DETAILED SPECIFICATION FOR HIGH PRESSURE LABSCALE REACTOR

I. Introduction

High pressure lab reactor is indented for conducting various R&D studies of specialty chemicals. Capacity shall be of 5 L (Total volume). The facility is to be used for high pressure gas/ liquid phase reactions.

II. Scope of supply

Sl. No.	Item description	Quantity
1	High pressure lab reactor of 5 lit capacity with accessories and instrumentation	1 unit
2	Shell and tube Condenser	1 unit
3	Condenser receiver pot	1 unit
4	Feed charging pot	1 unit
5	Gas charging set up	1 unit
6	Essential spares	1 Set as per section F
7	Skid structure	1 unit

III. Detailed specification of subsystems

A. High pressure lab reactor

- **Process conditions**
  - ✓ Process working volume : 3.5 L
  - ✓ Operating temperature : 200˚C (max.) / 5˚C (min.)
  - ✓ Operating pressure : Vacuum(-750mm Hg) (Min.) to 60 bar (g). (Max.)
- **MOC** (Reactor head and body) : SS 316 L.
- **Heating mechanism** : Flameproof Design heater with explosion-proof junction box with insulation and cladding
- **Agitator**
  - ✓ Ex-proof gas group IIC motor (zone 1) with 100-1450 RPM.
  - ✓ Zero leakage Magnetic drive coupling, (M-40) Material of Bush- carbon filled PTFE (CFT).
  - ✓ 2 stage 6-bladed turbine stirrer along with gas induction impeller as additional accessory.

- ✓ VFD for motor speed control.
- ✓ Cooling system for magnetic drive.

- **Temperature measurement:**
  - ✓ Programmable P.I.D temperature controller with high temperature alarm.
  - ✓ 2 Nos. of temperature transmitters with thermowell (one TT for liquid temperature measurement and one TT preferably for vapour temperature measurement).
- **Pressure measurement**: Digital pressure transmitter along with pressure gauge with vacuum protection. – 1 No.
- **Cooling mechanism: Helical cooling coil (chilled water circulation in VSSC scope).**
- **Safety features:** 2 Nos. of PSV with rupture disc (Inconel) with vacuum protection.
- **Nozzle details**
  - ✓ Gas feed with liquid sampling valve on same dip tube - 1
  - ✓ For agitator assembly - 1
  - ✓ Temperature measurement - 2
  - ✓ Pressure measurement – 1
  - ✓ Vacuum measurement -1
  - ✓ Cooling coil (inlet and outlet)
  - ✓ Liquid inlet - 1
  - ✓ Vent – 1
  - ✓ Bottom discharge – 1No.
- **Valves**
  - ✓ gas inlet valve and liquid sampling valve mounted on same dip tube – ½ inch
  - ✓ vent needle valve – 1 inch
  - ✓ SS ball valve liquid inlet to reactor – 1/4 inch
  - ✓ Flush bottom valve – 1 inch
  - ✓ Safety relief valves – 2 Nos. (Size as per design)

B. Shell and tube condenser

- Duty : 2000 kcal/hr
- MOC - Shell side/ Tube side : SS304/SS316
- Design pressure (bar, g) : Shell side 10.0, tube side : 10.0 /FV

- Design temperature (°C) : Shell side 50.0, tube side : 200.0
- Cooling medium through shell side and process fluid through tube side.

C. Condenser receiver pot

- Capacity : 2 L
- MOC : SS 316
- Design pressure(bar, g) : -1(FV)/10
- Design temperature (°C) : 150
- Nozzles & Valves: Nozzles for liquid inlet, vacuum gauge, vapour outlet to vacuum unit, spare nozzle and bottom discharge nozzle. All nozzles to be provided with appropriate valves.

D. Feed charging pot

- Capacity : 3 L
- MOC : SS 316
- Design pressure (bar, g) : -1(FV)/10
- Design temperature (°C) : 150
- Nozzles & Valves: Nozzles for feed valve with funnel, nitrogen inlet, pressure gauge, bottom discharge valve, pressure relief valve, hose pipe, non-return valve. All nozzles to be provided with appropriate valves.

E. Gas charging set up

- With high pressure regulator with pressure hose pipe
- NRV for 0-60 bar, g for H2,O2,N2,CO2, etc gas cylinders
- Mass flow controller (in flow control mode or pressure control mode with totalizer (up to 50 LPM).

