OIL INDIA LIMITED
(A Government of India Enterprise)
P.O. Duliajan, Pin – 786602
Dist-Dibrugarh, Assam

CORRIGENDUM

Amendment No. 1 Dated 28.10.2015
to
Tender No. SDG5523P15/08

This Amendment No. 1 dated 28.10.2015 to **Tender No. SDG5523P15/08 for Procurement of Pilot Dehydration Plant** is issued to notify certain amendments in the Tender Document. The amendments are given in Annexure-A to this page. All other Terms & Conditions of the Tender Document remain unaltered.

(D.Thakur)
Chief Manager (Materials)(FD)
For Head-Materials

Annexure-A

Existing Description	Modified Description	Remarks, if any
SECTION – A		
2.0 Process Description: 2.1 Objective of the process is to clean up the rated quantity of natural gas and remove moisture and C_5+Hydrocarbons (HC). Natural gas at 50 deg C (approx.) and 15 kg/cm^2 pressure shall pass through a Coalescence type Filter Separator for removal of any liquid in the flow stream. There are four adsorption beds in the process (two each for water vapor and HC removal). At a time, two (one each for water vapor and HC removal) will run in adsorption mode and the other two will run in desorption mode. The outlet stream of natural gas from the filters will pass successively through adsorption beds for water vapor and HC removal. Once an adsorption bed is saturated, it will be switched over to regeneration mode and there generated bed will be switched into the adsorption mode. 2.2 The dry gas (free of water vapour and heavier HCs) shall be delivered for downstream utilization. A part of the processed dry gas shall be used for high temperature regeneration of the saturated adsorption beds and therefore it will pass through a gas fired gas heater maintained at 300degC. Another part of the stream shall be used as cold regeneration purge stream for the beds during regeneration. 2.3 The wet gas from the beds during regeneration step will be sent into a Gas-Gas heat exchanger as hot stream. The dry gas (cold stream) to be used for regeneration gets preheated. The wet regeneration	**2.0 Process Description:** Objective of the process is to clean up the rated quantity of natural gas and remove moisture and C_{5+} Hydrocarbons (HC). Natural gas at 50°C (approx.) and 15 kg/cm^2 pressure shall pass through a Coalescence type Filter Separator for removal of any liquid in the flow stream. *There are eight adsorption beds in the process (two for water vapour and six for HC removal). At a time, four (one for water vapour and three for HC removal) will run in adsorption mode and the other four will run in the desorption mode.* The outlet stream of natural gas from the filters will pass successively through adsorption beds for water vapour and HC removal. *Once adsorption beds are saturated, **they** will be switched over to the regeneration mode and the regenerated **beds** will be switched into the adsorption mode.* The dry gas (free of water vapour and heavier HCs) shall be delivered for downstream utilization. A part of the processed dry gas shall be used for high temperature regeneration of the saturated adsorption beds. *In addition, if the required flow of hot regenerated gas is large, some raw feed gas may also be mixed with this stream before sending it through the electric heater. The electric heater shall heat this desired amount of gas for regeneration up to a temperature of about 300°C. The hot gas from the heater is then sent to the beds for regeneration at low pressure (~ 2-3 kg/cm^2). This*	Point nos. 2.1, 2.2, 2.3, 2.4 & 2.5 are removed and clubbed together. The changes incorporated are marked in red italics as per annexure I (attached).

gas from this exchanger will be delivered to nearby oil processing station. 2.4 Details of the process along with the process sketch is attached as Annexure –I (3 pages) 2.5It may be noted here that IIT, Guwahati is the consultant for the said Project and will be associated with OIL for the whole project including installation & Commissioning till testing of the complete pilot plant project in cycle. **3.0Scope of Work:** This is a TURN KEY PROJECT. The scope of work covers the following; i) Mechanical design, Fabrication and Supply of adsorption columns, all process piping, and gas fired gas heater, filter separator. ii) Procurement and supply of all bought out items like valves, control valves, instruments, control panel(s), adsorbents and any other items to meet the process requirement. iii) Cleaning, painting, testing, insulating the process equipment wherever required iv) Assembling all equipment and instrument on suitable skid(s). v) Erection, Testing and Commissioning of the pilot plant at the OIL's designated site. Vendor shall also be responsible for ensuring inspection of the equipment at the vendor's works by OIL's representative and also testing of any equipment at their works if required. Vendor shall also be responsible for pre-commissioning and commissioning activities to be performed at the site to the OIL's full satisfaction. This specification is not to be interpreted as limiting whereby the vendor is relieved of meeting the requirements specified herein.	*stream laden with high content of moisture and/or heavy HC at the outlet of the beds,will be delivered to a nearby oil processing station.* *A process flow diagram (PFD) of the pilot plant is shown in Annexure II. More elaborate description of process, required instrumentation and hardware is given in the Annexures III and IV.* It may be noted here that IIT Guwahati is the consultant for the said Project and will be associated with OIL for the whole project including installation & Commissioning till testing of the complete pilot plant project in cycle. **4.0 Scope of Work** This is a TURN KEY PROJECT. *The scope of work includes but not limited to the following:* *4.1 Development of P&ID, detailed engineering design of all the hardware and software including PLC, for the pilot plant.* *4.2 Vendor will submit all the detailed design, P&ID, other drawings, control logic, etc. of the pilot plant to OIL before starting of construction of the pilot plant.* *4.3 The land footprint with height clearance, power requirement and water supply requirement should be clearly spelt out by the vendor and needs to adhere to the facilities available at the OIL site. Finalization of the engineering design and P&ID diagram, etc. will be based on mutual agreement between OIL and the vendor. Construction of the pilot plant and procurement of bought out items shall only be started after final clearance from OIL.* *4.4 Procurement and supply of all bought out*	"Scope of work" point 3.0 is removed from the Tender Document and incorporated in point no. 4.0 as per annexure I (attached). The changes are marked in red and in italics.

The vendor shall be responsible for the pilot plant to be completed with all equipment, controls and instrumentation necessary to make the unit a self-contained one for smooth and safe operation. Sufficient descriptive information including a proposed skid layout must be furnished with the Vendors quotation to enable equipment size, performance, quality, and capacity and specification adherence to be determined. It is also necessary that the bidders should furnish complete information / data of the requirement in order to avoid seeking any clarification. The finalization of the engineering design and P&ID diagram will be based on mutual agreement between OIL and the vendor.	*items like valves, control valves, instruments, control panel(s), packing material and any other items required for fabrication of the pilot plant.* *4.5 Fabrication and assembling all components (hardware & software) to make the pilot plant* *4.6 Cleaning, painting, and insulating the process equipment wherever required.* *4.7 Transportation of all components of the pilot plant to OIL. The vendor will make necessary insurance coverage during transportation of the pilot plant and its components to OIL.* *4.8 Erection and commissioning of the unit at the designated site in OIL.* *4.9 The vendor shall be responsible for the testing facility to be completed with all equipment, controls, instrumentation, software necessary to make the unit a self-contained one for smooth and safe operation.* *4.10 Vendor shall also be responsible for commissioning activities to be performed at OIL to the full satisfaction of OIL.* *4.11 The vendor will also ensure post-commissioning training to OIL personnel/representatives on the operation of the pilot plant.* This specification is not to be interpreted as limiting whereby the vendor is relieved of meeting the requirements specified herein.	
4.0 Design Information:	**3.0 Process Design Basis**	

4.1 Process Design Basis: **4.1.1. Feed Condition:** **1) Feed Gas Flow Rate (Capacity) :** 10,000 SCMD (0.115 m^3/sec) 2) **Inlet Pressure (Maximum) :** 15.0kg/cm^2 3) **Inlet Gas Temperature :** 50^{0}C 4) **InletGas composition (Vol.%) :** an approximate range of gas composition as indicated below – Methane : 83.70 Ethane : 6.80 Propane : 4.50 *i*-Butane : 1.00 *n*-Butane : 1.30 Pentane : 0.80 Hexane plus : 0.70 Nitrogen : 0.20 Carbon dioxide : 1.00 Moisture : 5000 ppm **Total** : **100.00** **4.1.2 Climatic Conditions:** Maximum shed temperature :45Deg.C. Minimum shed temperature :6 Deg.C. Relative humidity :at 21 Deg.C. = 100% at 32 Deg.C. = 95% at 41 Deg.C. = 70% Height above sea level:Duliajan 119 m (392 ft.) Average rainfall :300 cm. Minimum Ambient temperature:5 Deg.C.	**3.1 Feed Condition** 1) *Feed Gas Flow Rate (Capacity) : 1,000 SCMD* 2) Regeneration gas flow rate : 2,000 SCMD 3) Inlet Pressure (Maximum) : 15.0 kg/cm^2 4) Inlet Gas Temperature : 50^{0}C 5) Inlet Gas composition (Vol.%) : an approximate range of gas composition as indicated below – Methane : 83.70 Ethane : 6.80 Propane : 4.50 *i*-Butane : 1.00 *n*-Butane : 1.30 Pentane : 0.80 Hexane plus : 0.70 Nitrogen : 0.20 Carbon dioxide : 1.00 Moisture : 5000 ppm Total : 100.00 **3.2 Climatic Conditions** Maximum shed temperature : 45^{0}C Minimum shed temperature : 6 ^{0}C Relative humidity : at 21 ^{0}C = 100% at 32 ^{0}C = 95% at 41 ^{0}C = 70% Height above sea level : Duliajan 119 m (392 ft.) Average rainfall :300 cm. Minimum Ambient temperature:5 ^{0}C	Design information stated in Point no. 4.0 is removed and incorporated at point no. 3.0 of annexure I (attached). Feed Gas flow rate changed from 10,000 to 1000 SCMD as shown in red in italics.

5.0 **Adsorption Column & Adsorbent** | Item	1 &2 columns for Water (as per annexure I)	3&4 columns for Heavier Hydrocarbon (as per annexure I) | |---|---|---| | Approx. Height ,m | 1.4 | 4.75 | | Approx. Diameter, m | 0.47 | 1.58 | | Approx no. of columns | 2 | 2 | | Adsorption time , hrs | 12 | 12 | | Regeneration Temp DegC | 300 | 300 | | Adsorption Inventory, Tons | 0.34 | 10.3 | *** Mechanical design pressure of all the vessels shall be 20 kg/cm^2**	Elaborately incorporated in Annexure III (Detailed Process Description and Hardware Requirements)(attached) at point no.24.	Point no. 5.0 has been removed and incorporated at annexure III(attached). Height , Bed Dia , Adsorption inventory has been changed.
6.0 Extent of Supply: **6.01** The Pilot Plant will consist of the following: (i) Filter Separator (Picco Coalescence Filter) : 01 No. – To arrest liquid particles in the flow stream Working pressure : 15 kg/cm2 Working Temperature : 50 Deg. C Filter efficiency : up to 05 micron (i) Adsorption column : 02 Nos. for C_{5+}Hydrocarbon adsorption	Incorporated in Annexure III (Detailed Process Description and Hardware Requirements)(attached) at point no.1,2,3,5,6,7,8,9,10,11,12,13 & 14.	Incorporated in Annexure III (Detailed Process Description and Hardware Requirements)(attached) at point no.1,2,3,5,6,7,8,9,10,11,12,13 & 14.

(ii) Adsorption column :02 Nos. for water vapour adsorption. All the above adsorption columns (ii) & (iii) shall be complete with necessary instrument, controls for automatic switching of adsorption and regeneration(desorption) cycles as given in Annexure I. Valves and timers are needed for switch over of streams between adsorption and regeneration beds as described in the process. (iii) Gas Fired Heater : 01 No. – For heating the lean gas for regeneration of the adsorbents. Heater for regeneration of the adsorbent media: 30% (max) of the dry process gas (3000 SCMD) will be used at a temperature of 300Deg C. Forced draft gas fired burner with burner management system having automatic on-off main burner to be provided. Pilot burner shall have flame failure shutdown switch. Pilot gas and main burner gas will be supplied to the burners from the residue gas line and each must have its own regulator and shut down valve. Details of burner instrumentation to be provided are given in instrumentation section (Section 8.0). (iv) Gas – Gas Heat Exchanger: 01 No. - To cool down the warm outlet wet gas after regenerating the adsorbents and to preheat the dry regeneration / fuel gas. The heat exchange will take place between regenerated wet gas and the dry regeneration / fuel gas. (v) Pressure Control Valve with pressure controller: 01 No. - Up-stream control valve will be used for transferring process lean gas to Low Pressure system.		

