KUWAIT OIL COMPANY (K.S.C.)

A subsidiary of Kuwait Petroleum Corporation

إحـــدى شركـــات مؤسســـة البتـــرول الـكـويتيـة
A Subsidiary of Kuwait Petroleum Corporation

PRODUCTION & PROJECTS (GAS) GROUP
GAS PROJECTS TEAM-II

Mutriba Remote Boosting Facility (MRBF) at North Kuwait

Technical Specification- Part A

(Doc. # MRBF-TS-G-002)

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1.0 INTRODUCTION

1.1 Mutriba hydrocarbon formation, present in North West area of Kuwait, is the single largest remaining undeveloped structure in Kuwait and potential prospects discovered at Ratawai Lime Stone, Ratawi Shale, and Minagish & Marrat Formations. As part of developing Mutriba Fields, Kuwait Oil Company intends to implement a phased development approach in view of remote location of Mutriba fields and to ensure alignment between well drilling/production and surface facility development.

1.2 Current scope of the project is limited, to install Mutriba Remote Boosting Facility, "MRBF" at North West area of Kuwait, for boosting the Reservoir pressure and routing to existing facilities for further assessment of the reservoir fluids. Mutriba Remote Boosting facility (MRBF) is proposed to handle 30 MBOPD production. "MRBF" has also been referred as "Facility" in this document.

1.3 MRBF is an Onshore Surface boosting station / facility and shall be implemented on Build-Own-Operate (BOO) basis by the Contractor. Accordingly, Contract period is divided into "Execution Phase" and "Operation & Maintenance (O&M) Phase".

1.4 This Technical Specification, MRBF-Part A along with Technical Specification General defines the requirements of the Contract with respect to Design and Engineering, Procurement, Supply, Installation, Construction, Inspection, Testing, Pre-commissioning, Commissioning, Performance test, Operation & Maintenance and all the related works of the Mutriba Remote Boosting Facility and all related works.

1.5 The Facility shall be built for handling Thirty Thousand Barrels of Stock Tank Oil Per Day (30 STMBOPD) of crude with 25 % water cut and Thirty Million Standard Cubic Feet per Day (30 MMSCFD) of sour gas from sour and wet reservoir fluids of Mutriba Fields as specified in relevant sections of Technical Specification.

1.6 Mutriba fields consist of two categories of reservoirs viz., - high pressure Jurassic reservoirs with very high H_2S (up to 40 mole % in the produced gas) and low pressure Cretaceous reservoirs with low H_2S (0-6 mole % in the produced gas). The arrival pressure of reservoir fluids from Jurassic is estimated to be at 300-350 psig (as MP Feed) while the arrival pressure of Cretaceous fields will be in the range of 200-250 psig (as LP Feed).

2.0 PROJECT OBJECTIVE & BRIEF DESCRIPTION

2.1 The objective of the project is to Boost the commingled reservoir fluids from Mutriba Fields to the required pressure to facilitate processing at existing Jurassic Production Facilities while facilitating Reservoirs performance assessment of Mutriba Field through well testing and samples testing in a safe and reliable manner by installing a Mutriba Remote Boosting Facility based on integrated skid mounted package approach on fast track basis.

2.2 Brief Process Description of the Facility is given as below;

2.2.1 The Facility consists of the following sections;

a) Inlet Headers for Jurassic and Cretaceous fluids along with testing section
b) Sour fluid heating section
c) Sour Fluid Transfer (boosting) and metering section
d) Utility & Supporting Systems for the above
e) Facility infrastructure like Buildings, Roads.
f) Facility integration /Tie-in with offplot works and flow lines

2.2.2 High Sour and wet Jurassic hydrocarbon reservoir fluids (MP) are received to the Facility through a flow line and trunk line gathering network. Similarly, sweet/low sour and wet Cretaceous hydrocarbon reservoir fluids (LP) are received to the Facility through dedicated flow line and trunk line gathering network.

2.2.3 High Sour & sweet/low sour feed passes through respective inlet headers and test header. Multi-Phase Flow Metering system is provided at the test header for testing of individual well. The fluid from the inlet headers are routed to heaters. Heaters are used for heating the fluid during winter scenario. Dedicated High Integrity Pressure Protection System - HIPPS is provided in each inlet header to protect the facility from high pressure from wells.

2.2.4 The Commingled well fluid from heater is routed to the multiphase pump suction to boost the fluid pressure to 1100-1200 psig. Separators and coolers (as required) are provided at the pump discharge as per vendor requirement. The pump discharge is transferred to existing facilities (EPF-50, JPF-1, JPF-2, JPF-3, JPF-4) through 10 numbers of 6" transfer lines as part of Technical specification part-B.

2.2.5 Utility and supporting system needed for the above process shall be built, generated and supplied within the Facility except for Company supplied Fuel Gas and brackish water/Source Water which are supplied by Company.

2.3 Refer to **Appendix- 1** to this Technical Specification for Block Flow Diagram of MRBF.

2.4 The Facility (MRBF) is located near to Mutriba Fields located at North West area of Kuwait.

3.0 SCOPE OF WORK

The Contractor's scope of works shall include design, engineering, procurement, testing, supply of materials/packages, shipping, delivery at site, Site Survey, Site preparation, Construction, Material Storage, Material management, Installation, Tie-ins, Integration, Completion, Chemicals / consumables supply, Waste Management, Pre-commissioning, Commissioning, Performance Test, Operations and Maintenance of Mutriba Remote Boosting Facility (MRBF) at North Kuwait, consisting of the following sections, systems, associated works and services as a minimum;

3.1 Sour Fluid Handling Section

3.1.1 Inlet & Test System

a) Inlet flow lines, Trunk lines & MP Production header package
b) Inlet flow lines, Trunk lines & LP Production header package
c) Inlet flow lines & Test header package
d) Multiphase Flow Meter (MPFM) package
e) High Integrity Pressure Protection System (HIPPS) package on MP and LP headers inlet to Oil Preheating system
f) Off skid and on skid piping, pipe racks including drain headers and utility headers
g) Off skid and on skid mechanical, electrical, instrumentation, civil, structural, cathodic protection and underground works

3.1.2 Oil preheating System

a) MP Inlet crude Preheater package
b) LP Inlet crude Preheater package
c) Off skid and on skid piping & pipe racks
d) Off skid and on skid mechanical, electrical, instrumentation, civil, structural, cathodic protection and underground works

3.1.3 Sour fluid Transfer (boosting) and metering System

a) Multiphase Pump Packages along with inlet headers mixing/blending system
b) HP Separator package with Liquid and gas flow metering.
c) Online analyzer packages for H_2S on Liquid and Gas outlet of Separator
d) Water cut analyzer in Separator liquid outlet line
e) Sour liquid and gas export lines and Tie-ins to Company transfer network with necessary piping, civil, structural, instrumentation and electrical works

3.1.4 Chemical injection systems – Sour fluid handling section

a) Corrosion Inhibitor - chemical injection system package for inlet, sour Gas & liquid section
b) Scale inhibitor - chemical injection system package for inlet section
c) Hydrate inhibitor injection systems at inlet and outlet
d) Off skid and on skid piping
e) Off skid and on skid mechanical, electrical, instrumentation, civil, structural, cathodic protection and underground works

3.2 **Utility & Supporting systems**

Utility systems shall consist of the following as detailed below:

3.2.1 Fuel Gas Conditioning & Distribution System

a) Fuel Gas inlet system
b) Fuel Gas polishing Package
c) HP Fuel Gas KOD Package
d) HP Fuel Gas Heater Package
e) HP fuel gas filter coalescer packages (2 x 100 %)

f) HP Fuel Gas distribution
g) LP Fuel Gas KOD Package
h) LP Fuel Gas Heater Package
i) LP Fuel Gas distribution
j) Off skid and on skid piping & pipe racks
k) Off skid and on skid mechanical, electrical, instrumentation, civil, structural, cathodic protection and Underground works

3.2.2 HP Flare System & Network

a) HP Flare network
b) HP Flare KOD package along with flare gas flow measurement
c) HP Flare KOD pumping system (2 X100%) package
d) HP Flare (sonic) Systems with low radiation type
e) Flare aviation lamps
f) High Intensity Ignition System Package
g) FFG Ignition Package
h) CCTV cameras for flare monitoring
i) Off skid/on skid piping & pipe racks
j) Off skid and on skid mechanical, electrical, instrumentation, civil, structural, cathodic protection and underground works
k) Fence for Flare

