

(To be completed, filled in, signed and stamped by the principal)

ANNEXURE 'A'

# OIL & GAS DEVELOPMENT COMPANY LIMITED

PROCUREMENT DEPARTMENT, ISLAHABAD  
FOREIGN SECTION C

Material: SUPPLY, INSTALLATION AND COMMISSIONING OF ENGINE DRIVEN GAS RECIPROCATING COMPRESSOR PACKAGE FOR NASHPA PLANT  
Tender Enquiry No: PROC-FC/CB/P&P/NASHPA-4900/20  
Due Date: FULL

Evaluation Criteria: FULL

## SCHEDULE OF REQUIREMENT

Sl. No.	Description	Unit	Quantity	Rate	Total
1	SUPPLY, INSTALLATION AND COMMISSIONING OF ENGINE DRIVEN GAS RECIPROCATING COMPRESSOR PACKAGE (AS PER TOR/SPECIFICATIONS ATTACHED)		1		

Note: BID BOND AMOUNT: USD 30,000/- OR EQUIVALENT PAK RUPPEE. THE ATTACHED TOR IS INTEGRAL PART OF SOR.

*(2 stage envelope)*

**AMINULLAH**  
 Dy Chief Engr. (P&P)  
 P&P-N, ERG-4074

**Oil & Gas Development Company Limited**  
**Process & Plants Department**



**SUPPLY, INSTALLATION AND COMMISSIONING OF SKID-  
MOUNTED GAS ENGINE DRIVEN LOW PRESSURE GAS  
RECIPROCATING COMPRESSOR PACKAGE FOR  
NASHPA PLANT**

AMIN ULLAH  
(Tech.)  
1974

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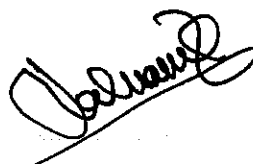
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## 1. Introduction:

OGDCL intends to procure 01 No Gas engine driven reciprocating compressor (complete package). The packaged unit shall consist of reciprocating compressor coupled with gas engine with all auxiliary equipment including fin-fan cooler(s), control panels, motor control units, local-off-remote switches etc. and shall be installed and operated at Nashpa Gas Processing Plant, Karak - KPK. The reciprocating compressor unit will be installed at the Plant to serve as a backup for existing stabilizer overhead compressor for low pressure gases. This document covers terms of reference for the supply & services, and design requirement & specifications:

## 2. Bidder qualification:

- 2.1. The bidder should be authorized dealer/representative of the OEM of the quoted engines and compressor (in case if the bidder itself is the Packager). In case the bidder is other than the Packager, then authority letter from the Packager to be furnished by the bidder.
- 2.2. The Packager of the offered compression unit must be an authorized representative of the OEMs of both the Reciprocating Compressor and the Prime mover (engine) for packaging. Authority letters from the OEMs of the engine and compressor confirming the same to be provided with the bid.
- 2.3. The OEMs or their Authorized Partner / Distributor / Dealer should have established dedicated workshop facilities (both for parts & services) within Pakistan for after sales service for offered brands of engine and compressor. These facilities should be capable to provide spare parts and services for Top End, Major Overhauling and troubleshooting of the offered brand of engine & compressor. Authorization letter from the OEMs showing confirmation and verifiable contact details of existing after sales services facilities in Pakistan to be provided in the bid.
- 2.4. The bidder / packager must have undertaken projects for supply of at least 05 nos. of such type of compression packages internationally or in Pakistan. Verifiable list to be provided in the bid.
- 2.5. The packager to have 10 years of experience of packaging similar compression packages.
- 2.6. The OEMs of engine and prime mover must have at least 15 years of manufacturing experience. Whereas the OEMs of electronics and instrumentation should be renowned and certified manufacturers having experience of at least 15 years.



### 3. Scope of Supply:

The compressor package should be complete and must consist of the following components at the minimum within the battery limits of the skid(s). The bidder to confirm the inclusion of each of the following components within the scope of supply in the technical bid:

#### 3.1. Main equipment:

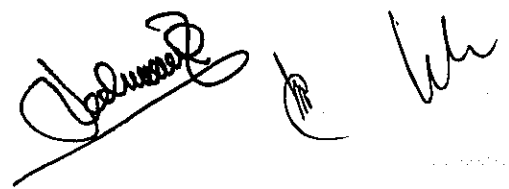
- 3.1.1. Reciprocating Compressor
- 3.1.2. Gas driven, turbocharged engine
- 3.1.3. Coupling along with guard / protection
- 3.1.4. Skid(s) for engine and compressor
- 3.1.5. Discharge & inter-stage gas air-cooler (manual adjustable louvres preferred)
- 3.1.6. Start-up/commissioning spare parts
- 3.1.7. Two-year spare parts both for compressor and engine

#### 3.2. Compressor lubrication System:

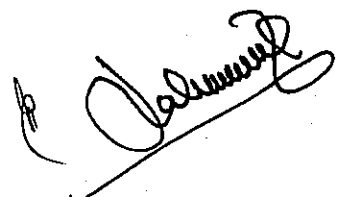
- 3.2.1. Oil Pump and Pre / post Lube Oil Pump
- 3.2.2. Oil cooler, Oil Filter, Oil Tank, tubing and piping of lubrication system
- 3.2.3. Compressor Crankshaft Oil Level Controller
- 3.2.4. Oil Thermostatic Valve
- 3.2.5. Force feed lubrication system