(vi) Check valve : 1 No. - To ensure one way flow of regeneration wet gas into LP unit (vii) Flow control valve with flow controller: 6 Nos. (S1, S5, S7, S8, S10 and S11 – Refer Annexure -I) (viii) The bidder to submit the following along with the bid: a) Submission of technical specifications of all equipment to be used and supplied. b) Submission of P&ID, different flow circuits, pressure/temperature control circuits etc. c) Submission of General Arrangement Drawing (GAD) (ix) Bidder to give an undertaking that detailed Mechanical/ Engineering Design with Engineering drawing including internals of all equipment shall be submitted if the order is placed on them.		

7.0 <u>Adsorbents</u>: Adsorbent Type-1 : Molecular Sieve 4A, 1/16'' pellets Adsorbent Type-2 : Silica Gel beads 2-5 mm The physical properties of the adsorbents to be supplied are as follows. (a) Molecular sieve 4A a. Size: 1/16" pellets or 2-4 mm spherical beads b. Water adsorption capacity: 20 wt % minimum at 18 mm Hg and 25 deg C (b) Silica gel: a. Size: 2-5 mm spherical beads b. Pure methane (CH_4) capacity: not more than 11 cc at STP/gm of silica gel at partial pressure of 9 bar and 20 deg C and not more than 6 cc at STP/gm of silica gel at partial pressure of 93 bar and 75 deg C. c. Pure *n*-pentane (C_5H_{12}) capacity: At least 40 cc at STP/gm of silica gel at partial pressure of 0.3 bar and 20 deg C and at least 6.5 cc at STP/gm of silica gel at partial pressure of 0.3 bar and 75 deg C. d. BET Surface area: Minimum 550 m^2/g (c) The adsorbents should be procured from reputed vendors such as Linde, UOP,M/s Chemicals India Company,M/s Drier Chemicals etc. The samples should be validated to OIL before actual purchase by the vendor. **** All the adsorption columns / equipment will be exposed to around 300 deg C, all equipment /vessels instrument andmaterials shall be selected accordingly.**	Incorporated in Annexure III (<u>Detailed Process Description and Hardware Requirements)</u> <u>(attached) at point no. 4</u>	Incorporated in Annexure III (<u>Detailed Process Description and Hardware Requirements)(attached) at point no. 4</u>

8.0 <u>Instrumentation System</u>: **<u>Project Requirement</u>:** The instrumentation& control system requirement pertaining to this pilot project is envisaged as per the following. However, the final quantity/specific range/exact requirement will depend on the final approval of the 'design of the pilot plant' by the qualified bidder. • **Monitoring & Control of Gas Fired Heater** - Burner Management System(BMS) for sequence of operation like Blower(purging) Motor on/off, pilot ignition, main burner on/off, safety shutdown, alarm etc. through a dedicated Small Programmable Logic Controller considering forced draft heater. - A dedicated temperature control function for maintaining the regeneration gas temperature between 130 - 300 deg C through Small Programmable Logic Controller and thereby controlling main burner fuel intake to the heater. - Temperature transmitter(s) - Temperature Gauge for local indication - Heater stack temperature transmitter for indication & safety shutdown - Fuel Gas Pressure Transmitter - A dedicated control panel for burner on/off, pilot & main flame status, fuel valves status, emergency manual shutdown, temperature & pressure indications, indicating Lamp etc. The panel will house the Small Programmable Logic Controller(SPLC) along with all standard accessories in the control panel as per standard engineering practice • **Monitoring & Control of Adsorption Columns** - Automatic changeover of columns from adsorption to regeneration & vice versa after	**5.0 Instrumentation** The instrumentation and control system requirement pertaining to this pilot project is envisaged as per the following in addition to the instrumentation and hardware included in Annexure III. However, the final quantity/specific range/exact requirement will depend on the mutually agreed version of the P&ID as indicated in the Scope of Work. 5.1 Provision for automatic emergency safety shutdown along with suitable ON/OFF valves. 5.2 All the instrumentation (for measurement/control of temperature, pressure, flow, etc.) will include independent display units at a suitable central location. 5.3 All field instruments shall be hooked up with the PLC control panel for necessary display& monitoring, start/stop actions, control etc. 5.4 All materials used are to be provided with test certificates. 5.5 The instrumentation work shall include design, engineering, calibration, testing, installation, supply, erection and commissioning of field instruments, local control panel(s) and instrumentation cable with all accessories, cable trays, junction boxes, erection hardware etc. as per requirements. 5.6 The following selected one or all instrumentation works are envisaged as	Point no. 8.0 has been removed and incorporated at point no. 5.0 of the revised specification of annexure I (attached). The Instrumentation is elaborated Incorporated in point no. 5.0 of Annexure I (attached). Changed to suit the new process requirement.

completion of definite time cycle operation, sequence of operation of control valves either in ON or OFF mode in the inlet & outlet sections of the respective columns through a dedicated Programmable Logic Controller (PLC). Provision for automatic emergency safety shutdown, manual step-up & step-down of time cycle operation of adsorption columns & manual changeover of adsorption column whenever process condition demands. - Pressure Transmitter(s) for adsorption columns(Total 8 nos. one each at the top and bottom for beds 1, 2,3&4). - RTDwith thermowell for adsorption columnsone each at the top and bottom for beds 1, 2,3, and 4.(Total = 8 nos.) - RTD with thermowell for Streams S1 (after filter separator), S5 (before entering the heat exchanger), S18 (before entering the heat exchanger) and S9 (at the outlet of the heater). (Total = 4 nos.) - RTD with thermowellat the following locations in beds 1 and 2. (Total = 4 nos.) a) 0.01 m from wall at a height of 0.7 m b) 0.22 m from wall at a height of 0.7 m - RTD with thermowellat the following locations in beds 3 and 4. (Total = 14 nos.) a) 0.01 m from wall at a height of 2.4 m b) 0.35 m from wall at a height of 2.4 m c) 0.70 m from wall at a height of 2.4 m d) 0.01 m from wall at a height of 0.8 m e) 0.01 m from wall at a height of 1.6 m f) 0.01 m from wall at a height of 3.2 m g) 0.01 m from wall at a height of 4.0 m - Temperature transmitters for all the above RTDs - Pressure & temperature switches for each columns for safety shutdown - Pressure & temperature gauges for each columns for local indication	minimum but shall not be limited to: 5.6.1 Engineering, supply, erection, testing and commissioning of field instruments, Burner Management System, instrumentation cables, junction boxes, serial link cable for PLC, Control Panels etc. 5.6.2 Cable lying through cable tray/cable trench from Gas Fired Heater/ Adsorption Columns/Gas-Gas Heat Exchanger to control panels via junction boxes with proper glanding, termination, ferruling, dressing etc. 5.6.3 Installation of junction boxes, I/O cabinets in the control panels. 5.6.4 Calibration of all instruments, leak test/hydro test of instrument impulse pipe, tubes, fittings etc. 5.6.5 To interface all instrumentation signals with the Programmable Logic Controller (PLC) in the control panel. 5.6.6 Supply of erection hardware's like cable gland, cable trays, support, SS tubing, fittings, flanges, valves, manifold, impulse tubing etc. 5.6.7 Supply of mandatory recommended spares for smooth running of the pilot plant after Post Commissioning Warranty. 5.6.8 Preparation of engineering drawing/documents/data sheet/P&ID etc. 5.6.9 Erection, testing & commissioning of ON-OFF control valves at the inlet & outlet of	

- Limit switches/LVDT for columns inlet & outlet valves status like ON/OFF and opening/closing position& sequence interlock and safety shutdown. - ON/OFF control valves - A dedicated main control panel for the adsorption columns which will comprises of Master Programmable Logic Controller, critical parameters display along with indicating lamps, start/stop & sequence of columns operation after getting required feedback signal (safety interlock) from the Small Logic Controller in Gas Fired Heater & vice versa, all standard accessories in the control panel as per standard engineering practice. - Solenoid valves. All solenoid valves to be housed in a separate enclosure with proper air supply regulator & filters assembly and to be placed near the near the main control panel for interlinking. - Tapping ports to withdraw sample for concentration analysis in each of the streams S1, S2, S4, S9, S13, S14, S15, S16 and S18 - Pressure gauges at suitable locations in the pipeline as per standard engineering practice. • **Monitoring & Control of Filter Separator** - Differential Pressure(DP) Gauge - Local pressure gauges for Inlet & Outlet of Filter Separator - Pressure transmitter in the filter separator outlet. The pressure transmitter signal to be feed to the Main Programmable Logic Controller for controlling columns operation based on the minimum & maximum permissible pressure limit as per design basis. • **Gas-Gas Heat Exchanger** - Local Pressure & Temperature gauges Control valve with positioner & I/P converter and pressure controller action (PID) from Main	Adsorption columns. 5.6.10 Necessary control logic shall be developed in the Programmable Logic Controller (PLC) for smooth operation & safety shutdown of the pilot plant as well as display of critical parameters in the control panel(s) along with indicating lamp. 5.6.11 Interconnecting Gas Heater Control Panel and main Control Panel of Adsorption Unit for safety interlock. 5.6.12 The system is to be provided complete with all instrumentation and valves for automatic operation and shutdown at all stages of the system. All pressure vessels are to be fitted with pressure safety valves. 5.6.13 All control valves and metering systems are to be provided with manually operated by-pass arrangements. All instruments should be provided with suitable isolation valves on both sides to enable proper maintenance.	

Programmable Controller (PLC) for Process Lean Gas to LP System. • **Gas Flow Measurement & Flow Control** - Gas Flow Measurement & flow control in the stream S4, S5, S7, S8, S10 & S11 - Gas flow measurement with Multivariable Transmitter along with orifice plate as per AGA-3. - All the above Gas Flow Calculation to be done in PLC with necessary programming software meeting requirement as per AGA-3. - PLC's must be compatible for gas flow allocution with sufficient memory (RAM) and display must be in the TFT display monitor. - Control valve(s) with positioned & I/P converter and flow control action(PD or PID) from main Programmable Logic Controller(PLC). **APPLICABLE CODES & STANDARDS** The following Indian and International codes and standards are generally used for design of Instrumentation works. In all cases, latest revisions with amendments if any shall be followed. Apart from the specific codes mentioned herein, all other relevant and related codes concerning the specific job under consideration and/or referred to in these codes and technical specifications are followed wherever applicable. a) ANSI/ISA S51.1 - Process Instrumentation Terminology. b) IEC 60529 - Classification of Degree of protection provided by Enclosures c) IEC 60079- Specification for Flame Proof Enclosure		

d) IEC 801 - Electromagnetic Compatibility for Industrial Process Measurement And control equipment e) IEC 902 - Industrial Process Measurement and Control terms and definitions. f) IEC 228- Conductors of insulated cables. g) IEC 5381- Specification for PVC insulation and sheath of insulated cables. h) API RP 520- Sizing and selection of safety relief valves. i) IS 1554 Part 1- PVC insulated (heavy duty) electric cables- working voltage upto And including 1100 V. j) IS 3975 -Mild steel wires, formed wires and tapes for armoring of cables. k) IS2147 - Degree of protection provided by Enclosures for low voltage Switchgears and control gears l) IS 2146 - Flame proof Enclosures of Electrical Apparatus m) BS EN 50054-Electrical Apparatus for the Detection and Measurement of Combustible Gas-General Requirements and Test methods. n) BS EN 50057 - Performance Requirements for Group II Apparatus Indicating up to 100% LEL o) BS 5308 Part 2 -Specification for PVC insulated cables. p) ISA S75.01-Control Valve Sizing **<u>Design Basis (Instrumentation):</u>** i) Field Transmitters should be intrinsically safe		

under leak proof enclosure for use in hazardous area. Function of the transmitter shall be transmission as well as indication. Type of transmitter shall be of electronic smart type transmitter compatible with fieldbus protocol of latest version with capability to handshake with any communicating device. The enclosure should be weather proof to IP 65. ii) RTD will be 4-wire duplex and thermo well's immersion length shall be suitable for the line size. RTD element shall be Pt 100 and it will be as per DIN 43760 and accuracy will be class A. iii) For Gas Flow Application (flow measurement) multivariable transmitter along with orifice plate shall be used. Multivariable transmitter shall be of electronic smart type transmitter compatible with fieldbus protocol of latest version with capability to handshake with any communicating device. This transmitter shall have RTD connectivity also for flow calculation as well as transmitting temperature to PLC. Accuracy of this transmitter should not be degraded beyond±0.15%. iv) All field instruments shall be hooked up with the respective PLC control panel for necessary start/stop, display& monitoring, sequence interlock & safety shutdown, gas flow calculation as per AGA-3. All control logic for sequence of operation and safety shutdown of the unit to be developed accordingly. v) A high resolution(1024 x 768, 18-bit color graphics) TFT display monitor unit with touch screen/ key board for monitoring of all parameters like Pressure, Temperature, Flow, Valves status(ON/OFF) etc. including alarm & graphical display shall be considered in PLC control panel. This LCD display unit shall be hooked up with the PLC through suitable communication protocol (Ethernet, RS 232, RS 485 etc.).		