3.2.3 LP Flare System & Network

a) LP Flare Network
b) LP Flare KOD package along with flare gas flow measurement
c) LP Flare KOD pumping system (2 X100%) package
d) Air assisted LP Flare system with aviation lamps
e) High Intensity Ignition System Package
f) FFG Ignition Package
g) 2X 100% air blowers with VFDs
h) CCTV cameras for flare monitoring
i) Off skid and on skid piping & pipe racks
j) Off skid and on skid mechanical, electrical, instrumentation, civil, structural, cathodic protection and Underground works
k) Fence for Flare

3.2.4 Diesel Storage & Transfer System

a) Diesel unloading system from Tanker
b) Diesel Storage Tank (7 days storage capacity)
c) Diesel Transfer Pumps package
d) Diesel coalescing filters (2X 100%) duplex type
e) Diesel distribution network
f) Off skid and on skid piping & pipe racks
g) Off skid and on skid mechanical, electrical, instrumentation, civil, structural, cathodic

protection and underground works

3.2.5 Closed Drain System

a) Closed Drain collection header & Network
b) Closed Drain Vessel package
c) Closed Drain vessel Pumps package
d) Off skid and on skid mechanical, electrical, instrumentation, civil, structural, cathodic protection and underground works

3.2.6 Open Drain System

a) Open Drain collection header & Network
b) Open Drain Vessel package
c) Open Drain Vessel Pumps package
d) Off skid and on skid mechanical, electrical, instrumentation, civil, structural, cathodic protection and underground works

3.2.7 HOT Oil package system - Storage, transfer, heating and distribution System

a) Hot oil vessel Storage and pumping system
b) Hot Oil package with necessary heating and fuel supply system
c) Hot Oil distribution, make up, drain and circulating system
d) Off skid and on skid mechanical, electrical, instrumentation, civil, structural, cathodic protection and underground works

3.2.8 Plant Air, Instrument Air and distribution systems

a) Air compressor packages 3 X 50%, with discharge pressure 150 psig (including nitrogen generation requirement)
b) Plant Air receiver – 1 No.
c) Instrument air receiver -– 1 No.
d) Instrument air dryer packages (2 X 100%)
e) Plant air distribution network
f) Instrument air distribution network
g) Off skid and on skid piping & pipe racks
h) Off skid and on skid mechanical, electrical, instrumentation, civil, structural, cathodic protection and underground works

3.2.9 Nitrogen System and distribution systems

a) Nitrogen Generation package – 1 X 100%
b) Nitrogen receiver (1 No.)
c) Nitrogen distribution network
d) Off skid and on skid piping & pipe racks
e) Off skid and on skid mechanical, electrical, instrumentation, civil, structural, cathodic protection and underground works

3.2.10 Emergency Diesel Generator System / Black Start Diesel Generator

a) 1 No. EDG – 2MW (minimum)
b) Diesel Day Tank (24 hours storage capacity)
c) Dummy Load Bank & Associated Switchgear
d) Off skid and on skid piping & pipe racks
e) Off skid/ on skid mechanical, electrical, instrumentation, civil, structural, cathodic protection and underground works

3.2.11 Power Generation and distribution System

a) N+1 numbers GTGs (N working +1 Standby) and associated supporting systems for approximate load of 12-16 MW
b) Power distribution systems and sub stations
c) Off skid and on skid piping & pipe racks
d) Off skid and on skid mechanical, electrical, instrumentation, civil, structural, cathodic protection and underground works

3.2.12 Firefighting System

a) Brackish water filters (2 X 100%) package
b) Chemical Injection System
c) Fire water Demand calculations & Network Hydraulic study
d) Fire water filling connections
e) Fire water Tanks (2 x 5000 BBLs) net storage capacity
f) Diesel driven Fire water main pumping system with minimum 2 X 2000 USGPM capacity configuration and as per KOC-L-009 and KOC-ME-009
g) Fire water Ring main, hydrants and monitors network as per KOC-L-009
h) Foam monitors/pourers as per KOC-L-009
i) Deluge systems as per KOC-L-009
j) Fire water jockey pumps as per KOC-L-009 /KOC-ME-009
k) Fire extinguishers, CO_2 Cabinets/Cylinders and other firefighting equipment as per KOC-L-009
l) Active & passive fire protection systems for the Facility
m) Fire & Gas detectors
n) Manual call point
o) Beacon, Hooter and evacuation sounder
p) Fire Alarm Control Panel (FACP) for Buildings
q) Fire Suppression System and Control Panel (FSCP) for Substations
r) Off skid and on skid mechanical, electrical, instrumentation, civil, structural, cathodic protection and underground works

3.2.13 Cathodic Protection System

Cathodic protection shall be provided for the following:

a) Underground steel pipelines & piping networks
b) Steel Tanks Internal Surface and On-Grade Steel Tank Bottom
c) Vessels Internal Surfaces

3.2.14 Common Instrumentation Systems

a) Central Control Room (CCR) along with required Operator & Engineering works stations, push buttons & furniture.
b) ICSS System (DCS, ESD, FGS & HIPPS Systems) along with required servers and works stations.
c) PAGA System.
d) CCTV System.
e) LAN/Telecom System.
f) Instrument Panels at MCB and marshalling room at Sub-stations

3.2.15 Common Electrical Systems

a) Modular elevated Type Substations – 1 No. along with Instrument Equipment Room
b) HV/MV Switchgears
c) LV Switchgears/MCC's
d) Power Transformers
e) MV/LV Motors & Local Control Stations
f) Normal/Emergency Distribution Boards
g) Variable Speed/Frequency Drives (VSD/VFDs) / Soft Starters
h) Lighting & Small Power System
i) UPS System (AC/DC) with Batteries & Isolators
j) Provision for E-SCADA System
k) Earthing and Lightning Protection System
l) Power/Control Cables & Bus duct System
m) Electric Surface Heating, as required
n) Cable Tray/Ladder Rack, Conduit & Duct bank System

3.2.16 Laboratory building along with required sampling & testing equipment and furniture.

3.2.17 Chemical unloading system and chemical storage building with necessary infrastructure.

3.2.18 Buildings & HVAC Systems

a) Control Room / building with furniture, HVAC, FACP and associated infrastructure
b) Electrical Substation with HVAC, FACP, FSCP and associated infrastructure.
c) Maintenance warehouse
d) Security Guard houses
e) Laboratory
f) Labor / Operator Rest area

3.2.19 Potable water supply, storage, pumping and distribution system.

3.2.20 Eye Wash & Safety showers as per KOC-L-009.

3.2.21 Drainage & Sewage System.

3.2.22 Shelters.

3.2.23 Corrosion coupons, corrosion probes, corrosion injection points, fluid sample connections, Corrosion Monitoring Systems as needed for the Facility (on the basis of internal corrosion risk and scale assessment study and KOC-MP-035 requirements).

3.2.24 Cranes/EOT cranes as per the requirements.

3.2.25 Parking.

3.2.26 Asphalt Internal access Roads and approach roads.

3.2.27 Paved walkways.

3.2.28 Medium Security Fence and security gates.

3.2.29 Compacted Gatch perimeter roads.

3.3 **Tie-in & Integration works with Company Facilities and Part-B SCOW**

MRBF shall be integrated with existing facilities / ongoing projects of the Company for required tie-in connections. The Contractor shall design, supply, install, test, commission and integrate the following tie-ins and interface works (as a minimum) from/to the Facility to well flow lines & pipelines laid under other projects by the Company. All connections & tie-ins to / from the Facility (along with associated electrical and instrument works as indicated in the reference drawings) shall be carried out by the Contractor. Contractor shall also check the available tie in points by conducting joint site visits with Company & sub-Contractors to ensure safe and comprehensive installation of tie-ins. The tie-in area locations are provided in the Plot plan **Appendix- 2A** to this Technical specification are indicative only. Contractor shall carryout site survey to finalize location of the tie-in points and same shall be agreed with the Company beforehand. Brief details of Tie-in & integration works are given as below;
The outlet from MRBF will be routed through the 6" pipelines under scope of work of Technical Specification-Part-B to existing Jurassic facilities for further treatment. However, the tie-in location at existing facilities shall be decided by Superintendent of Contract based on the production profile and nature of fluid. Contractor shall finalize the tie-in location with prior approval from Company.

3.3.1 Flow lines

a) Tie-in and integration of 30 no. 6"- 900# flow lines and 3 no.s of 12"-900# Trunkline to Inlet Manifold.
b) Tie-in & extension of 1 no. 4"- Q15B drain line from inlet area to the Facility Closed Drain / flare system.