#### 3.3. Process Gas System:

- 3.3.1. Inlet stainer
- 3.3.2. Process Scrubber
- 3.3.3. Pulsation Bottles (at both suction and discharge)
- 3.3.4. Pneumatic valve (Inlet, Outlet, Blow Down and Recycle)
- 3.3.5. Manual valves (Purge, inlet, outlet and bypass valves etc.)
- 3.3.6. Inlet Strainer Inlet and Each Pulsation Inlet
- 3.3.7. Process Scrubber (Each Stage Inlet)
- 3.3.8. Pulsation Bottles (Each Stage Inlet and Outlet)
- 3.3.9. Manual Valve (Purge and Inlet Ball Valve Bypass etc.)
- 3.3.10. Check Valve (Outlet)
- 3.3.11. Relief valves (Spring Type, 1st Stage Inlet, Each Stage Outlet and 01 set of PSV with set point of 725 psig, along with 02 isolating and bypass valves)
- 3.3.12. Process Gas Piping (on skid piping only)
- 3.3.13. Pressure transmitter for discharge header
- 3.3.14. Flange and Fitting



- 3.3.15. Scrubber Drain System (Auto-drain and Manual Drain)
- 3.3.16. Flow metering (orifice type) at the discharge of the final stage of the compressor (OEM standard)
- 3.4. **Compressor flow control system:**
  - 3.4.1. Variable Volume Pockets on all compressor cylinders
- 3.5. **Compressor / Engine Skid(s):**
  - 3.5.1. Piping of vents / drain to the edge of skids
  - 3.5.2. Earthing bosses (02 nos. at least) per skid
  - 3.5.3. Vibracon or similar arrangement for alignment of the engine
- 3.6. **Gas Engine Cooling System:**
  - 3.6.1. Jacket and Aux. Water Cooler (Air Cooler, Motor Driven)
  - 3.6.2. Expansion Tank (Each for Jacket Water and Aux. Water equipped with level switch and level gauge.)
  - 3.6.3. Manual Butterfly Valve
  - 3.6.4. Piping, Flange and Fittings (On-skid only)
- 3.7. **Gas Engine Lubrication System:**
  - 3.7.1. Main Lube Pump Driven by Gas Engine.
  - 3.7.2. Pre / Post Lubrication System
  - 3.7.3. Oil Filter(s)
  - 3.7.4. Gas Engine Crankshaft Oil Level Controller
  - 3.7.5. Oil Thermostatic Valve
  - 3.7.6. Oil Tube and Pipe
  - 3.7.7. Lube oil cooler (OEM recommended lube oil cooler which should be available as a standard part for the Engine model to be supplied).
  - 3.7.8. First Filling Oil
- 3.8. **Air Intake, Exhaust System and Fuel Gas System:**
  - 3.8.1. Air Filter
  - 3.8.2. Air Intake Pipe
  - 3.8.3. Exhaust Silencer (spark arresting)
  - 3.8.4. Exhaust piping and expansion joint(s) as per manufacturing standards (the expansion joint should be OEM a standard part of OEM of the engine)
  - 3.8.5. Catalytic Converter
  - 3.8.6. Exhaust Pipe Carbon Steel
  - 3.8.7. Turbocharger(s)



- 3.8.8. Fuel governing system
- 3.8.9. Fuel Gas Scrubber (Wire Mesh Demister and Coalescence filter)
- 3.8.10. Fuel Gas Scrubber Drain System
- 3.8.11. Fuel Gas Pressure Regulating Valve
- 3.8.12. Fuel Gas Solenoid Valve
- 3.8.13. Fuel Gas Pipe (within the Package/Skid Edge)

**3.9. Gas Engine Start System:**

- 3.9.1. Pneumatic starting motor
- 3.9.2. Inlet Ball Valve
- 3.9.3. Pipe Scope

**3.10. Instrumentation / Controls:**

- 3.10.1. Engine Electronic Control Unit (ECU) / ESM (Should be recommended from the OEM of the Engine and also should be a standard part of the OEM of the model of the engine to be supplied)
- 3.10.2. Speed governing system as per ISO 3046-4:2009
- 3.10.3. Fire and gas detection system for complete package
- 3.10.4. Machine protection system with complete scope as per API 670, 5<sup>th</sup> Edition. Bentley Nevada or equivalent make with same input and output ports as of Bentley Nevada. The system should be linked to local
- 3.10.5. Instrumentation, wiring, cable trays (on-skid)
- 3.10.6. Local instruments (for pressure, temperature, flow and level)
- 3.10.7. Unit Control Panel programmable PLC (on-skid) with HMI (HMI screen to be panel mounted, at least 19 inches) and must meet Hazardous Area Classification (provided in Section 6.4 and NEMA rating for outdoor installation
- 3.10.8. MCC for package motors, heaters, pumps
- 3.10.9. 1 x Laptop for configuration of PLC/HMI
- 3.10.10. Provision of 3<sup>rd</sup> party communication system to the Process Control Room of the Plant (compatible with Honeywell-Experion PKS R431.3, DCS Controller C300 (Series C form), which is installed at Nashpa Plant)
- 3.10.11. Bidder to confirm that the quoted model of instruments will have spare parts support in market for further 10 years after receipt of material to OGDCL.

**3.11. Painting and finishing:**

- 3.10.12. Proper painting and finishing of the complete compressor package as per applicable industrial standards.



**3.12. Canopy / Enclosure for Engine & Compressor:**

- 3.10.13. Complete canopy / enclosure for the engine and compressor incorporating the acoustic, thermal, vibration, health and safety and maintainability considerations in design.
- 3.10.14. Proper lighting and ventilation within the canopy / enclosure
- 3.10.15. Overhead crane with sufficient lifting capacity and 2 axis movement for maintenance jobs should be installed within the canopy of package.