F. Essential spares – 1 No for each type

- Head gasket
- Rupture disc
- Cooling coil bush, valve bush, bush for stirrer shaft
- O rings
- Needle valve
- Suitable spanners, Allen keys, clamp bolts, torque wrench etc

IV. <u>General accessories</u>

- **Skid structure:** Trolley mounting, shall be provided with provision for stirrer height adjustment.
- All the hose pipes connected to the reactor should have quick release couplings.

V. Instrumentation

- The system shall integrate all controls into a single display with display of motor speed, temperature of both bath and reaction contents, reaction pressure and time.
- Shall be provided with PC connectivity for data logging and reaction monitoring.
- The control station is at a distance of 20 m from the reactor. All sensors and cables should be provided accordingly.

VI. Make/Brands specifications

Sl. No.	Item name	Make
1.	Pressure regulator	TESCOM /Thomson/Swagelok/Festo
2.	Rupture disc	BS&B/Donadson SDD/REMBE/FIKE
3.	Pressure safety valves	AMAR/PNEUCON/TYCOSANMAR/CROSBY
4.	NRV/check valve	Swagelok/HAMLET/DKLOK/PARKER
5.	Needle valve	Swagelok/HAMLET/DKLOK/PARKER
6.	Automatic Pressure regulating valve	TESCOM/JORDAN/Flomatic/Tyco
7	Pressure transmitter and indicator	Wika/ Honeywell/Setra/Omega
8.	Temperature transmitter with temperature element /indicator	Wika/Honeywell/Tempsense/Omega/Setra
9.	Temperature controller	Eurotherm/Omega/Selec/Omron
10.	Tubes & Fittings	Swagelok/HAMLET/DKLOK/PARKER

VII. AMC

1. **Non comprehensive AMC**
   - On expiry of the warranty, the vendor shall ensure maintenance services for a further period of next three years. The proposed AMC is non- comprehensive and shall include any number of breakdown calls and also preventive maintenance at an interval of three months.
   - The vendor shall quote the yearly Non comprehensive AMC charges for a period of three years from the date of expiry of warranty.

2. **Unit rate of spares:** The vendor shall also indicate the unit rate of the common spares which may be needed during the AMC. If any item needs to be replaced during AMC, the same is to be indicated in writing by the vendor and on certification by the Department, the vendor has to supply the same at the rates already submitted along with tender.
3. In case the vendor fails to undertake the AMC from the date of expiry of warranty, the department will have the right to claim the losses or additional expenses (incurred in availing maintenance services through alternate means) from the performance BG.
4. **Back to Back Support from OEM/Technology partner:** The bidder shall ensure support from the OEMs/Technology partners for a period of 4 (1-year warranty + 3 year AMC) years. A letter from the OEM/ technology partner of all major products confirming service support including spares, software upgrades, etc. for next 4 years, shall be made available.

VIII. Specific Conditions:

1. **Documents to be provided along with offer**
   - Compliance Statement to all the requirements of the document.
   - List of make& model no. of items.
   - Catalogues, technical data sheets of all subsystems offered.
   - Proof of valid approvals / listing / (listing No., validity etc.)
2. **Bid evaluation criteria:** The merit of the offer will be decided on the basis of basic cost, warranty (1 year) and AMC (3 years) charges put together.
3. Detailed schematic drawing / P&ID of the lab reactor facility with exact sizing and dimensions with floor plan shall be submitted along with offer.
4. **Standards:** The reactor and associated nozzles and valves shall be as per ASME Section III Div I code for pressurised equipments, vessels, pipings and fittings.
5. Party shall provide ATEX certification for explosion proof motor for agitator.
6. All the sensors shall have valid calibration certificates provided from the NABL accredited labs.
7. All the sub systems shall be rated for vacuum and for pressure, in the mentioned range.
8. Appropriate number and sized nozzles shall be provided for the installation of monitoring instruments / sensors.
9. Party shall provide material compliance certificate for each of the components.
10. All data sheets of offered item shall be attached along with the bid.