3.3.2 Sour Fluid Transfer /Export (Refer Technical Specification, Part-B for details)

a) 10 no. 6”-C97B3 sour fluid transfer lines from facility to transfer network/Tie-ins, as per Technical Specification Part-B details.
b) Extension of 1 no. 4”- Q15B drain line from transfer area (Technical Specification –Part B) to the Facility Closed Drain system.

3.3.3 Fuel Gas (Refer Technical Specification, Part-B for details)

a) Extension of 1 no. 10”-C35B Fuel Gas supply line (Technical Specification Part B) from FG PIG L/R to Facility FG conditioning area.
b) Extension of 1 no.3”- C15B Blowdown line from Fuel Gas pig launcher receiver area.

3.3.4 Brackish water (Refer Technical Specification, Part-B for details)

a) Tie-in and extension of 2 no. 4”- F10A source water lines line (Technical Specification Part B) to brackish water inlet / Basket filter inlet (Q15A class) through a header, ESDV, PG /PT and flow meter.

3.3.5 Electrical interface/integration works

Integration of Lighting, cathodic protection and power supply to Pig Launcher area and export transfer pipelines near to MRBF. A 6 KW UPS Power for the Company supplied equipment shall be reserved with necessary distribution arrangement at MCB.

3.3.6 Instrument interface/integration works

Integration of Instrumentation, MOV and Fire & Gas from Fuel Gas PIG Launcher area to facility ICSS. Serial interface of RTU & FGS at Pig Launcher area to facility ICSS. Provide dedicated DCS operator station for monitoring and controlling the PIG Launcher area signals. Contractor shall provide necessary provision and permission to access the ICSS OPC Path for future integration to Company’s Management Information System. Provide necessary provision for PIG Launcher area cables entry to facility MCB and SS.

4.0 PROJECT DESIGN BASIS

4.1 Overall Facility Design

4.1.1 MBRF shall be designed to handle following capacities:

Table 4.1 (a) – Design Capacities

Description	Unit	Capacity (Note 1)
Sour Crude Oil	MBOPD	30 (5-30)
Sour gas	MMSCFD	30 (5-30)
Produced / Effluent water	MBWPD	10 (0-10)

Note 1: In view of New Fields and varied reservoir conditions/blends maximum guaranteed export oil capacity is fixed at 30 STMBOPD along with 25% water cut at the outlet MRBF. Corresponding gas capacity is expected to vary 18 – 30 MMSCFD. Further, during initial phase of commissioning and Operation, possibility exists that Inlet Flow rate to the Facility will be low and gradually increased based on wells availability.

4.1.2 Reservoir Fluids, Blends and arrival pressure

(a) Facility is expected to receive sour/sweet hydrocarbon fluids from various reservoirs of Mutriba and nearby Fields, located at NK with varied blends. Given below are the expected blends to the Facility;

Table: 4.1 (b) - Reservoir Blends

Name	Expected contribution of production from each Field (% Mole/Hr.) towards Facility Design				
	Jurassic Field			Cretaceous Field	
	Well-1	Well-2	Well-3	Well-4	Well-5
Blend 1	100	0	0	0	0
Blend 2	0	0	0	50	50
Blend 3	40	20	15	20	5
Blend 4	20	20	10	10	40

(b) Contractor shall note that the arrival pressure of Jurassic (MP) & Cretaceous (LP) well fluids will be in the range of 300-350 psig and 200-250 psig respectively with varied composition. Water cut is expected to vary from 0 – 25%.

(c) Inlet reservoir fluid with wide range of API shall be considered. API for cretaceous fluid range from 24-40 °API and for Jurassic fluid is 38-48 °API.

4.1.3 Facility Design Cases

In view of the varied reservoir blends and arrival pressures to the Facility, Contractor shall design the Facility for the following Cases;

a) CASE 1 (A/B) – Blend-1 with 25% Water cut-Summer/Winter
b) CASE 2 (A/B) – Blend-2 with 25% Water cut-Summer/Winter
c) CASE 3 (A/B) – Blend-3 with 25% Water cut-Summer/Winter
d) CASE 4 (A/B) – Blend-4 with 25% Water cut-Summer/Winter

Contractor shall identify the limiting cases of design for each equipment based on the above blends/simulations and ensure that Facility design is carried out to suit the most stringent parameter/value/requirement, as applicable. Maximum 40 mole % H_2S and 3 mole % CO_2 shall be considered for material of construction for sour process services.

4.1.4 Feed Inlet conditions & Composition

Inlet condition of each reservoir fluid for various design cases are given below:

Table 4.1 (c) – Arrival conditions and composition

S.NO.	Feed Streams	Arrival Pressure (Psig)	Arrival Temperature (° F) (Summer/Winter)	Composition
1	Case-1	300 - 350	140/40	Refer **Appendix- 5**
2	Case-2	200 - 250	140/40	
3	Case-3	Jurassic wells 300 – 350: Cretaceous wells :200-250	140/40	
4	Case-4	Jurassic wells 300 – 350: Cretaceous wells :200-250	140/40	

4.1.5 Over Design Margin

The following Overdesign margins shall be considered in finalizing the Facility design;
a) 10% for process section
b) 15% for Utility & Supporting systems except power
c) 25% of peak demand power

4.1.6 Turndown

30% of design capacity shall be considered for Turn down requirements of various sections of the Facility.

4.1.7 Process safe Guarding Requirements

The following safeguarding requirements shall be considered as minimum requirements while developing the Process Safe Guarding Philosophy for the Facility;

a) Process Sectionalizing of the Facility with Emergency Shut down Valves (ESDV's) and Emergency Blow Down Valves (EDBV's) to handle emergencies and safe disposal as well as to meet Company shut down philosophy at various levels of Plant Operating scenarios.
b) Independent sensing elements and Control systems for Basic Process Control, ESD and F&G systems
c) SIL – 3 rated ESD system and F&G systems for the Facility as a minimum requirement.
d) Dual PSVs for non-spared vessels / equipment
e) Double mechanical seals for the pumps handling toxic fluids (>500 ppm H2S). Multiphase pump seal system shall be as per vendor recommendation.
f) Double Block & Bleed isolation shall be followed for any one of the following cases, as minimum:
   i. Equipment and piping handling toxic H_2S fluids containing ≥ 500ppm(vol.) irrespective of pressure/temperature rating.
   ii. Equipment and piping handling toxic H_2S gas containing ≥ 500ppm(vol.) for toxic liquid) irrespective of pressure/temperature rating.
   iii. Equipment and piping with high pressure 600# and above, irrespective of temperature rating.
   iv. Equipment and piping with high temperature (>250^o C)
   v. Facility Battery Limits

g) Closed Drain system to ensure safe draining and recovery of Hydrocarbons
h) ESDV's at the Facility inlet & outlet lines
i) Process Safety protection by implementing individual protection layers (IPL's) for Loss of containment and equipment protection
j) Implementation of Level-1, Level-2, Level-3 & Level-4 shut downs as given below:

   i. Level 1: Facility Shutdown with Depressurization
   ii. Level 2: Facility Shutdown without Depressurization
   iii. Level 3: Process System/Package Shutdown
   iv. Level 4: Individual Process Equipment Shutdown

k) Sizing of Pressure relieving system of vessel/equipment corresponding to the limiting case of the following scenarios as minimum;

   i. External fire case (for Liquid expansion & vapor expansion scenarios)
   ii. Blocked outlet case
   iii. Upstream equipment/system gas blow by case
   iv. Level 1 emergency depressurization case
   v. Critical utility failure cases
   vi. Tube rupture case / idling fluid expansion case
   vii. Other specific cases, if any, recommended by /vendor/standards

4.1.8 Design Life

Minimum Design life of the facility shall be considered as 20 years.

4.1.9 Plot Plan & Lay Out Drawings

MRBF shall be installed at Northwest Kuwait.
Preliminary plot plan showing the plant coordinates, equipment lay out, plant buildings, substations/local instrument control rooms is provided in **Appendix- 2A to the Technical specification** for reference. Preliminary fence layout is provided in **Appendix No- 2B** for reference.
The Contractor shall develop the plot plan based on contractual requirements of the Facility and submit to the Company for review and approval.