vi) A standalone Burner Management System(BMS) along with requisite accessories or through PLC including IR flame detector, Ignition transformer with electrode, damper control, pilot & main burner regulator with control etc. shall be considered. vii) Based on the 'schematic flow diagram', shall have to design complete logic & sequence control operation and safety shutdown and assessment of total requirement of field & control instrumentation system for the entire dehydration unit. **<u>Scope of Work (Instrumentation)</u>:** i) The instrumentation work for the pilot project shall include design, engineering, supply, installation, calibration, testing, erection and commissioning of field instruments, local control panel(s) and instrumentation cable with all accessories, cable trays, junction boxes, erection hardwires etc as per requirements. ii) The following selected ones or all instrumentation works are envisaged in this pilot project as minimum but shall not be limited to: a) Engineering, supply, erection, testing and commissioning of field instruments, Burner Management System, instrumentation cables, junction boxes, serial link cable for PLC, Control Panels etc. b) Cable lying through cable tray/cable trench from Gas Fired Heater/ Adsorption Columns/Gas-Gas Heat Exchanger to control panels via junction boxes with proper glanding, termination, ferruling, dressing etc. c) Installation of junction boxes, I/O cabinets in the control panels. d) Calibration of all instruments, leak test/hydro		

test of instrument impulse pipe, tubes, fittings etc. e) To interface all instrumentation signals with the Programmable Logic Controller (PLC) in the control panel. f) Supply of erection hardware's like cable gland, cable trays, support, SS tubing, fittings, flanges, valves, manifold, impulse tubing etc. g) Supply of mandatory recommended spares for smooth running of the pilot plant after Post Commissioning Warranty. h) Preparation of engineering drawing/documents/data sheet/P&ID etc. i) Erection, testing & commissioning of ON-OFF control valves at the inlet & outlet of Adsorption columns. j) Necessary control logic shall be developed in the Programmable Logic Controller (PLC) for smooth operation & safety shutdown of the pilot plant as well as display of critical parameters in the control panel(s) along with indicating lamp. k) Interconnecting Gas Heater Control Panel and main Control Panel of Adsorption Unit for safety interlock. iii) The system is to be provided complete with all instrumentation and valves for automatic operation and shutdown at all stages of the system. All pressure vessels are to be fitted with pressure safety valves. **iv)** All control valves and metering systems are to be provided with manually operated by-pass arrangements. All instruments should be provided with suitable isolation valves on both sides to enable proper maintenance.		

Special Condition: i) All field mounted instruments (hazardous area) shall be 'Intrinsically Safe' under leak proof enclosure. ii) All signals from field instruments in hazardous area shall be routed through suitable Zener barrier/isolator. iii) All field instruments/control panel installed in Zone 1 are to be certified by CIMFR/ERTL and approved by DGMS as per OIL's approved safety policy as well as statutory body's requirement. Hence, the bidder to procure the various field instrumentation system/control panel which are already certified & approved by CIMFR/ERTL& DGMS and used in OIL's various installations subject to meeting the individual instrumentation design specifications. OIL will provide the list of the certified & approved only availablefield instrument/control panel along with the vendors address after final approval of the 'Pilot Plant Design'. iv) Main Control Panel of Adsorption Columns Unit to be erected & placed at a distance of 6 to 8 meters from the vessel skid. The panel should be purging type & to maintain a positive pressure of +3 PSI inside the panel. v) For Gas Fired Heater, Instrumentation System & Control Panel does not require CIMFR& DGMS certification as the Heater will be installed in safe area beyond Zone-2 which will be minimum 45 meters away from the process skid. However, all instrumentation system for heater should be intrinsically safe.	**6.0 Special Condition:** 6.1 All field mounted instruments (hazardous area) shall be 'Intrinsically Safe' under leak proof enclosure. 6.2 All signals from field instruments in hazardous area shall be routed through suitable Zener barrier/isolator. 6.3 All field instruments/control panel installed in Zone 1 are to be certified by CIMFR/ERTL and approved by DGMS as per OIL's approved safety policy as well as statutory body's requirement. Hence, the bidder to procure the various field instrumentation system/control panel which are already certified & approved by CIMFR/ERTL & DGMS and used in OIL's various installations subject to meeting the individual instrumentation design specifications. OIL will provide the list of the certified & approved only available field instrument/control panel along with the vendors address after final approval of the 'Pilot Plant Design'. 6.4 Main Control Panel of Adsorption Columns Unit to be erected & placed at a distance of 6 to 8 meters from the vessel skid. The panel should be purging type & to maintain a positive pressure of +3 PSI inside the panel. 6.5 For Gas Fired Heater, Instrumentation System & Control Panel does not require CIMFR & DGMS certification as the Heater will be installed in safe area beyond Zone-2 which will be	Roman i), ii), iii) , iv) & v) has been removed and marked as 6.1,6.2,6.3,6.4 & 6.5 under point no. 6.0 of annexure I.

Note: (i) The payment terms for the field instruments and control panel is as under – (a) The supplied field instruments including the control panel having CIMFRas well as DGMS certification will be paid 100% as per payment terms & conditions of the contract. (b) The field instruments including the control panel supplied without DGMScertification but having field trial approval of DGMS will be paid 50% of the total value of the supplied instruments/ control panel as per the payment terms & conditions of the contract. (ii) The bidder has to provide item wise cost break-up for all field instruments including control panel.	minimum 45 meters away from the process skid. However, all instrumentation system for heater should be intrinsically safe. 6.6 The payment terms for the field instruments and control panel is as under – 6.6.1 The supplied field instruments including the control panel having CIMFR as well as DGMS certification will be paid 100% as per payment terms & conditions of the contract. 6.6.2 The field instruments including the control panel supplied without DGMS certification but having field trial approval of DGMS will be paid 50% of the total value of the supplied instruments/ control panel as per the payment terms & conditions of the contract.	Note has been removed and all the points covered in the Note are included under special condition at point nos. 6.6
<u>Recommended vendor list for the instrumentation system shall be of the following make preferably.</u> Programmable Logic Controller: Allen Bradley/SIEMENS Control Panel : Rittal/Pyrotech/ICA/Altronic/Murphy Control Valves: Fisher / Fouress / Instrumentation Ltd. Transmitters (PR & Temp) : ABB/EMERSON Process/Murphy Pressure Switch:INDFOS/Switzer/Murphy Pressure & Temperature Gauges : Warrey/Bourdon/Precision/Murphy Safety Relief Valve : AIL/Farris. Solenoid Valves : ASCO / Rotex / Schradder Limit Switch/LVDT:Speed-O-Control/Remso Controls/Honeywell IS Barrier/Isolator/Repeater : P&F/MTL Digital Panel Indicator: Masibus/Honeywell/ABB	6.6.3 The bidder has to provide item wise cost break-up for all field instruments including control panel. Suggested Vendor list has been incorporated at point no. 22.0 of annexure III (attached).	Suggested Vendor list has been incorporated at point no. 22.0 of annexure III(attached).

RTD with Thermowell : Pyrotech Controls/ALTOP/General Inst./Murphy Instrument& Power cable : INCAB/Universal Cable/RPG Cables Instrument Fittings : Swagelok/Parker/IVI vales SS Tube : Sanvik Terminal Block :Phoneix/Elemex/Wago Interposing Relay : OEN/Jyoti/Omron Alarm Annunciator : IIC/Procon/Murphy Air Filter Regulator :Shavonorgren/Placka 24 V DC Power Supply :Phoenix/Silop Indicating Lamp:Concord/Telemechnic/Murphy Cable Gland :Baliga/Electromac Lugs :Dowells Junction Box: Baliga/Flexpro Chemically treated earth pit : Ashlok/Welcome World Engg/Power gomengg MCB (Miniature Circuit Breaker): MDS/HAGER/Wowells Fuse (LT): KAYCEE /GE/ALSTOM Push Button : KAYCEE/Telemechnic/Siemens Selector Switches : KAYCEE/Siemens Control switches : KAYCEE/Siemens Light Fittings (Panel Indoor) : GE/Bajaj/Philips Circuit Breaker (Inside panel): GE/Siemens/Schneider Ball Valves (for impulse line) : Flow Control/L&T/Flow Chem Globe Valves (for instruments) : L&T/Hawa valves/NECO Valves <u>GeneralSpecifications of the Instrumentation System</u>: **As per attached Annexure-II (attached)**		

9.0	**Valves:**		
9.1	The valves shall be selected as per the process condition and shall be procured from L&T, Virgo Valves & Controls. For hydrocarbon service, ball valves to be used.	Point no. 9.0 has been Incorporated at point no. 15.0 of Annexure III (attached).	Point no. 9.0 has been Incorporated at point no. 15.0 of Annexure III (attached).
9.2	Valve trim in hydrocarbon service shall be suitable for hydrocarbon with 10% carbon dioxide.		
9.3	All valves shall be of fire safe type as per API 1607 / BS 5146. Fire safe test shall be as per the standard and test certificate shall be furnished.		
9.4	Body, bonnet, cover etc. of all valves shall be from carbon steel casting or forged steel. Steel casting orforging shall be of radiographic quality as per procedure and acceptance criteria specified in ANSI B 16.34 – 1977.		
9.5	All valves shall be with flanged ends as per ANSI B 16.5.		
10.0	**Pipes and Fittings:**		
10.1	All piping materials and fabrication shall conform to ANSI B 31.3 (latest edition).	Point no. 10.0 has been removed & Incorporated at point no. 17.0 of Annexure III (attached).	Point no. 10.0 has been Incorporated at point no. 17.0 of Annexure III (attached).
10.2	All carbon steel fittings shall be as per ASTM A 234 WPB seamless.		
10.3	The vendor shall provide and connect all inter-all drain headers etc. Spool pieces, if required shall be provided to finally connect by the bidder to adjacent skids (if the number of skids is more than one) together at site.		
10.4	All connection in piping, valves etc. shall be through weld neck forged carbon steel flanges as per ANSI B 16.5.		
10.5	All pipe fittings shall be from carbon steel made through forging. Fabricated fittings such as bends, elbows, tees etc. made through welding are not allowed.		