11. **Drawing approval:** Party has to obtain GAD / design drawings approval from VSSC before commencement of the fabrication.
12. **Documents:** The following documents shall be submitted along with the supply.
    - GAD / design drawings with actual dimensions.
    - Detailed parts list and bill of materials.
    - Test and final inspection reports.
    - Manual and warranty certificates for all the equipments, subsystems ad instruments.
13. **Delivery Schedule:** Party shall adhere to the schedule as below.
    - **Submission of the design documents**: within 2 weeks from the date of receipt of PO.
    - **Intimation for Pre-delivery inspection:** Within 16 weeks from approval of design drawings by VSSC.
    - **Dispatch:** Within 2 weeks from intimation of dispatch clearance from VSSC.
    - **Installation and commissioning:** Within 2 weeks from the date of intimation of site readiness.
14. **Payment:** The vendor shall submit a cost break up as per the format given in the price bid. Payment will be made prorata as indicated below based on the price break-up.

Sl. No.	Event		Payment
1	On completion of supply of item and acceptance by Department	:	70%
2	On completion of installation and commissioning and successful demonstration	:	30%
3	AMC charge	:	On pro-rata basis after warranty period

I. General Conditions:

1. Party shall do the installation, commissioning and trial run of the system at VSSC, to our satisfaction.
2. Commissioning of the entire system shall be done in the presence of the representative of VSSC. All necessary instrumentation, equipment, materials and labour shall be provided by the vendor.
3. Since the requirement is for our time bound programme, party shall stick to schedule strictly.

4. Party shall incorporate any minor modifications required at the time of erection without any additional cost.
5. Party has to duly fill and submit the compliance matrix provided along with the offer, without any fail. Party has to bring out deviations if any, in the compliance matrix strictly.
6. Pre-delivery inspection will be done at party's site before dispatching the item to VSSC. Party has to assemble the entire system at our site and demonstrate the performance by conducting one trial with water heating.
7. Following tests will be done by VSSC at party's site before dispatching the item to VSSC
    - Dimensional inspection as per approved design drawing.
    - Hydrotest to be carried out as per the design conditions.
    - Functional test for ensuring the normal functioning of all sensors and indicators.
8. Safety relief valves shall be pressure tested separately and pressure test certificate shall be provided in the prescribed format with approval from authorized agency.
9. **Welding:** Welding shall be of highest quality meeting all the approved standard and leak proof. Ensure that all the joints are 100% leak proof.
10. All the items have to be properly packed during shipment with proper warning labels and loading instructions such that the same is received at the site without breakage. Any broken /damaged items /glass wares during transit has to be replaced without additional payment.
11. The following welding efficiency tests shall be done by the party and submit the test report along with the supply.
    - All butt weld joints shall be tested for ultrasonic testing.
    - Radiography testing shall be done for other weld joints.
    - Die penetration test (DPT) shall be conducted for all the weld joints.
12. **SS nuts and bolts:** All the flange joints shall be provided with suitable SS 316 nuts, bolts and washers. Few numbers of spare nuts and bolts shall be provided for all category sizes.
13. **Test Certificates:** The party shall produce manufacturer's test certificates and guarantee certificates in original in respect of all the items supplied at the time of testing and trials.
14. **Codes and Standards:** Design, Materials and manufacturing of the complete unit shall incorporate up- to-date technology / ASME/ISO/ IS specifications.
15. The detailed design, drawings along with technical specification of the reactor unit shall be submitted by the party for approval from VSSC before commencement of fabrication.

16. **Guarantee/Warranty:** The party shall offer 1 year comprehensive warranty for the items supplied from the date of commissioning. In case of defects during the guarantee period the supplier shall repair / replace the defective parts without any additional cost.
17. **Flange joints**: All the flange joints in the vessels, including nozzles shall be of raised face ensuring leak proof connection.
18. Party shall clearly specify the make, model number and specifications of the all the accessories such as pressure, temperature and vacuum gauges, valves, Safety relief valves, rupture disc etc.
19. Conformity to each of the specification in this annexure shall be clearly spelled out in the party's offer.
20. **Surface finish:** All SS parts shall be buffed, pickled and passivated as per standard.
21. The party shall carry out maintenance, free of cost during the guarantee period.
22. List of customers to whom same or similar item is supplied shall be indicated.
23. One-day training in operation, maintenance and administration of the system shall be given to VSSC personnel by the party.
24. The vendor shall be an ISO 9001:2015 certified firm.
25. The electric power/ water etc for erection &commissioning will be provided by the Department free of cost.
26. Party shall quote "FOR VSSC, TRIVANDRUM".