfly drain valve:  |  |  |
|    | Make: Reputed make  |  |  |
|    | Type: butterfly valve   |  |  |
|    | Size & Rating: 2" valve with 300# ASMEB16.5 flanges               |  |  |
|    | MOC: SS316  |  |  |
|    | Design pressure: 20 bar   |  |  |
|    | Design Temperature: 350 C   |  |  |
|    | Actuation: electropneumatic with 10 bar air and 4 to 20mA control |  |  |
|    | To be connected with the PLC/Microcontroller                      |  |  |

|     |   |  |  |
|-----|---|--|--|
| 9.  | Silencer:   |  |  |
|     | Fluid: Burnt gases with Steam and water   |  |  |
|     | Max flowrate: 2kg/s   |  |  |
|     | Noise: <80dB  |  |  |
|     | MOC: SS304  |  |  |
|     | Design pressure: 5 bar  |  |  |
|     | Design Temperature: 600 C   |  |  |
|     | The silencer should have drain and vent with isolation valves   |  |  |
|     | The Silencer should have sufficient lifting arrangement.  |  |  |
|     | The 10" line after the silencer should extend 3 meters above the terrace level  |  |  |
|     |   |  |  |
| 10. | Pipeline:   |  |  |
|     | The pipeline will be 4" with 40Sch seamless pipeline in the inlet and 6"/10"-10Sch pipe in the exhaust  |  |  |
|     | There is a 4" seamless pipeline already laid from the heater to the rig room, with just one manual valve in it. Any additional valve must be accounted for in this tender scope.  |  |  |
|     | <ul style="list-style-type: none"> <li>The supplier must purchase the required 6" pipe, 10" pipeflanges, gasket, bolts, T-joints and bends.</li> </ul>  |  |  |
|     | Pipeline supports has to given at 0.5-meter interval.   |  |  |
|     | There will be core cutting needed to take pipes through walls for exhaust lines.  |  |  |
|     | The welding and hydrotest must be performed by the supplier.  |  |  |
|     | The approximate pipeline length will be around 5 meters with bends for 4" line, 6" line will be another 6m long with bends, and 10" line will be around 5m long (no bends). There may be bends required in each of these lines. The supplier is advised to visit the site and take proper measurements before submitting the quote. |  |  |
|     |   |  |  |
| 11. | Gauges:   |  |  |
|     | Wall mounted Pressure and temperature gauges has to provided as mentioned in the drawing  |  |  |
|     | PG and TG make has to be Baumer/Forbes marshal/Wika.  |  |  |
|     | All pressure gauges shall be safety gauges with safety glass  |  |  |
|     | The pressure gauge range should be 0 to 25 bar  |  |  |
| 12. | Thermal insulation:   |  |  |
|     | All the hot surfaces in the inlet pipeline must to insulated with rockwool/ceramic wool and aluminum cladding   |  |  |
|     | The surface temperature after the insulation should be less than 60 C.  |  |  |

## Fuel Supply Line

Two fuel supply lines must be laid to feed and control, one each for, Hydrogen and Methane gases. The maximum operating pressure will be 25 bar and the operating temperature will to 20 to 60C. The detailed P&ID drawing is attached. The different elements of the fuel circuit are explained below: Care should be taken to incorporate appropriate flow controllers/measurement systems for the two different fuels in the individual fuel supply lines.