**3.13. Cables / Cable Accessories**

- 3.10.16. All Power, communication and control cables
- 3.10.17. All Cable glands, shrouds, lugs, junction boxes

**3.14. Installation material:**

- 3.10.18. Grouting material (chemicals / fillers / fibres / bolting etc.)
- 3.10.19. Earthing material
- 3.10.20. Material for construction of foundations
- 3.10.21. Shims for levelling / alignment

**4. Designing of the compression package:**

Complete designing of the package is in the scope of the bidder / supplier as per requirements specified in the proceeding sections including but not limited to:

- 4.1. Sizing and selection of all major and minor components and piping
- 4.2. Design of all pressure vessels and air cooler
- 4.3. Acoustic / vibration & Mechanical study per API 618 design approach 3 (M2-M5)
- 4.4. Torsional and pulsation Analysis
- 4.5. Enclosures incl. explosion relief opening in roof
- 4.6. Complete cooling, lube oil and lubrication system, including monitoring system for compressor lubrication
- 4.7. Venting systems
- 4.8. Control system design including ESD system
- 4.9. Control panel
- 4.10. Electrical system design, including single line diagrams, wiring and cabling plans



## 5. Operating and Control Philosophy:

The general requirements for operating and control philosophy of the compression package are briefly described in this section. The bidder / supplier to develop the control logic for normal operations / initial start / cold start / hot start / stop / emergency stop / ESD based on the following requirements which shall be reviewed and finalized during design review and HAZOP Study meetings (as per section 7 of this document).

- 5.1. The overall control, monitoring and alarm of compressor shall be done by dedicated SIL-3 rated PLC based control system, all the compressor data along with fire and gas leakage detection data shall be transmitted to new Engineering Workstations (EWS) and Operation Workstations (OWS) considered delicately for new LP compressor for monitoring and controlling. Engineering and operating workstations shall be placed in the plant control room. The package PLC shall also be provided with control panel mounted HMI/MMI for monitoring and controlling from the field.
- 5.2. The package PLC shall perform package process control and monitoring including process controlling, process shutdowns and emergency shutdowns due to the fire detection in accordance with the project Cause & effect Matrix and other relevant documents.
- 5.3. New LP compressor package PLC shall communicate with compressor engineering and operating workstations over dual redundant Ethernet / Fibre-optic communication link.
- 5.4. The system shall be designed such that it can display all required process variables and functions on the operator workstations. Graphic displays will mimic the physical equipment on multiple, easily accessible displays. The ability to control process set points and equipment start/stop functions will be provided to the operator at the Operator Workstations.
- 5.5. The system will notify the operator audibly and visually of any abnormal condition in the process. The alarms will be logged on the alarm printer, communicated to the operator by on screen display, and archived in the system for future retrieval. The system will automatically display the actual alarm condition description, time of occurrence, and alarm values on the bottom of the display.
- 5.6. The Engineering Workstation (EWS) shall be a programming and engineering computer station and it will be possible for experienced engineering technician to

easily make programming changes in the system via engineer workstation, a portable programming device (e.g. laptop), or from a Control panel mounted HMI / MMI from the field. Access for software changes will be password or key protected to eliminate unauthorized access.

- 5.7. Software changes involving control logic and set point changes will have different means of access or multiple level password protection schemes. The system will provide documentation of software in a user-friendly format based on operating field personnel viewpoint.
- 5.8. All Engine / Compressor parameters active / history trend "for approx. 01 month" to be provided on Local Pane HMI as well as operator workstations in CCR "for approx. 06 months".
- 5.9. Engine Reset options must be configured on Local HMI and Operator Workstations in CCR.
- 5.10. Redundant Ethernet / communication links should establish between PLC and Local HMI installed in UCP.
- 5.11. Instrumentation / Equipment installed in hazardous areas shall be protected by suitable method according to the area classification. All equipment shall be suitable to area classification, Zone-2 Gas Group II A T3.
- 5.12. All package/field instrumentation including transmitters, switches, I/P transducers, valves, fire detectors, gas detectors, manual call points and sounder / beacon shall interface directly with each package PLC Process monitoring, shutdown and controlling.
- 5.13. New LP compressor package shall internally employ a Fire and Gas detectors for fire and gas leakage detection.
- 5.14. The package PLC shall also be responsible to shut down the compressor on any major upset within the unit or on command from plant ESD system. The package PLC shall also be hardwire interfaced with existing Plant ESD System for Shutdown signals to / from plant existing Safety system in accordance with the overall hierarchy of existing shutdown levels used, numbered ESD-1 to ESD-4 as listed below:
  - 5.14.1. ESD-1: Emergency Shutdown (Fire & Major Gas Leak)
  - 5.14.2. ESD-2: Process Shutdown

## 5.14.3. ESD-3: Unit Shutdown

## 5.14.4. ESD-4: Single Device Shutdown

- 5.15. A Shutdown bypass system shall be configured for each of the variables that causes a shutdown sequence to start or for maintenance, calibration, etc. under password protection. Shutdown bypass (MOŞ) shall be configured for each of the variables that causes a shutdown sequence to start or for maintenance, calibration, etc. under password protection.

## 5.16. List of Meters and Alarms required:

S #	Tag #	Description	Range	Unit	LL	L	H	HH	Remarks
1	PT-2234	Suction Pressure	VTA	psig		√	√		
2	LT-2210	Suction KOD Level	VTA	%		√	√		
3	LSHH-212	Suction KOD Level	-	-				√	ESD-3
4	LSLL-2213	Suction KOD Level	-	-	√				ESD-4
5	TT-2229	Suction Temperature	VTA	F		√	√		
6	PT-2235	Discharge Pressure	VTA	Psig		√	√		
7	TT-2230	Discharge Temperature	VTA	F		√	√		
8	PSLL-2203	Discharge Pressure	-	-	√				ESD-3
9	PSHH-2204	Discharge Pressure	-	-				√	ESD-3
10	VSHH-223x	Fan Vibration	VTA	mm/sec				√	ESD-4
11	TT-2203	Discharge Temperature	-	-				√	ESD-3
12	TT-2231	Discharge Temperature	VTA	F		√	√		
13	LT-2211	Discharge KOD Level	VTA	%		√	√		
14	LSLL-2214	Discharge KOD Level	-	-	√				ESD-4
15	LT-2212	Discharge KOD Level	VTA	%		√	√		
16	LSHH-2213	Discharge KOD Level	-	-				√	ESD-3
17	LSLL-2215	Discharge KOD Level	-	-	√				ESD-4
18	PT-2236	Discharge Pressure	VTA	psig		√	√		