10.6 All welding joints shall be of radiographic quality as per API 1104 and at least 20% of the welding joints shall be radio graphed and radiographic films submitted to OIL. 10.7 Piping shall be arranged in such a manner to avoid crisscrossing or overhead problems. Piping or tubing of insufficient mechanical strength for standing or hanging shall be protected from personnel traffic. 10.8 All sub-suppliers items e.g., instruments, valves, pipes fittings etc. shall be from reputed manufacturer / supplier and should conform to relevant codes and standards. Note: Since the plant equipment will be exposed above 250 deg C, all valves /pipes / pipe fitting metallurgy shall be selected accordingly .		
11.0 Codes and Standards: The following codes and standards will apply: ASME VIII DIV. 1 Latest Edition ASME Section IX - Do- ANSI B 16.5 - Do- ANSI B 31.3 - Do-	Point no. 11.0 has been removed & Incorporated at point no. 19.0 of Annexure III (attached).	Point no. 11.0 has been removed & Incorporated at point no. 19.0 of Annexure III (attached).
12.0 Skids: 12.1 Each unit like adsorption column, heater, filter etc along with its instruments should be skid mounted. The skids should be fabricated from suitable structural steel section. The skids must be rugged and compact, being designed for transportation by trailer and fitted with two bars. Vendor to provide lifting arrangements for all the skids and minimum number of skid should be employed. Details of bolting down	Point no. 12.0 has been removed and incorporated at point no. 20.0 of annexure III(attached) under heading “Mounting”	Point no. 12.0 has been removed and incorporated at point no. 20.0 of annexure III(attached) under heading “Mounting”

for skids to be provided by vendor.		
13.0 Material of Construction: Materials to be used as follows: Vessels / Tanks:SA-515 Gr. 60 / 70 / IS:2002 Gr. 2 Shell flanges : SA-105 Nozzle flanges : SA-105 Supports : SA-283 Gr. C/IS:226 Nuts & Bolts : SA 193 Gr. B7 SA 194 Gr. 2H Materials for pipes, flanges, fittings to be in accordance with ANSI B31.3 / API 51 / ANSI B16.5. Material for instrument piping to be annealed seamless 316 stainless steel with Swagelok type fittings.	Point no. 13.0 has been removed and incorporated at point no. 18.0 of annexure III(attached).	Point no. 13.0 has been removed and incorporated at point no. 18.0 of annexure III(attached).
14.0 <u>Available Utilities:</u> **14.1 Electrical Power Supply:** Rated voltage : 240 V-AC (± 10%), 3 phase Rated frequency : 50 Hz (± 3%) Control voltage : 240V, 1 phase **14.2 Instrument Air:** Operating Pressure : 6 - 9 $kg/cm^2(g)$ (Normal / Maximum).		Point no. 14.0 has been removed.

Temperature : 65°C Maximum		
15.0 Inspection: Vendor to provide a schedule of onsite inspection for the manufacturing stages including bought-out items of instrumentation and controls with the tender at Vendor's Works. All materials to be used in the process of manufacturing are to be provided with test certificates. OIL's personnel may visit at any stages of execution of the job for which necessary facility and co-operation will have to be extended by the vendor and minimum 15 days prior intimation is required for schedule inspections.	Point no. 15.0 has been removed and incorporated at point no. 7.0 of annexure I(attached).	Point no. 15.0 has been removed and incorporated at point no. 7.0 of annexure I(attached).
16.0 Painting & Insulation: The equipment and skids are to be externally painted for environmental protection after thorough cleaning. As a minimum, this is to include zinc rich primer (1 coat) and epoxy based final covering. Vendor to provide the proposed specification with his tender. Cleaning shall be done through sand blasting before painting with spray. The heater delivery line (hot surfaces) shall be properly insulated with and then covered with aluminum sheet jacket.	Point no. 15.0 has been removed and incorporated at point no. 9.0 of annexure I(attached).	Point no. 15.0 has been removed and incorporated at point no. 9.0 of annexure I(attached).

17.0 Guarantee: 17.1 Vendor to stand guarantee for a period of 6 months from the date of successful commissioning of the plant for any type of mechanical, instrumentation design failures including performance of the equipment and instruments at specified conditions. 17.2 Guarantee period will start from the date the plant operates satisfactorily as per design parameters and ordered specifications.	Point no. 17.0 has been removed and incorporated at point no. 10.0 of annexure I(attached).	
18.0 Spares and Adsorbents: Spares and adsorbents wherever required for successful testing, commissioning and operation of the unit after erection at sites in all respect must be supplied by the vendor at their own cost.	Point no. 18.0 has been removed and incorporated at point no. 12.0 of annexure I(attached).	Point no. 18.0 has been removed and incorporated at point no. 12.0 of annexure I(attached).
19.0 **Testing and Commissioning:** 19.1 The vendor will be responsible for testing and commissioning of the unit at site. The commissioning period will be for 3 days (72 hours) and will be counted from the time when the plant becomes normal and operates as per design / ordered parameters. If the plant requires to be shut down before completion of 03 days operation period due to malfunctioning of equipment, instruments etc. supplied by the vendor, 03 days operation period will be counted afresh. Only after continuous operation of the unit for a period of 3 days (72 hours), it will be considered as commissioned successfully. 19.2 If any malfunction, abnormality occurs during trial/commissioning period, the party to rectify the same at their own expense.	**8.0 Testing and Commissioning** 8.1 The vendor will be responsible for testing and commissioning of the unit at site. The commissioning period will be for 3 days (72 hours) and will be counted from the time when the plant becomes normal and operates as per design / ordered parameters. If the plant requires to be shut down before completion of 03 days operation period due to malfunctioning of equipment, instruments etc. supplied by the vendor, 03 days operation period will be counted afresh. Only after continuous operation of the unit for a period of 3 days (72 hours), it will be considered as commissioned successfully. 8.2 If any malfunction, abnormality occurs during trial/commissioning period, the party to rectify	Point no. 19.0 has been removed and incorporated at point no. 8.0 of annexure I(attached).

	the same at their own expense.	
20.0 **Operation and maintenance:** 20.1 The pilot plant is expected to operate for 3 (three) months (90 days) continuously for establishing the process parameters and operating principle for a scaled up plant. The vendor shall have to provide round the clock operation and maintenance of the plant during this period. Accommodation and transportation for the vendor's staff during this period shall be arranged by the vendor. OIL may provide accommodation on chargeable basis. 20.2 Charges for operation and maintenance shall be quoted separately on per month basis.	Point no. 20.0 has been removed and incorporated at point no. 11.0 of annexure I(attached).	Point no. 20.0 has been removed and incorporated at point no. 11.0 of annexure I(attached).
21.0 Exception and Deviation: Vendor should mention separately, in clear terms the deviations and exclusions in his offer from the tender specification.	Point no. 21.0 has been removed and incorporated at point no. 13.0 of annexure I(attached).	Point no. 21.0 has been removed and incorporated at point no. 13.0 of annexure I(attached).
22.0 Delivery Schedule: Bidders are to give their best realistic delivery schedule.	Point no. 22.0 has been removed and incorporated at point no. 14.0 of annexure I(attached).	Point no. 22.0 has been removed and incorporated at point no. 14.0 of annexure I(attached).
	15.0 Bidding details: *The bidders should also include the following in their bid documents* *15.1 An undertaking that detailed Mechanical/ Engineering Design with P&ID drawing along with electrical/PLC and structural layout will be submitted if the order is placed on them.* *15.2 At least 12 months warranty for the test facility along with all its components will be provided.* *15.3 Complete information / data in order to*	Point no. 15.0 of annexure I (attached) has been newly incorporated.

	avoid seeking any clarification on the bid documents. *15.4 Material Supply: Cost of the materials along with transportation charge, taxes and insurance, if any. The optional items indicated should be quoted separately item wise.* *15.5 Erection & Commissioning: Cost of erection and commissioning of the plant at OIL site.* *15.6 In the price bid, bidders to quote the following:* *15.6.1 Material Supply (Lump Sum): Cost of the materials alongwith transportation charge, taxes and insurance, if any.* *15.6.2 Erection & Commissioning at site (Lump Sum) : Erection and commissioning of the plant.* *15.6.3 Operation & Maintenance (Per Month): Operation and Maintenance cost of the plant* *15.7 After the placement of the order to the successful bidder, the party will be asked to:* *15.7.1 Submit a detailed drawing and technical specification of all equipment of the test facility to OIL before fabrication for approval. P&ID, different flow circuits, pressure/temperature control circuits etc. should also be included in this document.* *15.7.2 Arrange for pre-delivery inspection* 15.7.3 *Ensure post-commissioning training to the OIL personnel for operation of the pilot plant.*	
	Point no. 16 & 23 are newly incorporated at annexure III (attached) and it should be part of the tender document.	Point no. 16 & 23 are newly incorporated. Shown in annexure III (attached) and it should be part of the tender document.

Process flow Diagram	Attached as Annexure II.	**The following changes are made –** **(i) 2 nos. electric heaters from 01 no. gas fired heater.** **(ii)one no. gas cooler** **(iii) 06 nos. heavy HC removal vessels instead of 02 nos.**
Instrumentation Data Sheets	Attached as Annexure IV	Elaborately explained.
Detailed Process description and hardware Requirements	Attached as Annexure-III	Elaborated and changes are made to suit the new process requirement.

ANNEXURE-I

1.0 Introduction

Oil India Limited (hereinafter referred to as OIL) is a premier National Oil Company engaged in the business of Exploration, Production & Transportation of Crude Oil & Natural Gas. Its operations are largely based in the North-Eastern part of India particularly in Assam and Arunachal Pradesh but extended its activities in different parts of India and abroad.

OIL uses natural gas at 13-15 kg/cm² for artificial lifting after compression to 80-90 kg/cm². This gas contains considerable amount of heavier (C_{5+}) hydrocarbons and saturated water vapour. OIL is interested to establish a suitable plant for removal of these heavier fractions of hydrocarbons (C_{5+}) and water vapour through adsorption process. Initially, OIL would like to setup a pilot plant to study the feasibility of the same.

Therefore OIL invites tender for Design, Fabrication, Supply, Installation and Commissioning of a Pilot Plant for removal of heavier Hydrocarbons (C_{5+}) and Saturated Water Vapours from Natural Gas by Adsorption Process in the field of OIL INDIA LIMITED in Upper Assam region of India.

2.0 Process Description

Objective of the process is to clean up the rated quantity of natural gas and remove moisture and C_{5+} Hydrocarbons (HC). Natural gas at 50°C (approx.) and 15 kg/cm^2 pressure shall pass through a Coalescence type Filter Separator for removal of any liquid in the flow stream. There are eight adsorption beds in the process (two for water vapour and six for HC removal). At a time, four (one for water vapour and three for HC removal) will run in adsorption mode and the other four will run in the desorption mode. The outlet stream of natural gas from the filters will pass successively through adsorption beds for water vapour and HC removal. Once adsorption beds are saturated, they will be switched over to the regeneration mode and the regenerated beds will be switched into the adsorption mode.

The dry gas (free of water vapour and heavier HCs) shall be delivered for downstream utilization. A part of the processed dry gas shall be used for high temperature regeneration of the saturated adsorption beds. In addition, if the required flow of hot regenerated gas is large, some raw feed gas may also be mixed with this stream before sending it through the electric heater. The electric heater shall heat this desired amount of gas for regeneration up to a temperature of about 300°C. The hot gas from the heater is then sent to the beds for regeneration at low pressure (~ 2-3 kg/cm^2). This stream laden with high content of moisture and/or heavy HC at the outlet of the beds, will be delivered to a nearby oil processing station.

A process flow diagram (PFD) of the pilot plant is shown in Annexure II. More elaborate description of process, required instrumentation and hardware is given in the Annexures III and IV.

It may be noted here that IIT Guwahati is the consultant for the said Project and will be associated with OIL for the whole project including installation & Commissioning till testing of the complete pilot plant project in cycle.

3.0 Process Design Basis

3.1 Feed Condition

1) Feed Gas Flow Rate (Capacity) : 1,000 SCMD
2) Regeneration gas flow rate : 2,000 SCMD
3) Inlet Pressure (Maximum) : 15.0 kg/cm^2
4) Inlet Gas Temperature : 50^0C
5) Inlet Gas composition (Vol.%) **:** an approximate range of gas composition as indicated below –

Methane	:	83.70
Ethane	:	6.80
Propane	:	4.50
i-Butane	:	1.00
n-Butane	:	1.30
Pentane	:	0.80
Hexane plus	:	0.70
Nitrogen	:	0.20
Carbon dioxide	:	1.00
Moisture	:	5000 ppm
Total	:	100.00

3.2 Climatic Conditions

Maximum shed temperature : 45 ^0C
Minimum shed temperature : 6 ^0C
Relative humidity : at 21 ^0C = 100%
at 32 ^0C = 95%
at 41 ^0C = 70%
Height above sea level : Duliajan 119 m (392 ft.)
Average rainfall : 300 cm.
Minimum Ambient temperature : 5 ^0C

4.0 Scope of Work

This is a TURN KEY PROJECT.
The scope of work includes but not limited to the following:

4.12 Development of P&ID, detailed engineering design of all the hardware and software including PLC, for the pilot plant.