4.1.10 Brief Operation & Maintenance Philosophy

a) Facility design shall ensure a safe and reliable operating Facility with 95% minimum availability. Necessary requirements for preventive maintenance and equipment health monitoring shall be ensured and monitoring activities shall be carried out by Contractor based on vendor/packager recommendations.
b) 2 X100% (or) N+1 sparing philosophy shall be followed for all rotating equipment, if not specified.
c) Individual rotating equipment package or Train isolation and Maintenance flexibility shall be provided.
d) Contractor shall develop Integrated Operation & maintenance Philosophy (based on Vendor/Packagers data) for the Facility and submit to the Company for information.
e) Contractor shall ensure carrying out necessary periodic monitoring/maintenance activities of rotating equipment and turbines as specified by vendor, to ensure the integrity.
f) Corrosion Monitoring program following KOC standard of practice and risk-based scheduling of installation/retrieval of coupons/probes and relevant fluid analysis & online analyzers capturing corrosive incidents in the piping network.
g) Equipment isolation philosophy and Maintenance Bypass philosophy shall be developed by Contractor during engineering phase and submitted to Company for information.
h) Considering high sour nature of fluid, Contractor shall design operating and isolation systems of the facility by including remote operating valves, safe purging , venting and draining wherever required to reduce manual intervention to bare minimum.

4.2 **Sour Fluid handling Section**

4.2.1 Inlet flow lines & Production Manifold package with the following;

a) Facility inlet shall have one (1) no. 16”- 900 # inlet MP production header, LP production header each and one (1) no. 8” – 900# Test Header. All inlet Headers shall be in compliance to C97B3 piping class of KOC-MP-010 and shall be compatible to the fluid being handled. Each header shall be provided with 30 numbers of slots to connect 6” Flow lines from reservoirs in Mutriba fields. Three (3) numbers additional 12” slots with associated piping/ESDVs/valves/instruments up to fence shall be provided for MP and LP production headers in order to connect the trunklines.
b) Each flow line with 6” - 900# -C97B3 specification shall be extended from facility Tie-in point to MP & LP Production headers and Test Header with required ESDVs,

MOVs/ROVs, PIT's , PGs, TGs, TITs , NRVs, isolation valves with spectacle blinds, sampling connections, draining system, purging system & instrument air system for ESDVs.

c) Each Trunk line with 12" - 900# -C97B3 specification shall be extended from Tie-In point to MP & LP production headers with required ESDVs, MOVs/ROVs, PIT's , PGs, TGs, TITs , NRVs, isolation valves with spectacle blinds, sampling connections, draining system, purging system & instrument air system for ESDVs.

d) Flow line/Trunk line interconnection valves to headers shall be MOVs/ROVs with remote operation in order to reduce the manual intervention due to high H_2S.

e) Inlet production header with PSVs, draining system, chemical injection provisions, corrosion coupon and corrosion probe.

4.2.2 Test Manifold package with the following with the following:

a) Extension of each flow line to connect to Test header with required isolation valves (MOVs)/ROVs, corrosion coupons, corrosion probes, sampling connections, draining system & instrument air system for ESDVs.

b) Test header with PSVs, draining system, chemical injection provisions, corrosion coupon and corrosion probe

4.2.3 Off skid piping, drains, instrumentation, electrical and instrumentation works associated with the above packages shall be included in skid scope and to be finalized based final lay out of the plant.

4.2.4 Flow lines, production header Operating, design conditions and material specifications are given as below:

Table 4.2 (a) – Inlet conditions & design data

S. No.	Parameter	Unit	Value
1.	Operating Pressure (MP)	psig	300-350
2.	Operating Pressure (LP)	psig	200-250
3.	Design Pressure (Max. / Min.) - MP/Test headers	psig	1740 / Full Vacuum
4.	Operating Temperature (Min. /Max.) MP/LP/Test	Deg. F.	40 / 180
5.	Feed Rate (MP/LP headers)	Total capacity to be considered.	
6.	Design temperature	Deg. F.	-20 / 200

4.2.5 HIPPS SYSTEM & MPFM Packages

a) Downstream equipment shall be protected against overpressure from well fluids with independent High Integrity Pressure Protection Systems (HIPPS).

b) HIPPS consists of HIPPS system, duel ESDVs, 2oo3 PIT, air vessel and accessories.

c) Multi Phase Flow Meter (MPFM) along with flow computer shall be provided to test single well fluid routed from Test header with necessary MOV/ROVs, ESDV's and accessories.
d) Test Header and Multiphase Flow meter shall be sized for the maximum oil rate and GOR of the well fluid.
e) Chemical injection provisions viz., Corrosion inhibitor and scale inhibitor are to be considered at each of the headers.
f) MPFM data is given as below;

Table 4.2 (b) – MPFM Data

S. No.	Parameter	Unit	Value
1	Fluid Name		Mutriba Sour reservoir Fluid (MU-RS/ MU-RL/ MU-MA/MU-RWLS/MU-RWS)
2	Gas Flow Rate	MMSCFD	1 – 10
3	Oil Flow rate	MBOPD	1 – 5
4	Water Cut	%	0-25 (Note-1)
5	Operating Pressure (MP)	psig	300-350 (Note-2)
6	Operating Pressure (LP)	psig	200-250 (Note-2)
7	Design Pressure (Max. / Min.)	Psig	1740/ Full Vacuum
8	Operating Temperature (Min. /Max.)	Deg. F.	40 / 180
9	Design temperature	Deg. F.	-20 / 200
10	Fluid properties	To be estimated based on composition	
11	Accuracy	+/- 2% for flow rate & GVF	
12	Response Time	5 seconds or better	

Note:
1. Water cut will be less initially (0-15 %) and will be increasing gradually.
2. MPFM shall be able to operate in the pressure range of 150-350 psig.
3. API for cretaceous well fluids will range from 24-40 °API while for Jurassic 38-48 °API.

4.2.6 Inlet Crude Preheater System

a) Independent inlet preheater shall be provided at the MP and LP header outlet to maintain the temperature during winter. Bypass provision shall be provided for the heater. Requirement of heater shall be reviewed considering the operating pressure and temperature of blended fluid.
b) Inlet preheater specifications are given as below:

Table 4.2 (c) – Inlet MP and LP Fluid Preheater Data

S. No.	Parameter	Unit	Value
1.	Operating Pressure (Shell /Tube)	Psig	(100 -120) / (300 – 350 for MP feed and 200-250 for LP feed)
2.	Design Pressure (Max. / Min.) - (Shell /Tube)	Psig	150 /FV (shell) 500/ FV (Tube)
3.	Operating Temperature (Min. /Max.)	Deg. F.	300 – 400 (shell) 100 – 104 (tube)
4.	Design temperature –	Deg. F.	450 (shell) 450 (tube)
5.	Heat Duty	MMBTU / Hr.	To be calculated based on heating crude from 40°F to104°F for limiting case.
6.	Pressure Drop (Max.)	Psi	10
7.	Type		AES (Removable Internals)
8.	Design Code		API 660, TEMA -R ASME Sec VIII Div. 1 with "U" stamp
9.	Material (As per NACE MR0175/ISO15156, TM-284)		Shell Side : SA516Gr.60/70 + 3mm CA Channel Side : SA516Gr.60/70 + INCONEL 625 cladding Tubes : INCONEL 625

Note 1: Shell side Heating medium design/operating conditions are tentative and shall be finalised during detailed design engineering.

4.2.7 Multiphase pumping and Separator system

Fluid from the preheaters shall be commingled at pump suction header with required mixing system and pumped to existing facilities through multiphase sour liquid transfer pumps. Given below are the minimum requirements;

a) Three (3) numbers Multiphase Transfer pumps (3 X 50% capacity) shall be provided to pump the sour liquid to Company network and to route to existing facilities (JPF-1,JPF-2, JPF-3, JPF-4 and EPF-50) for further processing. Each transfer pump shall be provided with variable speed motor drive.

b) Dedicated solid filter system shall be considered for each pump suction as an additional protection to avoid any solid ingress to the pumps.

c) Spill back control system and slug handling capabilities shall also be considered for Transfer pumps.

d) Each Sour liquid transfer pumps shall be provided with suction and discharge ESDV to close on High High and low low pressure at discharge and suction (to protect the pump against reverse flow).

e) Multiphase pump shut of pressure shall be less than the design pressure of transfer lines ie 1740 psig.

f) Necessary piping, control valve and cooler shall be provided for liquid line from separator to operate the pump during 100 % GVF case.

g) Contractor shall carry out Computerised flow dynamics to confirm the inlet header sizes to avoid any gas-liquid separation at pump suction affecting the performance of pumps. Necessary precautions shall be considered during design to confirm the pump performance for various flow rate. VFD & control system design of the pump shall be robust to accommodate pressure changes of suction, discharge pipe lines as well as liquid slugging.

h) Suction & discharge header piping, system integrity and surge analysis of pumps shall consider, single pump running/emergency shut down, 2 pumps running/emergency shut down as well as 3 pumps running/emergency shut down scenarios with supporting evidences.

i) Pump and motor assembly along with all associated utility supporting system shall be supplied as a skid unit. Mechanical run test along with pump motor, VFD control shall be carried out at skid vendor facility. In view of the criticality of Multiphase pump for operational requirement, upon completion of FAT, Pump performance test reports shall be submitted to Company.