S #	Tag #	Description	Range	Unit	LL	L	H	HH	Remarks
19	GD-22503	Gas Detection	VTA	LEL%			√	√	ESD-3-2002
20	GD-22504	Gas Detection	VTA	LEL%			√	√	ESD-3-2002
21	FD-22503	Fire Detection	-	-					ESD-3 (100N)
22	FD-22504	Fire Detection	-	-					ESD-3 (100N)
23	USD-2202	ESD Signal from DCS							ESD-3
24	FT-2203	Gas Flow	VTA	MMSCFD	√	√			
25	LSL-2216	Compressor Oil Supply Tank Level	-	-		√			
26	LSL-2217	Engine Oil Supply Tank Level	-	-		√			
27	LSL-2218	Engine Crankcase Oil Level	-	-	√	√			ESD-3
28	LSL-2219	Compressor Crankcase Oil Level	-	-	√	√			ESD-3
29	TSHH-2204	Compressor Lube Oil Temperature	-	-			√	√	ESD-3 (VTA)
30	TSHH-2205	Compressor Lube Oil Temperature	-	-			√	√	ESD-3 (VTA)
31	PT-2237	Compressor Lube Oil Pressure	VTA	psig	√	√			ESD-3 (VTA)
32	PT-2238	Engine Oil Filter Inlet Pressure	VTA	psig	√	√			
33	PT-2239	Engine Oil Filter Outlet Pressure	VTA	psig	√	√			ESD-3 (VTA)
34	LSL-2220	Auxiliary Water Surge Tank Level	-	-	√	√			
35	LSL-2221	Jacket Water Surge Tank Level	-	-	√	√			
36	TSHH-2206	Auxiliary Water Temperature					√	√	ESD-3 (VTA)
37	TSHH-2207	Jacket Water Temperature					√	√	ESD-3 (VTA)
38	PT-2240	Jacket Water Pressure	VTA	psig	√	√			
39	PT-2241	Fuel Gas Pressure	VTA	psig	√	√			
40	FT-2204	Fuel Gas Flow	VTA	VTA	√	√			
41	TT-2232	Compressor Bearing Temperature #2	VTA	F			√	√	ESD-3 (VTA)

S #	Tag #	Description	Range	Unit	LL	L	H	HH	Remarks
42	TT-2233	Compressor Bearing Temperature #2	VTA	F			√	√	ESD-3 (VTA)
43	SE-2202	Engine Speed	VTA	rpm			√	√	
44	VT-2203	Compressor Vibration	VTA	mm/sec			√	√	ESD-3
45	VT-2204	Engine Vibration	VTA	mm/sec			√	√	ESD-3
46	FS-2202	Digital No Flow Timer	-	-	√	√			ESD-3
47		Engine Coolant Fan Vibration					√	√	ESD-4
48	TT-2234 (Nos. as per engine model)	Engine Cylinder & Exhaust Temperature	VTA	F			√	√	ESD-3 (VTA)
49	TT-22xx (Nos. as per engine model)	Engine Main Bearing Temperature	VTA	F			√	√	ESD-3 (VTA)
50		ESM							All Alarms
51	PT-2242	Discharge Header Pressure	VTA	psig		√	√		

**Note:** VTA: Vendor to advise (vendor may recommend as per OEM Standard)

5.17. **List of Control & Shutdown Valves:** (vendor may recommend as per OEM Standard)

S #	Tag #	Description	Action	Fail Type
1	ESDV	Inlet Suction Shutdown Valve	On/Off	FC
2	LCV	Suction KOD Level Control Valve	On/Off	FC
3	SDV	Suction KOD Level Shutdown Valve	On/Off	FC
4	LCV	Discharge KOD Water Level Control Valve	On/Off	FC
5	SDV	Discharge KOD Water Level Shutdown Valve	On/Off	FC
6	LCV	Discharge KOD Oil Level Control Valve	Control	FC
7	SDV	Discharge KOD Oil Level Shutdown Valve	On/Off	FC

8	PCV	Discharge Pressure Control Valve	Control	FO
9	BDV	Depressurization Valve	On/Off	FO
10	ESDV	Gas Outlet Shutdown Valve	On/Off	FC

#### 5.18. Process flow diagram and Piping & Instrumentation diagram:

Proposed P&ID and PFD provided at the end of this document.

## 6. Other requirements:

### 6.1. Mechanical Design:

- 6.1.1. The compressor package with all auxiliary equipment to be designed for continuous duty / operation.
- 6.1.2. Engine and compressor with all auxiliary equipment to be brand new. Packager to provide certificates from the OEM bearing the serial numbers of the equipment and confirming that the engine is brand new.
- 6.1.3. Engine should be able to meet the rated power of the compressor with de-rating due to site conditions
- 6.1.4. All the engine components and auxiliaries must be OEM recommended and should be available as a standard part of the OEM of the engine.
- 6.1.5. Provision of sockets on the cylinders of the compressor for PV-analysis / condition monitoring.
- 6.1.6. The specifications of the engine should be declared in accordance with ISO 15550 and ISO 3046-1.(internationally recognised standard)
- 6.1.7. The layout of the compressor package including that of on-skid piping and cable trays should be such that there is ease of maintainability to carry out all the maintenance activities on the engine & compressor, without removal of any piping or auxiliary equipment.
- 6.1.8. Carbon steel vessels and internals shall have 3mm corrosion allowance applied to all pressure retaining parts and all surfaces of non-removable internals exposed to the process fluid. Removable internals shall have half the specified corrosion allowance on all surfaces exposed to process fluid.
- 6.1.9. Minimum wall thicknesses of carbon steel and low alloy nozzle necks, including corrosion allowance, should be as per piping code requirement.