|  |   |  |  |
|--|---|--|--|
|  | <b>Fuel Shed:</b>   |  |  |
|  | Fuel shed has to be provided in the Terrace area  |  |  |
|  | The cylinder storage area will need a cylinder holding structure. Non-combustible shelter material with side cladding to prevent uplift by air pressure. Adequate protection from direct sunlight must be provided. Provision for tying the hose restraints should be available.              |  |  |
|  | All the parts should be bodily grounded and connected to nearest earth pit.   |  |  |
|  | Building needs to have Lightning protection. Meeting IEC 62305 standard.  |  |  |
|  | Very good painting as per industry/safety standard.   |  |  |
|  | Adequate provision for entry and exit with cylinder (ramps etc....).  |  |  |
|  | Empty cylinders should be kept aside. Extend the length of the gas bank to accommodate empty cylinders.   |  |  |
|  | Zone-1 ,IIC,T6 or T4 classified peso approved luminous (Baliga/FCG/Rstall ) should be provided. All the electrical terminations should have ATEX approved, double compression gland. The luminous should be able to provide 200lux @750mm from floor level. The wiring should be flame proof. |  |  |
|  | Provision on the structure to switch ON the illumination with a Rotary switch. All the electrical equipment should be suitable for Zone-1, IIC, T6 or T4 classification.  |  |  |
|  | Anchoring of the cylinder holding structure with the civil foundation should be done.   |  |  |
|  | Rainwater gutters to be provided.   |  |  |
|  | Provision on the cylinder holding structure to house fire extinguisher, safety data sheets, PPE box (safety hard hat, safety goggle, antistatic cut resistant gloves and cotton lab coats)  |  |  |
|  | Toolbox to house anti sparking tools, Including adjustable wrenches and cylinder nozzle keys.   |  |  |
|  | Provisions on the shelter to place hazard communication signage.  |  |  |
|  |   |  |  |
|  | <b>High pressure Gas Manifold:</b>  |  |  |

|  |  |  |  |
|--|--|--|--|
|  | Cylinder nozzle (key operated valve) with guard  |  |  |
|  | Bull nose and SS braided hose with safety hose restraint wire for the high-pressure line   |  |  |
|  | Filter and check valve should be provided in the gas pipelines.  |  |  |
|  | ASME B31.3 & B31.9 orbitally weld SS316L header gas lines  |  |  |
|  | Composition of the regulator inlet manifold:   |  |  |
|  | Inlet valve  |  |  |
|  | Double station pressure regulator  |  |  |
|  | Safety capture Bonet SRV   |  |  |
|  | Outlet valve   |  |  |
|  | Purge line   |  |  |
|  | Vent line  |  |  |
|  | ASME safety relief valve   |  |  |
|  | <b>Tubing &amp; Fittings:</b>  |  |  |
|  |  |  |  |
|  | The tubing must be routed from fuel shed to the rig with all the required valves and fittings.   |  |  |
|  | The entire fuel circuit is made of ½” tubes and fittings. The ignition torch line alone will be ¼”   |  |  |
|  | All the tubes must be to be Swagelok SS316 tubes only.   |  |  |
|  | All the fittings have to be Swagelok or Parker make only.  |  |  |
|  | Only Welded joints/fittings has to be used, if welding is not possible double compression Ferrule fittings can be used.  |  |  |
|  | After installation of the fuel circuit, Helium leak test has to be performed and certified by the supplier.  |  |  |
|  | The approximate pipeline length will be around 40 meters with bends. The supplier is advised to visit the site and take proper measurements before submitting the quote. |  |  |
|  | <b>Gauges:</b>   |  |  |
|  | Wall mounted Pressure and temperature gauges has to provided as mentioned in the drawing   |  |  |
|  | PG and TG make has to be Baumer/Forbes marshal/Wika.   |  |  |
|  | All pressure gauges shall be safety gauges with safety glass   |  |  |
|  | The pressure gauge range should be 0 to 40 bar   |  |  |
|  | <b>Instruments connected to PLC:</b>   |  |  |
|  | All the pressure transmitters should have a range of 0 to 40 bar with accuracy of 0.1% of full scale value   |  |  |
|  | Pressure transmitters has to be Baumer/Forbes marshal/Wika.  |  |  |
|  | All fuel Pressure transmitters has to be Ex-d, ATEX approved for hazardous area Zone-1 ,IIC,T6 or T4 classification  |  |  |
|  | All the thermocouples have to K-type, Omega make thermocouples only.   |  |  |
|  | The SRV should give an indication in the PLC if they are opened  |  |  |
|  |  |  |  |