Table 4.2 (d) – Multiphase pump Operating & design data

S. No.	Parameter	Unit	Value
1.	Fluid flow rate (total)		Oil: 30 MBOPD Gas:30 MMSCFD Water: 0-10 MWPD
2.	No of pumps		3 Nos(2 working and 1 standby)
3.	Suction Pressure	psig	200-300
4.	Suction Temperature	°F	40-140
5.	Discharge pressure	psig	1100-1200
6.	Design Pressure (Max. / Min.)	Psig	1350/ Full Vacuum (note-1)
7.	Discharge Temperature	Deg. F.	Note 1
8.	Design temperature (Max./Min.)	Deg. F.	200 /- – Note 1
9.	Driver		Electric Motor
10.	Design code /Material		As per **Appendix- 14** – Material requirements for Mechanical Equipment

Note:

1. Design pressure and temperature shall be finalized by Vendor.

j) 3 phase High pressure separator shall be provided at Multiphase pump discharge header to separate the liquid and gas. Flow meters shall be provided on liquid and gas outlet streams. Liquid and gas shall be routed to ten (10) numbers 6”-C97B3 transfer network

lines for routing to existing facilities. Provision shall be considered to route the liquid and gas separately or combined fluid to facilities.

k) 3 phase HP Separator package basic design and operating data is given as below;

Table 4.2 (e) – 3 phase HP Separator Operating & design data

S. No.	Parameter	Unit	Value
1.	Operating Pressure	Psig	800 -1200
2.	Design Pressure (Max. / Min.)	Psig	1320/ Full Vacuum
3.	Operating Temperature	Deg. F.	100 – 140 (Note 1)
4.	Design temperature (Max./Min.)	Deg. F.	200 /- – (Note 1)
5.	Internal Diameter (Min.)	Inch	120
6.	Length (TL-TL) – Min.	feet	40
7.	Design code		ASME Sec VIII Div. 1 with " U " Stamp
8.	Material (As per NACE MR0175/ISO15156, TM-284)		Shell/Dish : SA516Gr.60/70 + 3mm INCONEL 625 cladding Internals : INCONEL 625

Note 1: Final temperature / pressure to be reconfirmed during vendor engineering phase and based on temperature at pump discharge and relief & blow down report.

Note 2: The dimensions mentioned in the above Table are minimum requirements. Dimensions shall be finalized during Engineering.

l) Separator shall be designed for minimum pressure drop and the following separation performance corresponding design flow rates;

Max. Liq. Carryover in gas 0.1 gal/MMSCF
Max. Oil in water : <1000 ppm v/v.
Max. Water in oil: < 5% v/v.

m) Inlet device, mist eliminator, vortex breaker, wave baffle, foam breaker, weir as a minimum shall be provided for Separators. De-sanding facility shall be provided for Separators.

n) Separator shall be designed for highest liquid rate as well as highest gas rate cases of design.

o) Necessary piping, recycling system for pumps, ESDV and isolation, Corrosion monitoring systems shall be provided for sour liquid and gas piping system.

p) Flowmeters & control valve shall be provided in the liquid and gas flow lines from separators.

q) Online H_2S analyzer shall be provided in the gas and liquid lines. Water cut analyzer shall be provided on the liquid outlet line.

r) Chemical injection shall be provided for the transfer crude/ liquid and gas piping.

s) Individual discharge header for liquid and gas should be provided at separator outlet

with provision for future connection. Gas and liquid header shall be connected to the 10 numbers of 6" piping with ESDV and MOV (remote operated). Isolation valves and back pressure control valve as required shall be provided on the discharge header / 6" piping to connect to the Export piping.

t) Contractor shall review and carry out slugging study for the gas and liquid after the separation and recombining. Recommendations of the study shall be incorporated in the design. The slugging study report shall be submitted to company.

u) Contractor shall carry out the hydrate study of the transfer / export pipelines and hydrate inhibitor injection shall be considered at gas and liquid outlet header. Additional hydrate inhibitor injection requirements on the transfer lines shall be finalized based on the hydrate study recommendations.

v) Fast loop sampling system shall be provided for continuous representative sample collection.

w) Sour liquid outlet to the transfer line to Company's Transit / export line shall be provided with Back Pressure Control Valve, ESDV and PITs, MOVs/ROVs, check valves, chemical injection provision and isolation valves. All piping materials for the same (upto Battery Limit) shall comply with piping class of KOC-MP-010 and its addendum.

x) As the transfer pipeline is connected to many existing facilities, back pressure for each line may vary. Precautionary measures shall be considered at facility to handle the back pressure floatation's. Export pressure may vary between 800-1150 psig due to the different destinations and the back pressures. Contractor shall consider expected variable pressure in the design of multiphase pump and the separator. HP separator shall be provided with ESDV at inlet and outlet streams and PCV to flare for gas outlet piping.

4.2.8 Sour Liquid Transfer Operating conditions

Given below are the treated export crude quality and conditions from the Facility which shall be guaranteed by Contractor;

Table 4.2 (f) – Transfer conditions

S. No.	Parameter	Unit	Value
1.	Export Crude Outlet Pressure (B/L)	psig	800 - 1180 (operating) 1740 (Design)
2.	Export Gas Outlet Temperature (B/L)	Deg. F	120 – 140

4.2.9 Chemical injection systems

The following chemical injection systems shall be considered;

a) Corrosion Inhibitor - chemical injection system package for inlet section, sour gas and liquid piping sections.

b) Scale inhibitor - chemical injection system package for inlet section

c) Hydrate inhibitor injection system at facility outlet header. Contractor shall carryout

hydrate study for the transfer / export lines and requirement of additional hydrate inhibitor in export lines shall be considered based on the hydrate study.

d) Corrosion coupons, corrosion probes and corrosion injection points for sour gas and liquid section.

e) Sample points

Details of the above systems shall be finalised based on Corrosion Risk assessment studies and Package supplier's recommendations during engineering phase.

4.3 Utility & Supporting Systems

Utility & supporting systems needed for safe and sustainable Operation, Maintenance, start up, shut down, pre commissioning, commissioning of the Facility, shall be adequately designed & installed. Given below are minimum requirements in this regard;

4.3.1 Fuel Gas System

Fuel Gas needed for the Facility will be sourced from Company Fuel Gas Network. Given below are the design requirements of Fuel Gas System;

Table 4.3 (a) – Company supplied Fuel Gas data

Sl No.	Parameter, unit	value
1	Fuel gas inlet pressure , psig	250-300
2	Fuel gas inlet Temperature, ℉	50-100
3	Design Pressure, psig	580
4	Fuel gas Composition	Refer **Appendix- 6**

a) Fuel Gas inlet system shall consist of the following as minimum;

i. Fuel Gas flow measurement system
ii. Fuel Gas polishing unit at the inlet
iii. Online H_2S Analyzer at polishing unit inlet and outlet
iv. Pressure controlling station with dual PCVs & ESDV
v. HP Fuel Gas Scrubber
vi. HP Fuel Gas Heater
vii. LP Fuel Gas Scrubber & PCV
viii. LP Fuel Gas heater

b) In addition to the above, additional FG system requirements specific to any vendor package (like Gas turbines), shall be provided by Contractor. Minimum capacity of fuel gas package shall be 10 MMSCFD. Any increase in capacity based on requirements shall be considered by Contractor.

c) In view of possible H2S presence in Company supplied Fuel gas suitable gas polishing

system to remove H2S from 300 ppm up to 4 ppm shall be installed for fuel gas within the Facility.

d) The composition of fuel gas is given in **Appendix- 6** to this document for reference

e) All piping materials for the FG system shall comply with C35B/C15B piping class of KOC-MP-010 and its addendum.