- 6.1.10. Skirts shall be designed for load conditions, but shall not be less than 6mm wall thickness. Minimum thickness of internal carbon steel attachments shall not be less than 6mm excluding corrosion allowance.
- 6.1.11. No corrosion allowance is required on stainless steel materials or materials protected by stainless steel.
- 6.1.12. All vessels, vertical or horizontal, shall be furnished with a minimum of two lifting lugs, which shall be designed for a load equal to two times the shipping weight.

## 6.2. Electrical Design:

- 6.2.1. All motors to be supplied with the package to have standardized frame sizes conforming to NEMA.
- 6.2.2. Motors having power of 15 to 37 kW must have DOL starter
- 6.2.3. Motors having power between 37 kW and 100 kW to have star / delta
- 6.2.4. Any motor having power above 100 kW should have soft starter

## 6.3. Instrumentation and Control System:

- 6.3.1. All field instrumentation to be supplied to have SIL-3 certification.
- 6.3.2. The control system shall comprise of on-skid stand-alone cabinets having the following:
  - 6.3.2.1. Redundant PLC controllers
  - 6.3.2.2. Analogue, Digital input / output modules (as per I/O requirements)
  - 6.3.2.3. Redundant communication equipment and cables
  - 6.3.2.4. Redundant power supply unit
  - 6.3.2.5. Input / Output Marshalling
  - 6.3.2.6. Redundant Modbus communication of compressor parameters with existing Plant DCS
  - 6.3.2.7. I/O modules quantity to have 20% additional spare capacity after complete utilization for future expansion
  - 6.3.2.8. Analogue I/O modules shall be selected for 24 V DC 4-20 mA loop powered signal instruments.
  - 6.3.2.9. Digital modules shall be selected for 24 V DC input / output dry contacts. However, isolation relays shall be provided between digital I/O modules and end devices.
  - 6.3.2.10. Vibration / Machine protection system should be provided with package.
  - 6.3.2.11. Battery operated instruments should not be provided.



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**6.4. HSEQ Requirements:**

- 6.4.1. The package should be designed for being installed in Hazardous Area Classification of Zone-02, temperature class T3.
- 6.4.2. The emissions of the engine / package should comply with National Environmental Quality Standards of EPA, Pakistan. Bidder to provide emission levels of the package for NO<sub>x</sub>, SO<sub>x</sub> and CO in mg/Nm<sup>3</sup> measured as per ASTM-D6522. (internationally recognised standard)
- 6.4.3. The built of the engine should comply with all the relevant NPFA Standard(s) and other safety standards.

**6.5. System Software:**

- 6.5.1. All the software associated with the equipment (for controls, HMI etc.) should be supplied as licensed.
- 6.5.2. Backup / installation media of all software to be provided

**6.6. Electrical Cables:**

All electrical / power supply cables to be provided by the bidder / supplier to have a length of 300 meters.

**6.7. Instrumentation Cables:**

The minimum requirement of instrumentation cables is provided in the following table. Bidder / supplier to follow similar specifications and length for provision of any other control cable for any other purpose not listed below:

S.No.	Signal Name	Cable Description	Cable Type	Cable Gland required at CCR panel	Cable Length (meters)
1	Communication Signal A	Flame Retardant (2P x 1.5mm <sup>2</sup> ), Individual & Overall Screen, Sunlight resistant, SWA	NIS	M25	550
2	Communication Signal B	Flame Retardant (2P x 1.5mm <sup>2</sup> ), Individual & Overall Screen, Sunlight resistant, SWA	NIS	M25	550
3	DCS Signals (Run, Stop etc) 5 signals	Flame Retardant (10C x 1.5 mm <sup>2</sup> ), Overall Screen, Sunlight resistant, SWA	NIS	M20	550



4	ESD Signals (Safety Shutdown) 3 Signals	Fire Resistant (3Px2.5mm2), Overall Screen, Sunlight resistant ,SWA	NIS	M25	550
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#### 6.8. Security clearance of expatriate experts (if any):

The security clearance of any foreign installation / commissioning experts to be deputed on the project is in the scope of the bidder / supplier. Bidder / supplier shall take the time required for security clearance into consideration for timely execution of the project. Also all mobilization / demobilization and travelling costs is in bidder scope.

### 7. Progress review, HAZOP Study & Design Review:

- 7.1. Within four (04) weeks (approx.) of after signing of contract / purchase order, the bidder / supplier is required to provide schedule of design, manufacture, delivery and commissioning program. The schedule shall indicate the time table of the activities including, manufacturing stages, assembly, testing and delivery of the equipment and commissioning.
- 7.2. The Manufacturer / Packager is required to submit the fabrication specifications and drawings for approval and schedule of design review and HAZOP meetings as soon as possible after establishment of LC.
- 7.3. The fabrication/manufacturing work shall commence only after finalization of design, drawings / specifications. The Manufacturer / Packager shall also submit bi-monthly progress reports indicating the manufacturing status.
- 7.4. The supplier / bidder is required to perform HAZOP Study of the plant during the design phase of the package.
- 7.5. The HAZOP Study shall be reviewed by 06 Nos (approx.) of OGDCL professionals consisting of Plant Operations, Mechanical, Electrical, Instrumentation and HSEQ Engineers. Bidder to arrange the HAZOP meetings at a suitable venue within Pakistan at its own cost.
- 7.6. Design review meetings shall follow the HAZOP Study which are also to be arranged by the bidder / supplier at its own cost till the finalization of the design and its approval by OGDCL.