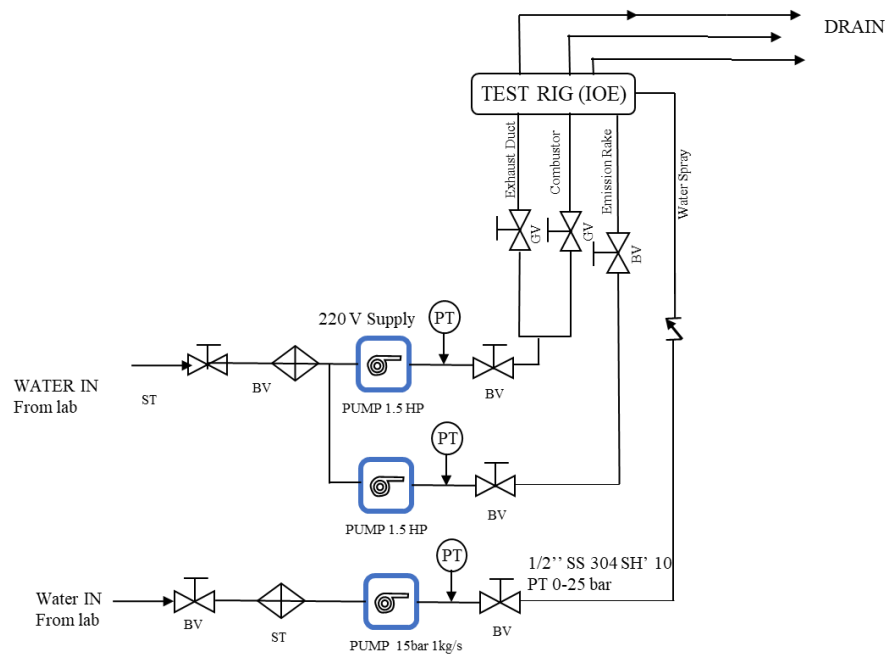




|  |   |  |  |
|--|---|--|--|
|  | Signal : 4 to 20mA,   |  |  |
|  | Mass flow meter has to be connected with plc  |  |  |
|  | <b>Fuel Mass flow controller:</b>   |  |  |
|  | Make: Emerson, Bronkhorst or equivalent   |  |  |
|  | Type: Coriolis  |  |  |
|  | Range: 0 to 25kg/hr   |  |  |
|  | Fluid: mixture of Hydrogen and Methane  |  |  |
|  | Accuracy: 0.1% of full scale  |  |  |
|  | MOC: SS316  |  |  |
|  | Design pressure: 40 bar   |  |  |
|  | Design Temperature: 60 C  |  |  |
|  | Signal : 4 to 20mA,   |  |  |
|  | Mass flow controller has to be connected with plc   |  |  |
|  |   |  |  |
|  | <b>General requirements:</b>  |  |  |
|  | All the electropneumatic Isolation ball valve should be Atex approved   |  |  |
|  | PLC Looping the cori flow meter with the isolation valve to shut-off during excess flow   |  |  |
|  | All the Vent lines must be 3 meters above terrace level and a flash back arrestor must be provided (s-type bend 45 deg angle, properly supported). All the vents should be independent. |  |  |
|  | Proportional safety relief valve should have a testing point  |  |  |
|  | Leak test with Helium test should be performed and certified  |  |  |
|  | All valves should be in normally closed position  |  |  |
|  | Gas tubes should enter 1 feet below the true ceiling, bring the vale alone to a operable height...  |  |  |
|  | Tube entry should be away from the emergency exit door.   |  |  |
|  | PVC sleeve for tube entry and use FM approved fire stop sealant to close the pVC sleeve   |  |  |
|  | Colour code has to be canary yellow with red bands.   |  |  |
|  | Lock enabled needle valve should be provided  |  |  |
|  | Put the ignition transformer in a safety enclosure, FRLSH cabling, safety enclose, glanding and earthing voltage rating of cable, cable should be harnessed....                         |  |  |
|  | For ignition DC transformer should be used. It can be Herco or equivalent make. The transformer has to be operated from the PLC.  |  |  |