4.3.2 Fuel Gas Distribution

a) Fuel gas distribution consists of HP Fuel gas distribution and LP Fuel Gas distribution networks.

b) HP Fuel Gas distribution is connected to Gas turbines and other HP Fuel gas requirements.

c) LP Fuel Gas distribution is connected to purging, pilot gas, stripping & blanketing requirements, if any

d) Major consumers of fuel gas shall be provided with flow measurement.

e) Start up/emergency Fuel gas line from Company supplied Fuel gas line to Flare system shall be connected with a flow meter and ESDV as a separate source.

f) Insulation & tracing requirements, if needed, shall be provided to FG piping.

g) Farthest end of FG header from supply point shall be provided with PT with Low alarm.

h) Purge gas to Flare system and tank /vessel blanketing shall be provided with shall be provided with PCVs, and ROs.

4.3.3 HP Flare System & Network

a) Sizing of HP Flare System & Network shall be finalised based on Relief & Blow down/depressurisation study, approved plot plan, vendor data and the limiting cases of the following operating scenarios as minimum;

i. Level 1 depressurization
ii. External fire (for Liquid expansion & vapor expansion scenarios)
iii. Blocked outlet
iv. Utility failure
v. Upstream equipment/system gas blow by case
vi. Normal operation of flare with pilot gas & purge gas only (zero flaring)

b) Flare network sizing, Peak Flare load, molecular weight, reliving conditions, back pressure requirements, flareheader size, liquid dropout rate shall be finalized based on relief and blow down details. Flare system design shall consider maximum liquid hydrocarbon carryover from upstream including HP separator.

c) Minimum HP Flare load shall be 40 MMSCFD & Minimum HP Flare stack height shall be 55 mts. Actual Flare height shall be finalised based on flare vendor data, radiation study & toxic gas dispersion study findings. The capacity of flare shall be finalised based on depressurisation and flare network study. HP flare shall be smokeless type and Ringlemann 0 shall be complied at 50 % design capacity as minimum requirement

d) Flare fencing shall be provided corresponding to a radiation intensity of 2360 W/m2 (including solar radiation of 950 w/m2) and H_2S concentration of 10 ppm H2S. Exact fencing distance shall be reviewed and approved by Company based on Radiation

/dispersion study as well as Contractual requirements.

e) Fluidic seal/velocity seal, air craft warning lights to be provided in the flare stack.

f) Dedicated FFG & HE ignition panel shall be provided for HP flares.

g) Minimum 3 no. of pilots with flame sensing feedback system (2oo3 duel temperature measurement) to be considered. Same shall be finalised during detailed Engineering.

h) Flare KOD shall be located above ground and shall be designed for highest liquid rate as well as gas rate corresponding to limiting cases of depressurisation.

i) Flare KOD shall be above ground vessel and shall be provided with 2X100% barrel type pumping system with auto cut in/cut off. Independent Level transmitters shall be considered for KOD pump operation and for Level 2 shut down of Facility due to High High level in flare KOD . 2oo3 voting shall be considered for Level 2 shut down of the Facility. Recovered oil shall be pumped back to closed drain system.

j) Ultrasonic flow meter shall be provided on the HP flare gas line to flare.

k) Emergency fuel gas supply line directly from battery limit to flare KOD O/L & pilot gas shall be considered for start-up/emergency purposes.

l) Sloping and no pockets requirement shall be ensured from relieving/depressurising sources to flare side. Flare header and pipe rack elevation shall be finalised accordingly.

m) Flare stack & network design shall ensure elimination of flame flash back and vacuum scenarios during all the possible operating situations including start up/emergency shut down. Fuel Gas purge connections with flow measurement and pressure control shall be considered at the dead end of major flare headers / sub headers and downstream of Flare KOD.

n) CCTV cameras shall be provided to monitor HP flare from control room.

o) In addition, export gas & fuel gas pipeline depressurisation line shall also be connected to Facility HP Flare system. Suitable isolation and piping connections shall be considered by Contractor from Tie-in point to closed drain vessel.

p) Flare piping shall comply with KOC-MP-010 and its addendum requirements.

4.3.4 LP Flare System & Network

a) Sizing of LP Flare System & Network shall be finalised based on Relief & Blow down/depressurisation study, approved plot plan, vendor/engg. consultant data and the limiting cases of the following operating scenarios as minimum;

i. External fire (vapor expansion case and liquid expansion case)
ii. Blocked outlet
iii. Utility failure
iv. Upstream equipment/system gas blow by case
v. Normal operation of flare with pilot gas & purge gas only (zero flaring)

b) Relief of very low pressure systems like Tank vapors if any, closed drain drum reliefs are to be connected to LP Flare system.

q) Flare network sizing, Peak Flare load, molecular weight, reliving conditions, back pressure requirements, flareheader size, liquid dropout rate shall be finalized based on relief and blow down details.

r) Minimum LP Flare load shall be 5 MMSCFD & any increase in capacity shall be considered during detail engineering. Minimum LP Flare stack height shall be 50 mts.

Actual Flare height shall be finalised by Contractor based on flare vendor data, radiation study & toxic gas dispersion study findings. LP flare shall be smokeless type and Ringlemann 0 shall be complied at 100 % design capacity.

c) Flare fencing shall be provided corresponding to a radiation intensity of 2360 W/m2 (including solar radiation of 950 W/m2) and H2S concentration of 10 ppm H2S. Exact fencing distance shall be reviewed and approved by Company based on Radiation /dispersion study as well as Contractual requirements.

d) Fluidic seal/velocity seal, air craft warning lights to be provided in the flare stack.

e) Minimum 2 no. of pilots with flame sensing feedback system (2oo2 duel temperature measurement) to be considered. Same shall be finalised during detailed Engineering

f) Air assisted LP Flare shall be considered with 2 X 100% VFD type motor driven air blowers. Air suction hoods shall be elevated and provided with suitable protection against dust ingress.

g) In order to facilitate operation of Flare during utility failure scenario, it is recommended to consider air blower load from Emergency power supply also.

h) Dedicated FFG & HE ignition panel shall be provided for LP flare.

i) Flare KOD system shall be designed for highest liquid rate as well as gas rate corresponding to limiting cases of depressurisation.

j) Flare KOD shall be above ground and shall be provided with 2X100% barrel type pumping system with auto cut in/cut off. Independent Level transmitters shall be considered for KOD pump operation and for Level 2 shut down of Facility due to High High level in flare KOD. 2oo3 voting shall be considered for Level 2 shut down of the Facility. Recovered oil shall be pumped back to closed drain system.

k) Ultrasonic flow meter shall be provided on the LP flare gas line to flare.

l) Emergency fuel gas supply line directly from battery limit to flare KOD O/L & pilot gas shall be considered for start up/emergency purposes.

m) CCTV cameras shall be provided to monitor LP flare from control room.

n) Sloping and no pockets requirement shall be ensured from relieving/depressurising sources to flare side. Flare header and pipe rack elevation shall be finalised accordingly.

o) Flare stack & network design shall ensure elimination of flame flash back and vacuum scenarios during all the possible operating situations including start up/emergency shut down. Fuel Gas purge connections with flow measurement and pressure control shall be considered at the dead end of major flare headers / sub headers and downstream of Flare KOD.

p) Flare piping shall comply with KOC-MP-010 and its addendum requirements.

q) Aviation Obstruction Lights (AOL) and control system shall be provided in accordance with the requirements of Federal Aviation Administration (FAA). AOL shall be retractable type for maintenance purposes at the ground level.

4.3.5 Diesel Storage & Transfer System

Diesel fuel is needed for operation of Emergency Diesel Generator and Fire water main pump drives. Brief requirements of Diesel storage & transfer system are given below;

a) A diesel storage Tank of 7 days net storage capacity shall be considered corresponding to peak consumption with suitable diesel unloading & earthing system. Tank dyke shall be considered to contain the volume, in case of leak.

b) 2X100% Diesel Transfer pumps shall be considered to transfer diesel from Tank to the consumers with flow measurement.
c) 2 X 100% duplex coalescer filters shall be considered on the discharge of Diesel transfer pumps. Each consumer is piping shall be provided with isolation.
d) Contractor shall make its own arrangements to supply Diesel to the Facility.