## 8. Installation of the package:

The bidder / supplier is required to provide the installation services as per following scheme of main installation works.

### 8.1. Construction of foundation(s):

8.1.1. The construction of foundations/grouting for all skid mounted equipment is completely in the scope of bidder, including the material and labour. The scope may be executed by any 3<sup>rd</sup> party local contractor authorized by the bidder. The local contractor for foundation construction should be well competent for such jobs. Foundation jobs may be started at OGDCL site prior to receipt of package to avoid delay.

8.1.2. The supplier / bidder to utilize the information provided in the soil test report attached with this document for the design of the foundations of the skids.

8.1.3. The design of the skids.

### 8.2. Placement of skids on foundations:

8.2.1. The placement of the skids shall be supervised by the bidder / supplier.

8.2.2. Shims / any other material to be used in placement to be arranged by the supplier.

8.2.3. The cranes along with operators, lifting material (cables, shackles, slings etc.) is in bidder scope. OGDCL crane (max 35 ton) /fork lifter (05 ton) may assist in case of availability in necessary situation. Supplier / bidder to provide the complete requirement of the lifting equipment along with rigging study for each of the skids.

8.3. **Levelling & Grouting of the skids:** Levelling and grouting of the skids to be completely carried out by the supplier / bidder / any authorised 3<sup>rd</sup> party firm hired by the bidder. The grouting material is also in the scope of the bidder / supplier.

8.4. **Alignment:** Alignment of the compressor with the prime mover (engine) and with gas cooler (if designed to be coupled with the prime mover) is also the responsibility of the bidder / supplier. The tools required for the alignment job shall also be arranged by the bidder / supplier.

8.5. **Off-Skid Piping:** All off-skid piping material as well as services for connection of the compression package with the tie-in points of the plant, shall be arranged

by OGDCL. Bidder / supplier to provide 3-axis orientation of all tie-in connections of the compression package after the finalisation of design in the form of isometrics / design.

**8.6. Cable laying and termination:**

8.6.1. Off-skid cable laying shall be performed by OGDCL, while cable termination and all other pre-commissioning activities pertaining to cabling shall be carried out by the bidder / supplier or any 3<sup>rd</sup> party firm authorized by the bidder.

8.6.2. Cables, cable glands, shrouds, junction boxes, lugs and all accessories related to cabling is included in the scope of bidder.

**8.7. Earthing:**

Complete earthing of the skid(s) of the compressor package is also in the scope of the bidder / supplier

**8.8. Installation, programming, testing and commissioning of Unit Control Panel:**

The installation, programming, testing and commissioning of on-skid Unit Control Panel (with HMI) and its communication existing Plant DCS is in the scope of the bidder / supplier or any 3<sup>rd</sup> party firm authorized by the bidder.

**8.9. Other installation / pre-commissioning jobs:**

Installation / pre-commissioning works other than described in section 8.1 to 8.8 are completely in the scope of the bidder along with complete resources / material.

**9. OGDCL's Responsibilities:**

9.1. OGDCL shall provide boarding, lodging and basic first aid cover to the Mechanical and E&I installation supervision and commissioning assistance experts of the bidder / supplier, up to a maximum of 06 persons at a single time. These facilities shall be standard as provided to any staff of OGDCL at Nashpa Site. OGDCL may facilitate the arrangement of any additional requirement regarding these facilities conveyed at the time of arrival of the experts of the supplier / bidder.

9.2. OGDCL to arrange and install off-skid piping and pipe fittings from the tie-in points of the plant to the compressor package, excluding pressure transmitter (PT-2242) at discharge header and PSV with isolating valves (as per section 3.3.11).

9.3. OGDCL shall only provide space within the premises of the plant for encampment / living to any 3<sup>rd</sup> party sub-contracting firm hired by the bidder. Electricity may be

provided by OGDCL with in plant premises however other facility of caravan like water, dining, living / office caravans etc. for the excess manpower to be arranged by the bidder / sub-contracting firm hired by the bidder / supplier.

9.4. OGDCL may provide its manpower (consisting of plant operations, mechanical, electrical and instrumentation engineers, technicians and other supporting staff) for the commissioning of the compressor package which will work under the supervision of experts deputed by the bidder / supplier for the installation and commissioning assistance. The manpower shall facilitate the experts of the bidder / supplier in the pre-commissioning and commissioning activities, however the manpower shall perform work only within its area of expertise (operations and maintenance of oil and gas plant / equipment) and shall not performed jobs that are defined completely in the scope of the bidder as per preceding section.

9.5. OGDCL may arrange 3<sup>rd</sup> party pre shipment inspection at its own cost.

## **10. Compliance with OGDCL's HSE Policy:**

10.1. While at site the workforce deputed by the bidder / supplier, including that belonging to any 3<sup>rd</sup> Party services firm hired by the bidder / supplier, must strictly comply by OGDCL's HSE Policy and Guidelines and contractor HSEQ manual.

10.2. OGDCL's Integrated HSE Management System along with basic safety guidelines are briefly described in the document "HSE Pledge Handbook - for Contractors & Service Companies", which may be issued to the workforce of the supplier / bidder on request.

10.3. The bidder / supplier shall provide personal protective equipment (PPEs) and covid 19 related material to all its workforce, including that of any 3<sup>rd</sup> party firm hired by the bidder to provide services.