4.13 Vendor will submit all the detailed design, P&ID, other drawings, control logic, etc. of the pilot plant to OIL before starting of construction of the pilot plant.

4.14 The land footprint with height clearance, power requirement and water supply requirement should be clearly spelt out by the vendor and needs to adhere to the facilities available at the OIL site. Finalization of the engineering design and P&ID diagram, etc. will be based on mutual agreement between OIL and the vendor. Construction of the pilot plant and procurement of bought out items shall only be started after final clearance from OIL.

4.15 Procurement and supply of all bought out items like valves, control valves, instruments, control panel(s), packing material and any other items required for fabrication of the pilot plant.

4.16 Fabrication and assembling all components (hardware & software) to make the pilot plant

4.17 Cleaning, painting, and insulating the process equipment wherever required.

4.18 Transportation of all components of the pilot plant to OIL. The vendor will make necessary insurance coverage during transportation of the pilot plant and its components to OIL.

4.19 Erection and commissioning of the unit at the designated site in OIL.

4.20 The vendor shall be responsible for the testing facility to be completed with all equipment, controls, instrumentation, software necessary to make the unit a self-contained one for smooth and safe operation.

4.21 Vendor shall also be responsible for commissioning activities to be performed at OIL to the full satisfaction of OIL.

4.22 The vendor will also ensure post-commissioning training to OIL personnel/representatives on the operation of the pilot plant.

This specification is not to be interpreted as limiting whereby the vendor is relieved of meeting the requirements specified herein.

5.0 Instrumentation

The instrumentation and control system requirement pertaining to this project is envisaged as per the following, in addition to the instrumentation and hardware included in Annexure III. However, the final quantity/specific range/exact requirement will depend on the mutually agreed version of the P&ID as indicated in the Scope of Work.

5.1 Provision for automatic emergency safety shutdown along with suitable ON/OFF valves.

5.2 All the instrumentation (for measurement/control of temperature, pressure, flow, etc.) will include independent display units at a suitable central location.

5.3 All field instruments shall be hooked up with the PLC control panel for necessary display & monitoring, start/stop actions, control etc.

5.4 All materials used are to be provided with test certificates.

5.5 The instrumentation work shall include design, engineering, calibration, testing, installation, supply, erection and commissioning of field instruments, local control panel(s) and instrumentation cable with all accessories, cable trays, junction boxes, erection hardware etc. as per requirements.

5.6 The following selected one or all instrumentation works are envisaged as minimum but shall not be limited to:

5.6.1 Engineering, supply, erection, testing and commissioning of field instruments, Burner Management System, instrumentation cables, junction boxes, serial link cable for PLC, Control Panels etc.

5.6.2 Cable lying through cable tray/cable trench from Gas Fired Heater/ Adsorption Columns/Gas-Gas Heat Exchanger to control panels via junction boxes with proper glanding, termination, ferruling, dressing etc.

5.6.3 Installation of junction boxes, I/O cabinets in the control panels.
5.6.4 Calibration of all instruments, leak test/hydro test of instrument impulse pipe, tubes, fittings etc.
5.6.5 To interface all instrumentation signals with the Programmable Logic Controller (PLC) in the control panel.
5.6.6 Supply of erection hardware's like cable gland, cable trays, support, SS tubing, fittings, flanges, valves, manifold, impulse tubing etc.
5.6.7 Supply of mandatory recommended spares for smooth running of the pilot plant after Post Commissioning Warranty.
5.6.8 Preparation of engineering drawing/documents/data sheet/P&ID etc.
5.6.9 Erection, testing & commissioning of ON-OFF control valves at the inlet & outlet of Adsorption columns.
5.6.10 Necessary control logic shall be developed in the Programmable Logic Controller (PLC) for smooth operation & safety shutdown of the pilot plant as well as display of critical parameters in the control panel(s) along with indicating lamp.
5.6.11 Interconnecting Gas Heater Control Panel and main Control Panel of Adsorption Unit for safety interlock.
5.6.12 The system is to be provided complete with all instrumentation and valves for automatic operation and shutdown at all stages of the system. All pressure vessels are to be fitted with pressure safety valves.
5.6.13 All control valves and metering systems are to be provided with manually operated by-pass arrangements. All instruments should be provided with suitable isolation valves on both sides to enable proper maintenance.

6.0 Special Condition:

6.1 All field mounted instruments (hazardous area) shall be 'Intrinsically Safe' under leak proof enclosure.
6.2 All signals from field instruments in hazardous area shall be routed through suitable Zener barrier/isolator.
6.3 All field instruments/control panel installed in Zone 1 are to be certified by CIMFR/ERTL and approved by DGMS as per OIL's approved safety policy as well as statutory body's requirement. Hence, the bidder to procure the various field instrumentation system/control panel which are already certified & approved by CIMFR/ERTL & DGMS and used in OIL's various installations subject to meeting the individual instrumentation design specifications. OIL will provide the list of the certified & approved only available field instrument/control panel along with the vendors address after final approval of the 'Pilot Plant Design'.
6.4 Main Control Panel of Adsorption Columns Unit to be erected & placed at a distance of 6 to 8 meters from the vessel skid. The panel should be purging type & to maintain a positive pressure of +3 PSI inside the panel.
6.5 For Gas Fired Heater, Instrumentation System & Control Panel does not require CIMFR & DGMS certification as the Heater will be installed in safe area beyond Zone-2 which will be minimum 45 meters away from the process skid. However, all instrumentation system for heater should be intrinsically safe.
6.6 The payment terms for the field instruments and control panel is as under –
6.6.1 The supplied field instruments including the control panel having CIMFR as well as DGMS certification will be paid 100% as per payment terms & conditions of the contract.
6.6.2 The field instruments including the control panel supplied without DGMS certification but having field trial approval of DGMS will be paid 50% of the total value of the supplied instruments/ control panel as per the payment terms & conditions of the contract.

6.6.3 The bidder has to provide item wise cost break-up for all field instruments including control panel.

7.0 Inspection

Vendor to provide a schedule of onsite inspection for the manufacturing stages including bought-out items of instrumentation and controls with the tender at Vendor's Works. All materials to be used in the process of manufacturing are to be provided with test certificates. OIL's personnel may visit at any stages of execution of the job for which necessary facility and co-operation will have to be extended by the vendor and minimum 15 days prior intimation is required for schedule inspections.

8.0 Testing and Commissioning

8.1 The vendor will be responsible for testing and commissioning of the unit at site. The commissioning period will be for 3 days (72 hours) and will be counted from the time when the plant becomes normal and operates as per design / ordered parameters. If the plant requires to be shut down before completion of 03 days operation period due to malfunctioning of equipment, instruments etc. supplied by the vendor, 03 days operation period will be counted afresh. Only after continuous operation of the unit for a period of 3 days (72 hours), it will be considered as commissioned successfully.

8.2 If any malfunction, abnormality occurs during trial/commissioning period, the party to rectify the same at their own expense.

9.0 Packing and Insulation

9.1 The equipment and skids are to be externally painted for environmental protection after thorough cleaning. As a minimum, this is to include zinc rich primer (1 coat) and epoxy based final covering. Vendor to provide the proposed specification with his tender. Cleaning shall be done through sand blasting before painting with spray.

9.2 The heater delivery line (hot surfaces) shall be properly insulated with and then covered with aluminum sheet jacket.

10.0 Guarantee

10.1 Vendor should stand guarantee for a period of 6 months from the date of successful commissioning of the plant for any type of mechanical, instrumentation design failures including performance of the equipment and instruments at specified conditions.

10.2 Guarantee period will start from the date the plant operates satisfactorily as per design parameters and ordered specifications.

11.0 Operation and Maintenance

11.1 The pilot plant is expected to operate for 3 (three) months (90 days) continuously for establishing the process parameters and operating principle for a scaled up plant. The vendor shall have to provide round the clock operation and maintenance of the plant during this period. Accommodation and transportation for the vendor's staff during this period shall be arranged by the vendor. OIL may provide accommodation on chargeable basis.

11.2 Charges for operation and maintenance shall be quoted separately on per month basis.

12.0 Spares and adsorbents

Spares wherever required for successful testing, commissioning and operation of the unit after erection at the sites in all respect must be supplied by the vendor at their own cost.

13.0 Exception and Deviation:

Vendor should mention separately, in clear terms the deviations and exclusions in his offer from the tender specification.

14.0 Delivery Schedule:

Bidders are to give their best realistic delivery schedule.

15.0 Bidding details:

The bidders should also include the following in their bid documents

15.1 An undertaking that detailed Mechanical/ Engineering Design with P&ID drawing along with electrical/PLC and structural layout will be submitted if the order is placed on them.

15.2 At least 12 months warranty for the test facility along with all its components will be provided.

15.3 Complete information / data in order to avoid seeking any clarification on the bid documents.

15.4 Material Supply: Cost of the materials along with transportation charge, taxes and insurance, if any. The optional items indicated should be quoted separately item wise.

15.5 Erection & Commissioning: Cost of erection and commissioning of the plant at OIL site.

15.6 In the price bid, bidders to quote the following:

15.6.1 Material Supply (Lump Sum): Cost of the materials alongwith transportation charge, taxes and insurance, if any.

15.6.2 Erection & Commissioning at site (Lump Sum) : Erection and commissioning of the plant.

15.6.3 Operation & Maintenance (Per Month): Operation and Maintenance cost of the plant

15.7 After the placement of the order to the successful bidder, the party will be asked to:

15.7.1 Submit a detailed drawing and technical specification of all equipment of the test facility to OIL before fabrication for approval. P&ID, different flow circuits, pressure/temperature control circuits etc. should also be included in this document.

15.7.2 Arrange for pre-delivery inspection

15.7.3 Ensure post-commissioning training to the OIL personnel for operation of the pilot plant.

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SECTION # B

(i) For any HSE matters not specified in the contract document, the contractor will abide the relevant and prevailing Acts/rules/regulations/ pertaining to Health, Safety and Environment.

(ii) Contractor will be allowed to work normally during working hours i.e. from 7 AM to 3 PM. Sometimes in special circumstances this duration may be extendable upto 5 PM with due permission from Installation Manager / OIL's Engineer.

(iii) All expenses including air fare, boarding, lodging, enroute expenses etc. will be borne by the successful bidder.

(iv) All the required commissioning tools shall be arranged by the contractor.

(v) The site will be made available to vendor in properly graded condition. M/s. Oil India Limited will provide only necessary support during the unloading and installation on the civil foundation.

(vi) For sampling purpose, sampling ports at inlet and outlet at designated locations with manual valves are to be provided.