4.3.6 Closed Drain System & Network

Closed drain system collects hazardous liquids from process vessels or pipe manifolds to facilitate shut down, maintenance and start up activities. Given below are brief requirements;

a) Each hydrocarbon equipment of the Facility shall be connected to the closed drain system with suitable isolation and piping. The piping shall be sloped with no pockets towards Closed Drain Vessel which is located below the Grade level at suitable depth.
b) Hydrocarbon drains from all instruments shall be suitably connected to closed drain system.
c) Closed Drain system & vessel volume shall take the following operating scenarios into consideration;

i. Draining of the largest vessel connected to the network
ii. Simultaneous draining of the vessels/equipment
iii. Start-up/Shut down requirements

d) Closed Drain system shall be floating on Flare and designed for 100 psig/full vacuum as minimum.
e) In order to handle potential gas blow by scenarios from the upstream equipment, Closed Drain Vessels shall be equipped with the following instrumentation as minimum:

i. PCV designed for gas blow by scenario (from the upstream equipment)
ii. A pressure Transmitter with High Alarm PCV designed for gas blow by case and
iii. PSV designed for gas blow by case (from the largest upstream equipment)

f) In addition, 2 numbers of 4" each for transfer pipeline depressurisation/ drain line and inlet flow line / trunk line drains shall also be connected to Facility closed drain system. Suitable isolation and piping connections shall be considered by Contractor from Tie-in point to closed drain vessel.
g) Closed Drain vessel shall be provided with a suitable pumping system with 2 X 100% capacity. Minimum size of the vessel and pumping rate shall be finalised based on start-up time and hold up.
h) Closed Drain pit shall be provided with dewatering pump and vacuum tanker connection.
i) Discharge from closed drain shall be routed to inlet header / pump suction header.

4.3.7 Open Drain System & Network

Open drain system collects contaminated liquids from package skid plates, pump bays due to maintenance/cleaning/washing activities. Given below are brief requirements;

a) Each package drain / paved area surface drain of the Facility shall be connected to the open drain system with suitable isolation and piping. The piping shall be sloped with no pockets towards Open Drain Vessel which is located below the Grade level at suitable depth.
b) Open Drain vessel shall be provided with a suitable pumping system with 2 X 100% capacity. Minimum size of the vessel and pumping rate shall be finalised based on start-up time and hold up.
c) Discharge from Open drain shall be routed to inlet Heater with provision for Tanker connection.
d) Open Drain pit shall be provided with dewatering pump and vacuum tanker connection.

4.3.8 Heat Transfer Fluid / Hot oil Package

a) Hot oil system shall be used as heating medium for inlet heater and other heating requirements of the facility.
b) Hot oil system shall be closed loop system filled with Heat transfer fluid.
c) Fuel gas based heating system should be used for hot oil package. Possibility of electric heating system shall be checked and included by contractor to reduce the fuel gas consumption.
d) Heat transfer fluid shall be thermally stable, high performance and long lasting environmentally friendly fluid, offering a precise temperature control.
e) Package shall include necessary storage / expansion vessels, circulation pumps (2 x 100 %), redundant hot oil electric heaters (2 x 100%), hot oil drainage system, hot and cold oil distribution, necessary process control and other requirements for successful operation of the system. Deluge shall be provided for hot oil storage / expansion vessels as per HSE studies.
f) Details of Hot oil package from vendor shall be submitted to Company.
g) Nitrogen blanketing for vessels as required shall be considered to avoid air ingress
h) The capacity hot oil package shall be based on the heat duty requirement of the inlet heater and other heating requirement of the facility.

4.3.9 Brackish Water for fire water system

Water requirements for the firefighting water for the facility shall be generated from Brackish water which will be supplied by Company from source water wells (2 nos) located near to the Facility through pipe line. Given below are the minimum requirements of Brackish water system;

Company supplied Brackish Water conditions are given as below;

Table 4.3 (b) – Company supplied Brackish water data

S. No.	Parameter	Unit	Value
1.	Inlet temperature (at Tie-in)	Deg. F	60 - 120
2.	Inlet pressure (at Tie-in)	psig	14 – 60 (to be reconfirmed)
3.	Design Temperature (pipe line) Max./ Min.	Deg. F	200/26
4.	Design Pressure (pipe line)	psig	200 psig
5.	Flow Rate	Bbl./Day	5000 - 8000
6.	Brackish Water Composition		Refer **Appendix- 6**

a) Contractor shall Extend the Brackish water supply lines from the Tie in point to Tank filling nozzles of Fire water Tanks. Brackish water inlet manifold, tie-in requirement including Civil, structural, instrumentation, mechanical and piping works shall be considered in contractor scope of work

b) Filling line shall be provided with basket filters (2 x 100%) to remove the suspended solids from source well water. Further, each Tank filling line shall be provided with an ESDV, Level control valve and a flow measurement device to monitor the filling rate.

c) 2 numbers of fire water tank each with working capacity 5000 bbl shall be provided with auto level make up system.

d) Fire water Tank requirements as per KOC-L-009 shall be complied for Fire water Tanks design & installation.

e) Utility water station with brackish water connections for the facility shall be provided based on the equipment layout / plot plan

f) Potable water supply for drinking and other applications of MRBF facility, O&M requirements shall be arranged by Contractor considering the remote location of facility. Necessary storage, pumping and distribution shall be provided accordingly.

g) Chemical Injection skids to add biocide, scale inhibitor and corrosion inhibitor for brackish water lines shall be provided.

4.3.10 Instrument Air, Plant Air Systems & Distribution

Instrument air & Plant air systems are needed for Facility shall be supplied from 3X50% compressors & 2 X 100% Dryers system. Minimum Requirements are given as below;

a) Air compressors with 3 X 50%, each of 500 SCFM @ 150 psig discharge pressure shall be installed to meet plant air & instrument compression requirements. Compressor capacity shall include the requirement of air for nitrogen generation unit. In case of additional capacity requirements based on vendor data, same shall be included in the capacity.

b) Compressors shall be Dry screw type and motor driven compressors. Compressor shall be protected against inlet suction low low pressure, High High discharge temperature and pressure by installing dedicated transmitters. In addition, equipment monitoring transmitters shall be provided as per vendor requirement.

c) Instrument air dryer packages 2 X 100%, each of 1000 SCFM capacity shall be

considered with an online dew point measurement instrument. Dew point of instrument air shall be -40°C at the dryer outlet conditions. On line due point measurement shall be provided.

d) ESDVs shall be provided with their respective receivers as per instrument specifications.
e) Separate Plant air receiver 1 no. and 1 no. instrument air receiver shall be considered for to ensure 30 minutes residence time for instrument and plant air.
f) Total air flow measurement and flow measurement from each receiver shall be provided.
g) Instrument air header shall be provided with 2oo3 PIT for Level-2 shut down.
h) Equipment monitoring, Auto cut in of air compressors, start up, shut down and loading of compressors shall be provided from Local control panel as well as from DCS.
i) Air suction hoods shall be elevated and protected against dust ingress suitably.
j) Distribution: Isolation valves to be provided for major instrument air/plant air branches.
k) Farthest end of instrument/plant air header (from supply point) shall be provided with PT with Low alarm.

4.3.11 Nitrogen Generation System & Distribution

Nitrogen generation system is needed for purging fuel gas/ process gas Flare systems and for commissioning/ start up /shut down requirements. Given below are minimum requirements;

a) Minimum capacity of Nitrogen generation: 200 SCFM
b) Nitrogen purity : 95 - 98%
c) Nitrogen receiver shall be provided.
d) Nitrogen quality (purity) on line analyzer shall be provided with auto diversion Facility.
e) Common air compressors for Nitrogen and instrument air shall be considered. In this case, capacity of air compressors shall cater total air requirement of instrument and nitrogen generation.
f) Nitrogen distribution network shall be based on purge & start up requirements.
g) Distribution: Isolation valves to be provided for major nitrogen air branches. Farthest end of nitrogen air header from supply point shall be provided with PT with Low alarm.

4.3.12 Emergency Power Generation System

Emergency Diesel Generator of min. 2 MW shall be considered to meet the emergency power demands of the Facility.

Separate above ground diesel storage day tank for EDG shall be considered with necessary piping, instrumentation, civil and structural works.

4.3.13 Power Generation System

The power required for the Facility operation shall be generated & distributed internally using Gas Turbine Generators. Based on preliminary details, power requirement is in the range of 12 to 16 MW. Contractor shall ensure n+1 GTGs (n operating and 1 standby).

In view of the criticality of power, Contractor shall ensure the availability power generation & distribution system on sustained basis.