10.4. The bidder to follow OGDCL's work permit system at site for all the pre-commissioning / commissioning activities.

## **11. Factory Acceptance Test (FAT):**

11.1. FAT of the complete package to be carried out either at the premises of the OEM or the Packager.

11.2. The bidder / supplier to submit "inspection and testing procedure" for the package to OGDCL for the FAT 02 month before the equipment is ready for the test.

- 11.3. The Inspection and Testing Procedure for FAT shall cover the following as a minimum:
- 11.3.1. Assembling sequence, including inspection and testing.
  - 11.3.2. Proposed check of system architecture against approved for construction documents
  - 11.3.3. Proposed physical inspection of equipment
  - 11.3.4. Proposed functional test of Control System
  - 11.3.5. Proposed check of documentation
- 11.4. The FAT shall include, but not be limited to the following:
- 11.4.1. Simulation and observation of all included inputs / outputs to confirm operation of Control System. In accordance with the P&IDs, Control Philosophy, Cause & Effect matrices, Logic Diagrams and I/O Schedule.
  - 11.4.2. Confirmation of correct functions of all communication links.
  - 11.4.3. Confirmation of availability of all specified screen functions and Operator
  - 11.4.4. Interface functions, including a proof test of automatic switchover to the redundant workstation upon failure of one workstation.
  - 11.4.5. Verification / Confirmation of correct functions of all communication links and protocols.
  - 11.4.6. FAT shall also include 6 hours soak test, graphics & data base verification, logic / cause & effect verification.
- 11.5. FAT shall be conducted at manufacturer's work place where the system has been assembled & similar Control System have been tested so far and should have all necessary infrastructure, latest equipment, spare parts and expert human resources readily available.
- 11.6. The Factory Acceptance Test shall be witnessed by 2 nos. OGDCL Engineers. The boarding / lodging and the travel cost/tickets of the OGDCL engineers to be borne by the bidder / supplier. Any relevant document required (like invitation letter etc) for visa processing to be provided by bidder.

## 12. Commissioning:

- 12.1. The Supplier shall carryout all commissioning works.
- 12.2. The supplier shall be responsible for supplying all necessary testing equipment, tools and the like for successful start-up and commissioning. Allowance shall be made for full testing of all aspects for the control system during commissioning.



- 12.3. Commissioning of the control system will take place in conjunction with the commissioning of the package skid instrumentation involving the OGDCL's Operations and Maintenance Sections at the field, which shall ultimately take over the operation of plants.

### **13. Site Acceptance Test (SAT)**

- 13.1. The site acceptance test shall be performed after completion of all jobs pertaining to installation & commissioning of the compressor package at site.
- 13.2. The test should cover complete loop testing of all inputs and outputs.
- 13.3. The SAT should also cover performance testing of the machine for 72 hrs at the peak load within the operating range of the compressor. The test shall be considered successful after the unit runs for 72 hrs continuously without any interruption.

### **14. Performance Guarantee**

- 14.1. The performance of Gas Engine Driven Reciprocating Compressor Package shall be guaranteed for the site conditions and performance (operating) Parameters / requirements given in Scope & Specifications. The guarantee shall be valid for a period of twelve 12 months from date of Site Acceptance Test or 18 months after receipt of complete material, whichever completes earlier.
- 14.2. If Gas Engine Driven Reciprocating Compressor Package do not meet the specified guaranteed performance parameters / requirements during the above mentioned operating period (despite remedial actions i.e. repairs, alterations, modification and replacement by Manufacturer) during a period of three (03) months. Bidder to depute its manpower for installation commissioning without any delay after receipt of package at OGDCL site.

### **15. Delivery period of the project:**

- 15.1. The shipment of the complete package shall take place 10 months from the establishment of L/c.
- 15.2. The period for installation & commissioning shall start from the notice given by OGDCL after successful inspection and receipt of the complete package to the site. The installation/commissioning of the package shall be completed within 04 months after the delivery of the compressor at site.

**16. Documentation required:**

- 16.1. Operation & Maintenance manuals for quoted compressor, engine and all auxiliary equipment
- 16.2. P&ID of the package showing limit of supply
- 16.3. MTCs of piping and vessels
- 16.4. Data sheets of all instrumentation
- 16.5. Detailed as built drawings of fin fan coolers, fin-fan cooler bundle and pressure vessels
- 16.6. Performance curves / performance data in case of all scenarios (low and high suction and discharge pressures.
- 16.7. Make/model for engine, compressor and other electrical and instrumentation parts to be mentioned in technical bid. Any material having Indian origin is not acceptable.

**17. Design parameters:**

The package must satisfy the complete ranges of parameter given below:

Sr.	Parameter	Values / ranges
1.	Suction Pressure (psig)	50 to 100
2.	Suction Temperature (deg. F)	80 to 150
3.	Final Discharge Pressure (psig)	500 to 650
4.	Max Discharge Temperature (deg. F)	115
5.	Flow capacity (MMSCFD) (min)	5 (Five)
6.	Gas Composition and properties	Provided at 17.1
7.	Fuel Gas Composition	Provided at 17.2
8.	Ambient Temperature	Min 35 deg F and Max 122 deg F
9.	Elevation	2700 ft. above sea level

Note: The compressor model to be selected / designed to guarantee a flow of 5 MMSCFD of the gas within complete ranges of suction and discharge temperature and pressure.