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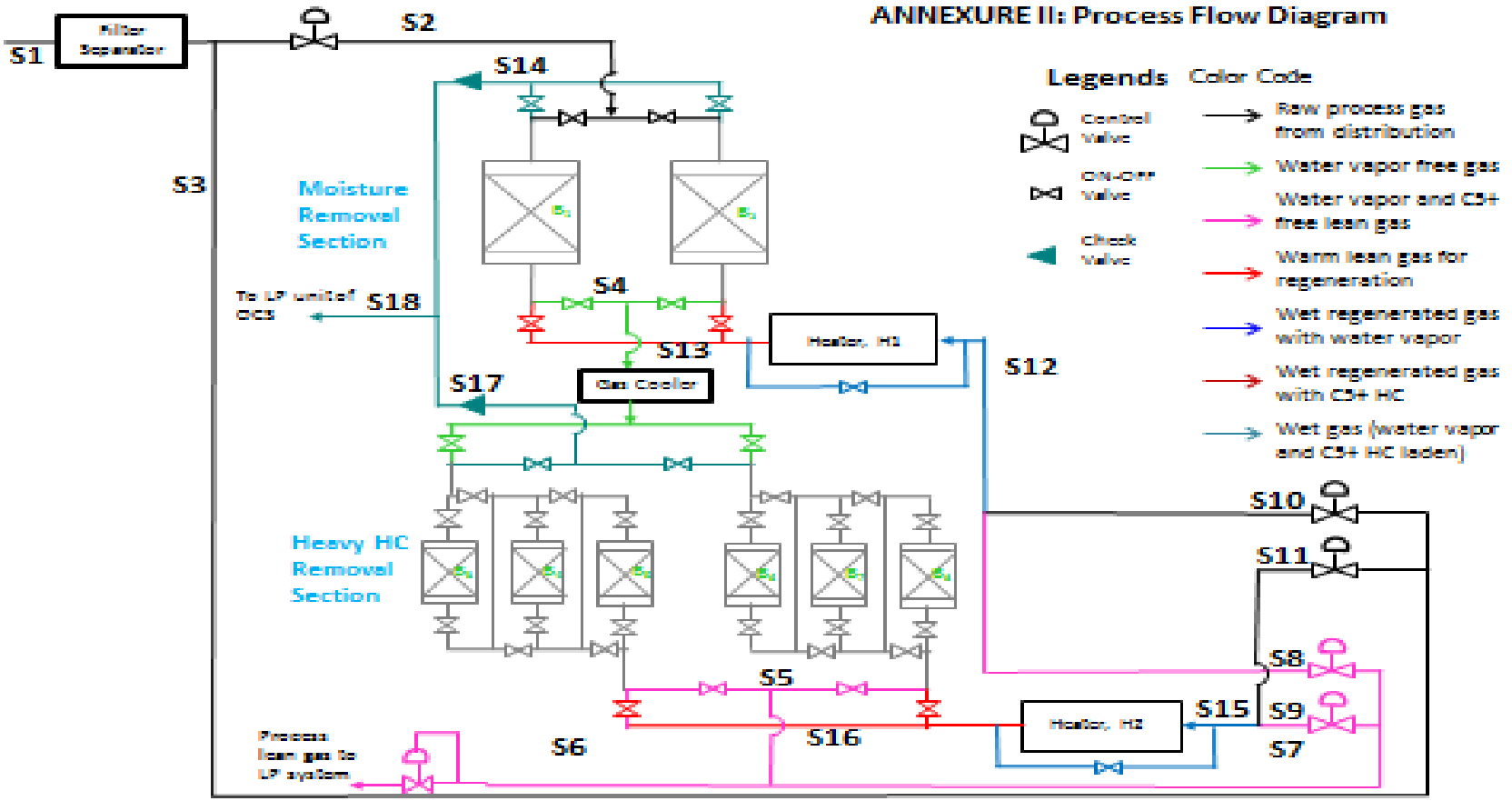
ANNEXURE II: Process Flow Diagram
Legends
Color Code
Control Valve
ON-OFF Valve
Check Valve
Raw process gas from distribution
Water vapor free gas
Water vapor and C5+ free lean gas
Warm lean gas for regeneration
Wet regenerated gas with water vapor
Wet regenerated gas with C5+ HC
Wet gas (water vapor and C5+ HC laden)
Filter Separator
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
S13
S14
S15
S16
S17
S18
Moisture Removal Section
Heavy HC Removal Section
Gas Cooler
Heater, H1
Heater, H2
To LP unit of OCS
Process lean gas to LP system

ANNEXURE-III

Detailed Process Description and Hardware Requirements

The following is a detailed description of the process (refer to process flow diagram in Fig. 1) along with hardware, instrumentation and other engineering requirements. All the instrumentation (for measurement/control of temperature, pressure, flow, level, mass etc.) will include independent display units at a suitable central location. All the adsorption columns / equipment will be exposed to around 300°C, all equipment /vessels instrument and materials shall be selected accordingly. The design pressure should be 20 kg/cm^2.

1.0 Process Gas: The process gas is a slip stream from an existing pipeline network at one of the gas collection stations (GCS) of OIL India limited. This stream (S1) is passed through a filter separator to remove entrained liquid before splitting it into streams S2 and S3. The stream S2 will be the feed to adsorption beds (max. flow rate of 1000 SCMD). The stream S3 is further split into S10 and S11 to be used in the regeneration step (max. flow rate of 1000 SCMD). The likely composition of this stream is as indicated in the Section 3.1 of Annexure I.

2.0 Filter separator: A chamber for efficient removal of entrained liquid in the gas/vapor stream has to be placed before the moisture removal column. This operation may reduce the load on the column(s). The separator should be suitably designed to handle the throughputs expected during the operation. The expected maximum flowrate of stream S1 is 2000 SCMD.

Monitoring & Control of Filter Separator should include:

- Differential Pressure(DP) Gauge
- Local pressure gauges for Inlet & Outlet of Filter Separator
- Pressure transmitter in the filter separator outlet. The pressure transmitter signal to be feed to the Main Programmable Logic Controller for controlling columns operation based on the minimum & maximum permissible pressure limit as per design basis.

3.0 Adsorber Columns: There are eight adsorption beds (B1-B8) in the unit. While beds B1 and B2 will be used for moisture removal, beds B3-B8 will be used for removal of C5+heavy hydrocarbons. At any given time, one of the two beds (B1 or B2) will be in adsorption mode for removal of moisture, while the other one will be in regeneration mode. Similarly three (B3-B5 or B6-B8) of the six beds will be in adsorption mode for removal of heavy hydrocarbons, while the other three will be in the regeneration mode.

Each beds should be suitably designed to contain the adsorbent material with appropriate support screens. A suitable design should also be provided for good distribution of gas/vapors at the top and bottom of each one of the beds.

All the above adsorption beds shall be complete with necessary instrument, controls for automatic switching of adsorption and regeneration (desorption) cycles. Valves and timers are needed for switch over of streams between adsorption and regeneration beds as described in the process.

Monitoring & Control of Adsorption beds should have the following specifications:

- ON/OFF control valves as indicated in the Process flow diagram (Annexure II).

- Automatic changeover of columns from adsorption to regeneration & vice versa after completion of definite time cycle operation, sequence of operation of control valves either in ON or OFF mode in the inlet & outlet sections of the respective columns through a dedicated Programmable Logic Controller (PLC). Provision for automatic emergency safety shutdown, manual step-up & step-down of time cycle operation of adsorption columns & manual changeover of adsorption column whenever process condition demands. In addition, provision should also be available to operate valves such that the beds B3-B5 (and B6-B8) can be run either in series or in a parallel fashion to accept the feed or regeneration gas.
- Pressure Transmitter(s) for adsorption columns (Total 8 nos. one each for beds B1-B8).
- RTDs with thermowell along the height of each bed spaced at a distance of about 1 meter.
- Temperature transmitters for all the above RTDs
- Pressure gauges on each columns for local indication
- Pressure & temperature switches for each columns for safety shutdown
- Limit switches/LVDT for columns inlet & outlet valves status like ON/OFF and opening/closing position & sequence interlock and safety shutdown.

4.0 Column packing: The columns will be packed with suitable adsorbent materials. The beds B1 and B2 will be packed with 4A molecular sieves (1/16" pellets). Beds B3-B8 will be packed with Silica Gel beads 2- 5 mm.

The physical properties of the adsorbents to be supplied are as follows.

- Molecular sieve 4A:
  - Size: 1/16" pellets or 2-4 mm spherical beads
  - Water adsorption capacity: 20 wt % minimum at 18 mm Hg and 25°C
- Silica gel
  - Size: 2-5 mm spherical beads
  - Pure methane (CH_4) capacity: not more than 11 cc at STP/gm of silica gel at partial pressure of 9 bar and 20°C and not more than 6 cc at STP/gm of silica gel at partial pressure of 93 bar and 75°C.
  - Pure n-pentane (C_5H_{12}) capacity: At least 40 cc at STP/gm of silica gel at partial pressure of 0.3 bar and 20°C and at least 6.5 cc at STP/gm of silica gel at partial pressure of 0.3 bar and 75°C.
  - BET Surface area: Minimum 550 m^2/g

The adsorbents should be procured from reputed vendors such as Linde, UOP, M/s Chemicals India Company, M/s Drier Chemicals, M/s Sud Chemie etc. The samples should be validated with OIL before actual purchase by the vendor.

5.0 Electric heater: For heating the process gas to be used in regeneration of the adsorbent beds, two electric heaters (one each for hydrocarbon removal and moisture removal sections) will be used. A dedicated temperature control function for maintaining the regeneration gas temperature between 130 - 300 deg C should be provided for each one of the heaters.

- Temperature transmitter(s) and display units including provision for local display
- Heater temperature transmitter for indication & safety shutdown
- Emergency manual shutdown, temperature & pressure indications, indicating Lamp etc. should be included along with all standard accessories as per standard engineering practice.

- All electric heaters should be provided with automatic bypass valves.

6.0 Gas Cooler: A intermediate gas cooler is to be provided in stream S4, to cool the dehydrated gas (max. flow rate 1000 SCMD). The heat exchanger should be designed to cool the gas by 50 deg C. Running utility water for the cooler will be available, if necessary.

7.0 Pressure Control Valve with pressure controller: Up-stream control valve will be used for transferring process lean gas to Low Pressure system.

8.0 Check valve: Check valves will be used as necessary to ensure one way flow of regeneration wet gas into the LP unit. In addition, check valves should be included at other locations as per standard engineering practice.

9.0 Gas Flow Measurement and Control Valve flow controller:

Monitoring & Control of gas flow measurement and flow control should have the following specifications:

- Gas Flow Measurement & flow control are need in streams S2, S8, S9, S10 and S11 (Annexure II).
- For Gas Flow Application (flow measurement) multivariable transmitter along with orifice plate shall be used.
- All the above Gas Flow Calculation to be done in PLC with necessary programming software meeting requirement as per AGA-3.
- Multivariable transmitter shall be of electronic smart type transmitter compatible with fieldbus protocol of latest version with capability to handshake with any communicating device. This transmitter shall have RTD connectivity also for flow calculation as well as transmitting temperature to PLC.
- Accuracy of the transmitter should not be degraded beyond ±0.15%.
- PLC's must be compatible for gas flow allocution with sufficient memory (RAM) and display must be in the TFT display monitor.
- Control valve(s) with positioned & I/P converter and flow control action (PD or PID) from main Programmable Logic Controller (PLC).

10.0 Temperature indicators, transmitters and controllers: The pilot plant is being installed as a R&D unit. The process data will be collected extensively. Hence, several temperature transmitters are to be placed along the length of the beds as indicated in section 3.0 in this annexure. All temperature transmitters in the adsorber beds will be well inserted into the solid adsorbent bed and be hermitically sealed. In addition to the above temperature transmitters and that needed in the temperature control in the heaters, additional transmitters as needed in the process unit as per standard engineering practice should be included. All the temperature transmitters should be linked to the PLC display.

All the transmitters will be 4-wire duplex RTD and thermo well's immersion length shall be suitable for the line size. RTD element shall be Pt 100 and it will be as per DIN 43760 and accuracy will be class A.

11.0 Pressure indicators, transmitters and gauges: In addition to the pressure transducers on the adsorber columns as indicated in section 3.0 in this annexure and in the electric heater units, additional pressure transmitters are needed for streams S2, S3, S6, S12, S14, S15 and S17. Additional transmitters as per standard engineering practice and necessary for safe operation of the unit should also be included. All pressure transducers should be linked to the PLC. Pressure gauges shall be provided at several locations in the process unit for local monitoring as per standard engineering practice.

12.0 Pressure safety valves: All the adsorber columns and heaters and other sub-units of the process should be equipped with suitable pressure safety valves to prevent over pressurization.

13.0 Sampling points: Sampling points on the gas lines will be suitably designed along with necessary manual valves, so that samples can be withdrawn safely for analysis. The sampling points to withdraw gas samples shall be provided on S2, S4, S5 (3 nos.), S12, S14, S15 and S17 (3 nos.).