## Water Injection Line

A new fuel supply line must be feed the water inside the rig. The water line will take water from the lab area and inject it into the rig at high pressure. The water P&ID drawing is attached below:



The major parts of the circuit are explained below:

|           |   |  |  |
|-----------|---|--|--|
|           | <b>Water pumps:</b>   |  |  |
|           | The pump will feed water at high pressure to the combustor, rig and emission rake.  |  |  |
|           | The pumps for the combustor and emission rake should be able to pump up to 8 bar at low flow rates.   |  |  |
|           | The pump for the combustor should be capable of supplying up to 15 bar at 1kg/s   |  |  |
|           | The RPM of the pumps should be controlled from PLC (using VFD) to maintain a set pressure in the line.  |  |  |
|           |   |  |  |
| <b>2.</b> | <b>General requirements:</b>  |  |  |
|           | All the pipes upstream of the pump can be in uPVC   |  |  |
|           | The pipes and fittings downstream of the pump has to be in 1/2'' SS304 pipe suitable for 20 bar pressure  |  |  |
|           | The approximate pipeline length will be around 5 meters with bends. The supplier is advised to visit the site and take proper measurements before submitting the quote. |  |  |
|           | The pressure transmitter in each line has to be connected to the PLC.   |  |  |
|           | Tank level gauge has to provided and installed in the main tank   |  |  |
|           | After pump venting point, isolation ball valve and non-return valve, when connected to a tank   |  |  |
|           | Inlet and outlet of the pump will need a runner bellow to absorb thewater hammering effect.   |  |  |
|           | Pump should be on civil foundation  |  |  |
|           | Temperature has to be monitored in the hot side of the line   |  |  |

|  |   |  |  |
|--|---|--|--|
|  | Water flow indicator/ switch to ensure running pump without water   |  |  |
|  |   |  |  |
|  | <a href="#"><u>Fuel leak detection system</u></a>   |  |  |
|  | Honeywell make fuel leak detection sensors has to purchased and installed in the Lab area to monitor the fuel leaks. The lab should be provided with two H2 and two methane leak detection sensors. The location of the sensor will be provided later. The sensors will have to be integrated with the PLC/Microcontroller. The sensors has to be ATEX approved for hazardous area Zone-1 ,IIC,T6 or T4 classification. All the wires and cables in the lab area and H2 storage area should be FRLSH cables (fire resistant low smoke halogen free cables) with ATEX approved glands and proper cable dressing. The sensors need to be calibrated after installation and tested with known sample.                                    |  |  |
|  | <a href="#"><u>PLC/Microcontroller with HMI interface using LabView or SCADA</u></a>  |  |  |
|  | All the instruments and control valves have to monitored and controlled using PLC or micro controller. Supplier has to decide the capacity of the PLC based on the Inputs and outputs listed in the P&ID drawing. SCADA or LabVIEW interface has to be provided. The Control logic and the preliminary display screen is detailed in an <b>attached power point document</b> . The supplier may preferably choose Labview, as IITM as License for the same. The computers required for the HMI has to include in the scope. Existing instruments will be connected to the PLC, necessary provisions have to be provided for the same. The building fire alarm PLC must be linked with the lab PLC for transmitting emergency signals. |  |  |
|  | The flow controller along with the pipelines must be shown to operate are the required flow conditions as given in the above tender. The first time experiment run assistance must also be given when the full rig experiment is done.  |  |  |
|  |   |  |  |
|  | <a href="#"><u>General and Electrical Requirements</u></a>  |  |  |
|  |   |  |  |
|  | Fuel shed area also should have a separate lightning  |  |  |