**17.1. Gas Analysis report for the Process Gas:**

Sr.#	Components	Mole %
1.	Methane C <sub>1</sub>	63.753
2.	Ethane C <sub>2</sub>	0.000

3.	Propane C <sub>3</sub>	20.115
4.	I-Butane nC <sub>4</sub>	3.174
5.	N-Butane iC <sub>4</sub>	4.968
6.	I-Pentane iC <sub>5</sub>	1.337
7.	N-Pentane iC <sub>5</sub>	1.134
8.	Hexane Plus C <sub>6+</sub>	1.729
9.	Carbon Dioxide Co <sub>2</sub>	3.077
10.	Nitrogen N <sub>2</sub>	0.713
11.	Hydrogen Sulphide H <sub>2</sub> S	-
12.	<b>Specific Gravity</b>	0.9936
13.	<b>Calorific Value (BTU/ft<sup>3</sup>)</b>	1617.91
14.	<b>Temperature (F)</b>	104
15.	<b>Sample pressure (Psi)</b>	72

**Note:** Sample dated 22-Jun-2019. Sample point: Overhead Compressor Inlet. Sampling performed by in-house laboratory at Nashpa Plant.

17.2. **Fuel Gas Specifications:**

Sr.#	Components	Mole %
1.	Methane C <sub>1</sub>	89.414
2.	Ethane C <sub>2</sub>	7.710
3.	Propane C <sub>3</sub>	0.324
4.	I-Butane nC <sub>4</sub>	0.002
5.	N-Butane iC <sub>4</sub>	0.002
6.	I-Pentane iC <sub>5</sub>	-
7.	N-Pentane iC <sub>5</sub>	-
8.	Hexane nC <sub>6</sub>	0.009
9.	Carbon Dioxide Co <sub>2</sub>	1.697
10.	Nitrogen N <sub>2</sub>	0.842
11.	Hydrogen Sulphide H <sub>2</sub> S	-



12.	<b>Specific Gravity</b>	0.615
13.	<b>Calorific Value (BTU/ft)</b>	1051.6

### 18. Applicable standards:

No.	Item	Applicable standard(s)
1.	Compressor	API 618, API11P, ISO 13631
2.	Coupling	API 671
3.	Pressure Vessel	ASME VIII, I
4.	Process Piping	ASME B31.3
5.	Flange	ASME B16.5
6.	Heat Exchanger	API 661
7.	Electrical Component	IEC 60079
8.	Engine rating / other specs	ISO 15550 & ISO 3046-1
9.	Exhaust emissions levels	NEQS of EPA, Pakistan
10.	Noise emissions (for electric rotary equipment)	IEC 60034-9
11.	Measurement of exhaust emissions	ASTM-D6522
12.	Machine protection system	API 670, 5 <sup>th</sup> Edition
13.	Control Valve Sizing	ANSI/ISA-75.01.01
14.	Process Piping	ASME B 31.3
15.	Flanges & bolts	ASME B16.5

### 19. Units of measurement:

The following units shall be used in all documents, instrumentation supplied on or with the package and information engraved on the equipment name / rating plates.

Description	Unit
Temperature	°F
Pressure (gauge)	psig
Pressure (absolute)	psia
Mass	lb
Volume	ft <sup>3</sup>
Length	ft

Alternate Length	in
Liquid Relative Density Liquid Absolute Density Vapour Flowing Density	sp gr T F/60 F API and lb/gal @ 60 F lb/ft <sup>3</sup>
Flowing Quantities Mass Vapour Liquid	lb/h MMSCFD US gpm
Standard Quantities Vapour Liquid Enthalpy	10 <sup>6</sup> std ft <sup>3</sup> /day at 60 F and 14.65 psia bpd at 60 F Btu/lb
Heat Rate	mm Btu/h
Electrical Power	kW
Electric voltage	Volts
Compression power	Horsepower (HP, kW)
Time	Seconds, hours, days
Viscosity Concrete density Concrete strength Steel Strength	cP Pounds per cubic foot (pcf) Pounds per square inch (Ksi) Ksi
Exhaust emissions (gases)	mg/Nm <sup>3</sup>

## 20. Format of financial bid:

The following format to be incorporated in the financial bid:

Sr.	Description of equipment / services	Prices in USD
A	Price of the complete compressor package.	
B	Installation supervision, commissioning, foundation, start-up and on-site training (lump sum prices)	
C	Price of start-up/commissioning spares (including lube oil(s), coolants for 1 <sup>st</sup> fill and filters, strainers etc.(unpriced list to be provided with technical bid)	
D	Factory acceptance test at packager/bidder works	
E	Price of 02 year spares for the package (individual item wise with part numbers)	
F	Special Tools	

**Note:** The bid evaluation criteria is 'main equipment wise', therefore the evaluation shall be done on the basis of combined price of 'A', 'B' 'C' & 'D' only. 02 year parts and Special Tools will be optional and shall be ordered completely or selectively by OGDCL.

## 21. Pre-shipment inspection

The pre-shipment inspection shall be in OGDCL's scope. Its charges shall be borne by OGDCL and shall be carried out by a 3<sup>rd</sup> party firm hired by OGDCL. The bidder / supplier to provide ample time within the delivery period for the pre-shipment inspection.

## 22. Transportation and on-delivery inspection

22.1. Manufacturer / Packager is required under the Contract to deliver the Equipment / material on CFR Karachi Basis.

22.2. The Manufacturer / Packager shall submit to the before shipment:

22.2.1. A list of packages which by virtue of their nature, size or weight may give rise to difficulties in transport or handling.

22.2.2. The probable timetable of shipment in accordance with the schedule so that deliveries are made in the most convenient order for Site Work.

22.3. After the receipt & clearance of the goods at Karachi port the packages may be inspected in the presence of the supplier / bidder's representatives at OGDCL's Korangi Base Store / Warehouse in West Wharf, Karachi. On acceptance of the complete package by OGDCL, material acceptance certificate(s) shall be issued by OGDCL.

## 23. Payment terms:

- (a) 70% against shipment through LC
- (b) 10% after receipt of material and successful inspection at OGDCL store/site.
- (c) 20 % After successful site acceptance test (SAT)

## 24. Bidding procedure

TWO STAGE, TWO ENVELOPE