14.0 Insulation: All the pipelines for hot regeneration gas streams will be well insulated to minimize heat loss as described in section 9 of Annexure I.

15.0 Valves:

- The valves shall be selected as per the process condition and shall be procured from L&T, Virgo Valves & Controls. For hydrocarbon service, ball valves to be used.
- Valve trim in hydrocarbon service shall be suitable for hydrocarbon with 10% carbon dioxide.
- All valves shall be of fire safe type as per API 1607 / BS 5146. Fire safe test shall be as per the standard and test certificate shall be furnished.
- Body, bonnet, cover etc. of all valves shall be from carbon steel casting or forged steel. Steel casting or forging shall be of radiographic quality as per procedure and acceptance criteria specified in ANSI B 16.34 – 1977.
- All valves shall be with flanged ends as per ANSI B 16.5.
- In addition to the ON/OFF valves indicated in the process flow diagram all the sections of the unit should be equipped with isolation valves (not included/shown in the PFD) as per standard practice.
- All solenoid valves to be housed in a separate enclosure with proper air supply regulator & filters assembly and to be placed near the near the main control panel for interlinking.

16.0 Control panel:

- A dedicated main control panel for the adsorption columns which will comprise of Master Programmable Logic Controller, critical parameters display along with indicating lamps, start/stop & sequence of columns operation after getting required feedback signal (safety interlock) from the electric Heater & vice versa, all standard accessories in the control panel as per standard engineering practice.
- All field instruments shall be hooked up with the respective PLC control panel for necessary start/stop, display& monitoring, sequence interlock & safety shutdown, gas flow calculation as per AGA-3. All control logic for sequence of operation and safety shutdown of the unit to be developed accordingly.
- The unit will be controlled through a single PLC placed at a suitable location. A high resolution (1024 x 768, 18-bit color graphics) TFT display monitor unit with touch screen/ key board for monitoring of all parameters like Pressure, Temperature, Flow, Valves status(ON/OFF) etc. including alarm & graphical display shall be considered in PLC control panel. This LCD display unit shall be hooked up with the PLC through suitable communication protocol (Ethernet, RS 232, RS 485 etc.).
- Based on the process flow diagram (Annexure II), total requirement of field & control instrumentation system for the entire process unit should be assessed and instrumentation should be designed accordingly. This should include implementation of complete operation logic, sequence of control operation and safety shutdown.

- Field Transmitters should be intrinsically safe under leak proof enclosure for use in hazardous area. Function of the transmitter shall be transmission as well as indication. Type of transmitter shall be of electronic smart type transmitter compatible with fieldbus protocol of latest version with capability to handshake with any communicating device. The enclosure should be weather proof to IP 65.

17.0 Pipes and Fittings:

- All piping materials and fabrication shall conform to ANSI B 31.3 (latest edition).
- All carbon steel fittings shall be as per ASTM A 234 WPB seamless.
- The vendor shall provide and connect all inter- all drain headers etc. Spool pieces, if required shall be provided to finally connect by the bidder to adjacent skids (if the number of skids is more than one) together at site.
- All connection in piping, valves etc. shall be through weld neck forged carbon steel flanges as per ANSI B 16.5.
- All pipe fittings shall be from carbon steel made through forging. Fabricated fittings such as bends, elbows, tees etc. made through welding are not allowed.
- All welding joints shall be of radiographic quality as per API 1104 and at least 20% of the welding joints shall be radio graphed and radiographic films submitted to OIL.
- Piping shall be arranged in such a manner to avoid crisscrossing or overhead problems. Piping or tubing of insufficient mechanical strength for standing or hanging shall be protected from personnel traffic.
- All sub-suppliers items e.g., instruments, valves, pipes fittings etc. shall be from reputed manufacturer / supplier and should conform to relevant codes and standards.
- Since the plant equipment will be exposed to about 300 deg C, all valves /pipes / pipe fitting metallurgy shall be selected accordingly.

18.0 Material of Construction: The materials to be used as follows.

Vessels / Tanks	:	SA-515 Gr. 60 / 70 / IS:2002 Gr. 2
Shell flanges	:	SA-105
Nozzle flanges	:	SA-105
Supports	:	SA-283 Gr. C/IS:226
Nuts & Bolts	:	SA 193 Gr. B7, SA 194 Gr. 2H
Pipes, flanges and fittings	:	ANSI B31.3 / API 51 / ANSI B16.5
Instrument piping	:	Annealed seamless 316 stainless steel with Swagelok type fittings

19.0 Codes and Standards: The latest editions of ASME VIII DIV. 1, ASME Section IX, ANSI B 16.5 and ANSI B 31.3 will apply.

20.0 **Mounting**: The pilot plant unit will be skid mounted suitably. Each unit like adsorption column, heater, filter etc along with its instruments should be skid mounted. The skids should be fabricated from suitable structural steel section. The skids must be rugged and compact, being designed for transportation by trailer and fitted with two bars. Vendor to provide lifting arrangements for all the skids and minimum number of skid should be employed. Details of bolting down for skids to be provided by vendor.

21.0 **Instrumentation Data Sheets:** The instrumentation data sheets for various hardware are given in Annexure IV. Any items not included in the list will be chosen by vendor in such a way that safe and reliable operation of the process unit is ensured.

22.0 **Suggested Vendor List**: A suggested vendor list for various components of the test facility instrumentation systems is indicated below. The third-party supplier for the pilot plant will be asked to use components only from the suggested vendors. In case of non-availability of any component manufactured by the listed vendor(s) during the time of procurement and fabrication of the pilot plant, other product with similar specifications/quality from other reputed vendors (with proper documentation and justification) may also be considered with prior approval of OIL. For any components, not mentioned in the list below but required to be incorporated in the testing unit, the successful bidder may suggest a list of vendors for those components and get approval from OIL before procuring and using them in the pilot plant.

22.1	24 V DC Power Supply	Phoenix/Silop
22.2	Air Filter Regulator	Shavonorgren/Placka
22.3	Alarm Annunciator	IIC/Procon/ Murphy
22.4	Ball Valves (for impulse line0	Flow Control/L&T/Flow Chem
22.5	Cable Gland	Baliga/Electromac
22.6	Chemically treated earth pit	Ashlok/Welcome World Engg/Power gomengg
22.7	Circuit Breaker (Inside panel)	GE/Siemens/Schneider
22.8	Control Panel	Rittal/Pyrotech/ICA/Altronic/Murphy
22.9	Control switches	KAYCEE/ Siemens
22.10	Control Valves	Fisher / Fouress / Instrumentation Ltd.
22.11	Digital Panel Indicator	Masibus/Honeywell/ABB
22.12	Fuse (LT)	KAYCEE /GE/ALSTOM

22.13	Globe Valves (for instruments)	L&T/Hawa valves/NECO Valves
22.14	Indicating Lamp	Concord/Telemechnic/ Murphy
22.15	Instrument & Power cable	INCAB/Universal Cable/RPG Cables
22.16	Instrument Fittings	Swagelok/Parker/IVI vales
22.17	Interposing Relay	OEN/Jyoti/Omron
22.18	IS Barrier/Isolator/Repeater	P&F/MTL
22.19	Junction Box	Baliga/Flexpro
22.20	Light Fittings (Panel Indoor)	GE/Bajaj/Philips
22.21	Limit Switch/LVDT	Speed-O-Control/Remso Controls/Honeywell
22.22	Lugs	Dowells
22.23	MCB (Miniature Circuit Breaker)	MDS/HAGER/Wowells
22.24	Pressure & Temperature Gauges	Warrey/Bourdon/Precision/ Murphy
22.25	Pressure Switch	INDFOS/Switzer/ Murphy
22.26	Programmable Logic Controller	Allen Bradley/SIEMENS
22.27	Push Button	KAYCEE/ Telemechnic/Siemens
22.28	RTD with thermowell	Pyrotech Controls/ALTOP/General Inst./ Murphy
22.29	Safety Relief Valve	AIL /Farris.
22.30	Selector Switches	KAYCEE/ Siemens
22.31	Solenoid Valves	ASCO / Rotex / Schradder

22.32	SS Tube	Sanvik
22.33	Terminal Block	Phoneix/Elemex/Wago
22.34	Transmitters (PR & Temp)	ABB/EMERSON Process/ Murphy

23.0 Process Conditions:

Location	Temperature(deg C)	Pressure (kg/cm^2)	Flow (SCMD)	Composition
S1, S2, S3, S10, S11	5-50	10-15	S1: 0-2000 S2: 0-1000 S3: 0-1000 S10: 0-500 S11: 0-1000	See section 3.1 in Annexure I
S4	Before cooler: 10-80 After cooler: 10-50	10-15	0-1000	Same as S1, water content considerably less than 5000 ppm
S5, S6, S7, S8, S9	10-60	10-15	S5: 0-1000 S6: 0-1000 S7: 0-1000 S8: 0-500 S9: 0-1000	Same as S4, C5+ hydro carbons considerably lower.
S12	5-60	10-15	0-500	In between that of streams S8 and S10 (depends on their flow rates).
S13	40-300	2-5	0-500	Same as that of S12.
S14	40-300	2-5	0-500	Increased water content (higher than even 5000 ppm). Others, same as that of S13.
S15	5-60	10-15	0-2000	In between that of streams S7 and S9 (depends on their flow rates).
S16	40-300	2-5	0-2000	Same as that of S15
S17	40-300	2-5	0-2000	Increased heavy hydrocarbon content (considerably higher than that in feed S1)
S18	40-300	2-5	0-2000	Increased water and heavy hydrocarbon content (considerably higher than that in feed S1)

B1-B2	5-300	2-15	0-1000	Depends on the process stage and streams being introduced.
B3-B8	5-300	2-15	0-2000	
Heaters (H1, H2)	5-300	Feed: 10-15 Delivery: 2-10	H1: 0-500 H2: 0-2000	H1: Same as that of S12 H2: Same as that of S15

24.0 Sizing and capacity: The sizing and capacity of the adsorbent beds in given below.

	Moisture removal beds (B1, B2)	Hydrocarbon removal beds (B3, B4, B5, B6, B7, B8)
Adsorption Bed Height (active available for loading adsorbent) ,mm	1300	7500
Adsorption Bed Diameter (ID), mm	165	165
Adsorption Inventory, kg per bed	20	120
Total adsorption Inventory, kg	40	720
Adsorption cycle time , hours	12	8

ANNEXURE-IV

DATA SHEETS FOR INSTRUMENTATION SYSTEM

1.0 Data Sheet of Orifice Plate		
1.1	Application	Low Fluid(Gas) Velocity Flow Measurement
1.2	Design Standard	BS-1042, Part-1
1.3	Number of Tapings	One additional pair of taps for performance test
1.4	Diameter Ratio	Between 0.4 to 0.7
1.5	Accessories	Flanges, Gaskets, Nuts & bolt, valves etc

2.0 Data Sheet of Multivariable Transmitter(MVT) for Flow Measurement		
2.1	Type	Electronic SMART Type MVT, Capacitance/Pizoresistance type
2.2	Output	Any protocol(Analog, HART, FF etc)
2.3	DP Range	As per design basis
2.4	Static Pressure Range	As per design basis
2.5	Isolation Material fill fluid	316 L SST Silicon
2.6	Drain/Vent Material	SST
2.7	O-Ring	Glass Filled TFE
2.8	Process Input	RTD
2.9	Transmitter Housing Material	SST ½" – 14 NPT
2.10	Terminal Block	Standard
2.11	Meter	LCD Meter
2.12	Bracket	Coplaner SST Bracket for 2" pipe
2.13	Bolts	CS Bolts
2.14	Approval	Intrinsic Safety Certification
2.15	Enhanced Measurement Solution(EMS)	Mass Flow and measured variables(DP, P & T)
2.16	Power Supply	+ 24 V DC
2.17	Load Driving Capacity	250 – 1100 ohms
2.18	Accuracy	1% of mass flow rate
2.19	Stability	At least 5 zero
2.20	Enclosure Protection	IP-65
2.21	Cable Entry	½" NPT(F)
2.22	Electrical Area Classification	IEC Zone 2, Gas Group II A/II B, T6
2.23	Function	Transmission & Indication
2.24	Mounting	Yoke
2.25	Rangibility	40% or better
2.26	Element	Diaphragm
2.27	Element Material	SS316L
2.28	Valve Manifold	Required
2.29	Over Range Protection	Required