|  |   |  |  |
|--|---|--|--|
|  | protection equipment with independent continuity grids, lightning protection pits and testers.  |  |  |
|  | Fuel gas leak detection system should be interlocked and have interface capabilities to automatically shut OFF the fuel gas admittance, turn ON ventilation system, and turn off electrical power supply to the air heater.   |  |  |
|  | Static bonding and grounding should be done for the fuel storage area, cylinder manifolds and distribution pipelines with bonding and grounding monitoring stations   |  |  |
|  | Functional grounding on noncurrent carrying parts, cylinder holding parts, structure, fuel leak detection system and all ATEX approved equipment must be done and should be connected to an independent earthing pit  |  |  |
|  | Inspection grid for functional check of grounding in the gas bank and in the rig area has to be provided.   |  |  |
|  | Electrical power distribution boards, circuit boards or LT panels as required for the control panel and pumps/valve actuators in the area where there is hydrogen shall be meeting the flame proof and explosion proof construction requirement and 7 levels of electrical protection systems |  |  |
|  | Over current and overload protection  |  |  |
|  | Transient voltage surge suppression.  |  |  |
|  | Single phase prevention or line voltage monitor and tripping system   |  |  |
|  | Microprocessor based earth leak relay interlock with main circuit breaker shall be set not more than 30 mA and tripping time not more than 15ms   |  |  |
|  | Ground fault monitor – tripping system when earthing continuity is not established  |  |  |
|  | Permanent electrical safety device to ensure verification of zero energy before opening of panel  |  |  |
|  | Multi-function meter and lockable emergency stops   |  |  |
|  | All the lighting in the rig area and gas bank area must be flame proof and explosion proof, suitable for Zone-1 gr-IIC, T6 classification area. Avoid CFL lighting, use only LED lighting.  |  |  |
|  | In the gas bank area, lab area and operating room, there should be emergency switches which can stop gas admittance. Another switch should be provided to kill all the electrical supply.   |  |  |
|  | Polycarbonate protection guard must be provided for all energized parts in electrical box   |  |  |
|  | All the wires and cables in the lab area and fuel storage area should be FRLSH cables (fire resistant low smoke halogen free cables) with ATEX approved glands and proper cable dressing,   |  |  |
|  | Metal raceway requirements:   |  |  |
|  | 30% overboard clearance on metal raceway.   |  |  |
|  | 25/6mm hot dip galvanised Gi Earth strips within the raceway.   |  |  |

|                     |  |  |  |
|---------------------|--|--|--|
|                     | Non-corrosive Ni-cd bolts and securing screws  |  |  |
|                     | Inspection grid for the earth strips within the metal raceways should be provided  |  |  |
|                     | Gray colour coding should be followed for metal raceway  |  |  |
|                     | Grounding of noncurrent carrying parts on metal raceway.   |  |  |
|                     | Glanding for knockouts on the metal raceway should be done   |  |  |
|                     | Mounting of metal raceway should be done on floor mounted elevated supports to avoid contact with moisture laden walls                                 |  |  |
|                     | The power supply cables, and adaptors of the laser, camera etc. must be changed to flameproof, if they are kept inside the lab area.                   |  |  |
|                     | All designs for electrical systems should be done with ergonomic clearance and sufficient access for maintenance                                       |  |  |
|                     | 2 hr rated fire stop sealants for all penetration services entering the test area.   |  |  |
|                     | Product safety certifications required   |  |  |
|                     | Submit the list of qualified manufacturers for the field devices, classified electrical systems  |  |  |
| Other requirements: |  |  |  |
|                     | Installation of the flow control system and demonstration of the required flow rates must be done in NCCRD building 4 <sup>th</sup> floor and terrace. |  |  |
|                     | Commissioning should demonstrate the required flow rates in all of the flow control systems together.  |  |  |
|                     | Warranty of 1 year from the date of commissioning is required.   |  |  |
|                     | Please contact Mr. Shreeswaraj (7972354647) or Prof. Muruganandam( <a href="mailto:murgi@ae.iitm.ac.in">murgi@ae.iitm.ac.in</a> ) for visiting site.   |  |  |

**SIGNATURE OF BIDDER ALONG WITH  
SEAL OF THE COMPANY WITH DATE**