3.0 Data Sheet of Resistance Temperature Detectors		
3.1	Element	4-Wire RTD
3.2	No of Elements	Duplex
3.3	Calibration	As per DIN 43760
3.4	Element Material	Pt 100
3.5	Resistance at 0^{o} C	100 Ohm
3.6	Leads	Hermetically Sealed
3.7	**Sheath**	
3.7.1	OD	8 mm
3.7.2	Material	SS316
3.7.3	Nipple & Union Mat.	SS316
3.8	No of Wires	Four Wires
3.9	Head Cover Type	Screw Cap of Die Cast Aluminium of SS chain
3.10	Cable Entry	½" NPT
3.11	No of Entries	Two(one SS pluged)
3.12	Protection Class	Intrinsically Safe EExia and Weather proof to IP 65
3.13	**Thermowell**	
3.13.1	Material	SS316
3.13.2	Construction	Drilled bar stock upto immersion length 500 mm(or depending on the design basis of pipe dia), otherwise fabricated
3.13.3	Process Connection	2" flanged/ 1" NPT(M)
3.13.4	Instrument Connection	¼" or ½" or 3/8"
3.13.5	Options	
3.13.6	Extra Nipple Extension	150 mm

4.0 Data Sheet of Temperature Transmitters		
4.1	Function	Transmission & Indication
4.2	Type	Electronic Smart Type with any protocol(Analog, HART, FF etc)
4.3	Class	MFR Std
4.4	Mounting	Yoke
4.5	Protection Class	Intrinsically Safe EExia and Weather proof to IP 65 as per IEC 60529/ IS 2147
4.6	Electrical Area Classification	IEC Zone 2, Gas Group II A/II B, T6
4.7	Power Supply	24 V DC
4.8	Cable Entry	½" NPT(F)
4.9	Accuracy	+/- 0.1% of span
4.10	Self-Diagnostic Facility	Yes
4.11	Transmitter Output	4-20 mA DC
4.12	Load Capability	600 ohm at 24 V DC
4.13	Sensor Element	Pt 100
4.14	Calibration	As per DIN 43760
4.15	Options	
4.15.1	Mount. Acc. For 2" Pipe	Yes
4.15.2	Intrinsically safe Output Meter(LCD)	Yes

5.0 Data Sheet of Pressure Transmitters		
5.1	Function	Transmission & Indication
5.2	Operating Principle	Capacitance/Peizo-resistance
5.3	Type	Electronic Smart Type with any protocol(Analog, HART, FF etc)
5.4	Class	MFR Std
5.5	Mounting	Yoke
5.6	Protection Class	Intrinsically Safe EExia and Weather proof to IP 65 as per IEC 60529/ IS 2147
5.7	Electrical Area Classification	IEC Zone 2, Gas Group II A/II B, T6
5.8	Intrinsically Safe	Yes
5.9	Power Supply	24 V DC
5.10	Cable Entry	½" NPT(F) with SS plug
5.11	Accuracy	+/- 0.075% of span
5.12	Rangeability	40:1 or better
5.13	Transmitter Output	4-20 mA DC
5.14	Load Capability	600 ohm at 24 V DC
5.15	Service	Natural Gas
5.16	Element	Diaphragm
5.17	Body Material	SS316
5.18	Element Material	SS316L
5.19	Process Connection	½"NPT(F) or 3/8" NPT(F)
5.19.1	Process Connection Location	Bottom
5.20	Fill Fluid	Silicone Oil
5.21	Zero & Span Adjustment	Non-interactive Type
5.22	Zero Suppression & Elevation	100% of span continuously adjustable externally
5.23	Adapter 'O' Ring	PTFE
5.24	Over Range Protection	Yes
5.25	Options	
5.25.1	Intrinsically safe Output Meter(LCD)	Yes in Engg. Unit
5.25.2	Mounting Accessories suitable for 2" NB Pipe	Yes
5.25.3	2 Valve Manifold	Yes

6.0 Data Sheet of Pressure Switch		
6.1	Type	Seal Diaphragm, Piston Actuated
6.2	Sensing Element Material	AISI SS-316 Diaphragm/Piston. All other wetted part SS-316
6.3	Case Material	Epoxy coated steel plate or die-cast aluminium with neoprene gasket and clear glass. Cover conforming to IP-65(Explosion proof for NEC Class 1, Division 1 Area)
6.4	Setter Scale	Black graduation on white liner scale. Graduation 0-100% with red pointer for set points
6.5	Over Range	150% of maximum pressure
6.6	Adjustments	(a) Internal Set point (b) Internal Differential adjustment nut with dial for at least 10% of span(min.)
6.7	Process connection	Suitable as per design basis(or any ½" NPT(M) / 3/8" NPT(M)/ ¼" NPT(M) bottom connected)
6.8	Switch Configuration	Two SPDT
6.9	Switch Rating	240 V, 5 A AC / 220 V, 0.5 A DC
6.10	Switch Type	Snap Acting, Shock & Vibration proof
6.11	Adjustability	a) Set point adjustable over span range b) Differential adjustment by 10 percentage of span(min.)
6.12	Sealing ring	Viton, Buna-N
6.13	Terminal Block	Suitable for full ring lugs for cable connections
6.14	Cable Connection	½" NPT(F) or 3/8" NPT(F) or ¼" NPT(F)Conduit connection or compression gland(as per design requirement)
6.15	Enclosure class	IP 65
6.16	Performance	Accuracy ± 1%, Accuracy of setting indication of ± 1.5%
6.17	Name Plate	Tag number, services engraved in stainless steel Tag plate

7.0 Data Sheet of Control Panel		
7.1	Type	Enclosed self-supporting
7.2	Material	Heavy gauge CRCA sheet steel, reinforced to provide self-standing and rigid assembly
7.3	Thickness	Not less than 3 mm
7.4	Surfacing	Clean and smooth finish with anti-rust and anti-corrosion primer coating
7.5	Color	
7.5.1	External	Light Grey
7.5.2	Internal	Glossy white
7.6	Dimensions	As per design standard
7.7	Enclosure class	IP-65
7.8	Temperature	
7.8.1	Environment	Maximum 50 deg C
7.8.2	Internal temperature control	Maintained at optimum value for system equipment
7.9	Door location	Back with door latch (removable)
7.10	Cable connection	Plug in

7.11	Process signaltermination practice	Screwed, terminal point, wire wrap or manufacturer's standard with 100 mm (minimum) gap between terminal block
7.12	Card mounting	As per PLCstandard rack
7.13	Wiring	
7.13.1	Terminal blocklocation	30 cm above floor, easy accessible and maintenance
7.13.2	No of processTermination per Terminal	Two (2) maximum
7.13.3	Insulation grade	600 V or above
7.13.4	Designation	All cables shall be marked for identification by color code wires etc
7.13.5	Termination spare	20% after complete installation
7.13.6	Cable and fitting	Prefabricated cable from process termination to the system cabinet with connection on both sides.
7.13.7	Internal wiring	One fused terminal block with required glass fuse rating for each input and output.
7.14	Isolation	All circuit including shield isolated from cabinet
7.15	Panel lighting	Panel tube light should be ON while opening the door

8.0 Data Sheet of TFT Display Monitor		
8.1	Operator Input	Keypad, Touch, or Key/Touch
8.2	Display Description	Color active-matrix TFT
8.3	Display Size	15 inch
8.4	Display Area (WxH)	304 x 228 mm (12.0 x 9.0 in)
8.5	Resolution	1024 x 768, 18-bit color graphics
8.6	Luminance	300 cd/m2 Nits
8.7	Backlight	50,000 h life, min., field replaceable
8.8	Real-time Clock	Battery backed clock timestamps critical data, ± 2 minutes per month Battery life: 4 year min. @ 25 °C (77 °F)
8.9	Touch Screen Description	8-wire analog resistive Actuation: 1 million presses; operating force: 10…110 g
8.10	Keypad Description	Stainless-steel membrane Numeric, navigation, and function keys Actuation: 1 million presses; operating force: 10…340 g
8.11	Function Keys	40 (F1…F20, K1…K20)
8.12	Operating Systems	Windows CE 6.0 with extended features/file viewers or better
8.13	Application Software	FactoryTalk View Machine Edition FactoryTalk ViewPoint, version 1.2 or later
8.14	Memory	512 MB nonvolatile flash and 512 MB RAM
8.15	Communication Ports	Ethernet (10/100 Mbps, Auto-MDI/MDI-X), RS-232, (2) USB host, (1) USB device, Network interface for optional DH+/DH-485, or ControlNet (scheduled or unscheduled) communication module

8.16	External storage	Secure Digital (SD) card, supported by hot-swappable SD card slot USB flash drives supported by high-speed, hot-swappable, 2.0 USB ports
8.17	Input Voltage AC	AC: 85…264V AC, 47…63 Hz
8.17.2	Input Voltage DC	DC 18…32V DC (24V DC nominal)
8.18	Power Consumption	
8.18.1	Power Consumption, AC	160VA max
8.18.2	Power Consumption, DC	70 W (2.9 A at 24V DC)
8.19	Operating Temperature	0…55 °C (32…131 °F)
8.20	Dimension	
8.20.1	Keypad (HxWxD) or Key/Touch	330 x 469 x 65 mm 12.97 x 18.46 x 2.55 in.
8.20.2	Touch Screen (HxWxD)	330 x 416 x 65 mm 12.97 x 16.37 x 2.55 in.

9.0 Data Sheet of Solenoid valve		
9.1	Type	NORMALLY CLOSED DIRECT ACTING (3 way normally closed input port connected to out port, energized- out put port connected to exhaust)
9.2	Size	Port size:1/4", Connection size: 1/2" NPT
9.3	Protection Class	Intrinsically safe ,Flameproof, IP-67, All construction safety as per IEC61508, Suitable for Zone-1 Zone 2 hazardous area
9.4	Power Supply	24 V DC
9.5	Enclosure	Electrical enclosure as per EN 60529, Aluminium IP-67, Zone II 2/G/D Eexd IIC T6, T4 IP 67
9.6	Service	AIR & Natural Gas
9.7	Body/Material	316SS, CORE & PLUG NET 430F SS, CORE TUBE 303 SS or 304 SS
9.8	RIDER RING	PTFE
9.9	SPRINGS	303 SS or 304 SS
9.10	Duty	Continuous, heavy duty
9.11	WATTAGE	0.7 TO 12 WATT

10.0 General Data Sheet of PLC (Programmable Logic Controller)		
10.1	Make	Preferably Allen Bradley
10.2	Total number of points	As per design
10.3	No of Instruction	As per design
10.4	No of Inputs/Outputs	As per design
10.5	Input Type	Analog/Digital/AC/DC/RTD/Thermocuple/All types of FieldBus protocol etc
10.6	Output Type	Analog/Digital/AC/DC/RTD/Thermocuple/All types of FieldBus protocol etc
10.7	Processor	32/64 bit processor, maximum 0.5 micro seconds cycle time/1k words
10.8	flash memory(non-volatile)	Maximum 128 MB

10.9	User Memory	384 KB to 3 MB
10.10	Expandable	Yes
10.11	Maximum no of channels	As per design basis of I/O
10.12	Programming	Computer programmable
10.13	PLC Programming Software	LD/SFC/IL/FBD/ST/RLL
10.14	Application Software	Gas Flow Calculation Software as AGA-3 for main PLC
10.15	Power	24 V DC/230 V AC
10.16	Communication Port	For Heater PLC: Ethernet- 1 no, RS 232: 1no For Main PLC: Ethernet-1 no, RS232- 2no
10.17	Controller Task	Maximum 32 tasks, Maximum 100 programs/ tasks
10.18	Controller Application	General purpose, Small to medium size applications
10.19	Features	Visual LED indicators/Non-volatile Memory(EEPROM)/Integral Power Supply/Surge Protection/ Timer(s)/Counter(s)
10.20	Mounting	Panel Rack Mounted