4.3.14 Fire Fighting System & Network

Comprehensive Firefighting system shall be provided to comply with KOC standard KOC-L-009 and shall consist of the following, as minimum;

a) Fire Water Demand & Network Hydraulic Study;
Contractor shall carry out the fire water demand calculations for the following cases and submit for Company's information;

i. Worst case scenario of the Facility
ii. Farthest location of fire from fire water pumps

b) 2 numbers of Fire water storage Tanks each with 5000 Bbl net storage capacity minimum. Any additional capacity requirements based on the maximum fire water demand as per KOC-L-009, shall be included in Contractor scope of work.
c) 2 X 100% Diesel driven Fire water main pumps (each of 2000 gpm minimum capacity). The discharge pressure of the pump shall be finalized based on network hydraulic study to KOC-L-009 requirements.
d) 2X100% Fire water jockey pumps
e) Fire water Ring main with 12" size as minimum
f) Fire water hydrants & Monitors
g) Foam System & skids
h) Deluge system & deluge skids as needed
i) Passive fire protection as needed for equipment and structures
j) Fire extinguishers & equipment boxes
k) Fire fighting for Gas Turbines
l) Fire suppression system for Substation
m) Safety showers & Eye/Face wash units

4.3.15 Chemical injection systems

Chemical injection for applicable Utility systems shall be finalised and provided based on Corrosion Risk assessment studies and Package Suppliers recommendations during engineering phase.

4.3.16 Laboratory, Sampling & Testing Requirements

As a part of Reservoir fluid surface data collection for future Field development activities, compositional data, sulphur species & bulk properties need to be analysed on regular basis. Accordingly, Contractor shall provide lab sampling & testing services, as per the minimum requirements mentioned below. Further details are provided in **Appendix- 11 to this Technical Specification**.

a) Contractor shall provide necessary sampling equipment, laboratory equipment and associated services to collect and test the samples in a safe and accurate manner, as per the requirements specified in Appendix-11. The test methods shall comply with relevant

ASTM / International standard methods, which shall be submitted to Company.

b) Sampling and testing which cannot be handled in Contractor Laboratory can be conducted by recognised and Company approved Laboratory, which has experience in testing high sour fluids and required Lab testing equipment.

c) Contractor shall ensure necessary arrangements are made to collect, transport and test the samples in safe and reliable manner, considering high toxic nature of fluid. Further all the quality requirements for testing the samples and reporting the results shall be complied as per international standards/ procedures.

d) Contractor shall ensure availability of skilled manpower, infrastructure, chemicals, consumables for efficient and safe functioning of lab on sustained basis during the Contract period.

e) Lab sampling, testing procedures and equipment manuals shall be submitted to Company for information.

f) In view of handling hazardous fluid samples in the lab, a dedicated drain and safe venting system shall be provided laboratory building.

g) The Contractor shall ensure availability of adequate sampling points and collect sample in a safe and reliable manner, minimizing toxic exposure to personnel.

h) Necessary sample collection equipment and transfer system shall be ensured by the Contractor.

5.0 SPECIFIC PROJECT REQUIREMENTS

5.1 Project Quality Manual (PQM)

a) Project specific Quality Manual shall be developed based on Company Specification No. KOC-Q-014 for all the Project quality requirements. It shall address how the Contractor intends to maintain sufficient QA / QC staff and resources specifically assigned to the Contract and shall ensure their ability to perform their duties in accordance with the Contract requirements during all phases of the Contract. This System should cover all the phases of BOO type project.

b) The Contractor shall also establish Project quality plan in accordance with KOC-Q-014 and submit the same for Company review and approval. This quality plan shall address all the QA/QC requirements and ensure the necessary measures & controls are in place for execution of the project.

5.2 Material Requirements for Piping and Equipment

a) Material selection basis for the equipment and piping for the facility shall be developed by the Contractor. This basis will be applicable for corrosion, scale and risk assessment study for the equipment, piping, valves and instrumentation items.

b) Minimum material requirement for major Mechanical equipment are provided in **Appendix- 14** to this Technical Specification.

c) Selection of the piping material including valves shall be in in line with KOC-MP-010 and its Addendum (Refer **Annexure- 1** to **Appendix- 13**). The minimum metallurgy for the piping shall be as per pipe class specified on the Piping & Instrumentation Diagrams, details of which are available in KOC-MP-010 & its Addendum.

d) Corrosion Risk analysis & Scale Assessment study shall be conducted during detail

engineering and ensure that the selected metallurgy of piping as provided in P&ID is suitable for the process conditions. In case upgradation is required, contractor shall do so at no cost and time impact to the company. However any down gradation of metallurgy is not permitted. This is applicable for the piping and valves inside the equipment skids / vendor packages also. Corrosion risk analysis shall incorporate the online analyzers and shall propose for capturing corrosive incidents and associated chemical injection system.

5.3 **Mechanical Equipment / Package Design criteria**

a) Refer **Appendix- 12 to this Technical specification** for Mechanical design package criteria. Some of critical equipment data sheets are also provided as annexure to this Appendix, for guidance.
b) All packaged systems shall consist of Piping, Valves, Electrical, Instrumentation and Controls within the skid.

5.4 **Piping Technical Specifications**

The basis for overall design of process/utility piping, the requirements governing the arrangement of equipment and piping are provided in Piping Technical specification **Appendix- 13 to this document**.

5.5 **Electrical Works inclusive of all associated electrical equipment & materials**

The scope of work shall comprise engineering, detailed design, site survey, studies, procurement & supply of materials, shipping & delivery to site, construction, testing, pre-commissioning, commissioning, performance testing and as-built documentation for Electrical works.

Electrical power shall be generated within the facility by providing Gas Turbine Generators (GTG) and distribute in Modular Substation. The Substation shall provide power to different areas of the facility such as Utilities, Oil and Water sections.

Diesel Generator shall be utilized for Black Start of GTG's and Emergency Power Supply of the facility, which includes all critical and essential loads.

For further details of Electrical works, refer **Appendix- 17 to this Technical Specification** for Electrical Technical Specifications & Drawings of the facility.

5.6 **Instrumentation & Controls Works inclusive of all associated equipment & materials.**

The scope of work shall comprise engineering, detailed design, site survey, studies, procurement & supply of materials, shipping & delivery to site, construction, testing, pre-commissioning, commissioning, performance testing and as-built documentation for instrumentation works.

Refer **Appendix- 16** for Instrumentation Technical specifications and Annexures to **Appendix-16** (Instrumentation Technical Specifications) for Instrumentation drawings and other

Specifications applicable for the Facility.

5.7 **Civil, Structural and Architectural Works inclusive of all associated equipment & materials**

The scope of work shall comprise design, detailed engineering, site survey, studies, procurement & supply of materials, shipping & delivery to site, construction, testing, performance testing and as-built documentation for Civil, structural and Architectural works.

Refer **Appendix- 18** to this Technical Specification for Civil, Structural and Architectural Technical specification & Drawings of the Facility.

5.8 **Cathodic Protection Works inclusive of all associated equipment & materials**

The scope of work shall comprise engineering, detailed design, site survey, studies, procurement & supply of materials, shipping & delivery to site, construction, testing, pre-commissioning, commissioning, performance testing and as-built documentation for cathodic protection works.

The works to be executed by the Contractor shall comprise of design, detailed engineering, procurement, supply, installation, quality assurance and control, testing and commissioning of the new cathodic protection system as below;

a) Buried underground metallic sections of pipelines/ piping shall be provided with Cathodic Protection as per KOC-L-015.
b) Tanks & Vessels internal surfaces submerged in water or electrolyte shall be provided with Cathodic Protection system as per KOC-L-018.
c) External bottom plate surfaces of storage tanks shall be provided with Cathodic Protection System as per KOC-L-026.
d) All Cathodic Protection materials shall be in accordance with KOC-L-012.
e) All Cathodic Protection TR units shall be located outside high security fence in accordance with KOC standards.
f) Cathodic Protection Transformer Rectifier Unit for Tank internal CP system shall be Variac type control (type-II) as per KOC-L-012.

All Cathodic Protection works shall be carried out in accordance with KOC standards.

5.9 **Codes, Standards & Regulations**

All equipment and systems of Facility shall be as per prevailing Company Standards and/or International codes and standards. However, Basic Engineering Data shall comply with Contractual requirements. (List of relevant KOC, international standards are attached in Appendix-8 to this Technical Specification).

5.10 **Waste Handling**

Waste handling during execution and operation phase shall be as per KOC.EV.008.

5.11 **Site Quality Control Plan**

The Contractor shall develop project specific site quality control plan based on Company standard for general QA/QC requirement KOC-Q-14. The plan shall cover the various site activities for the Project titled "Mutriba Remote Boosting Facility (MRBF) at NK." which shall include Quality Systems, Inspection and Testing, Organization, Material Control, Process Control, Non-conformance Control and Quality Records. Contents of this Site Quality Control Plan and shall be applicable to the Contractor and their Subcontractors.

5.12 **Factory Acceptance Test**

a) Contractor shall ensure to carryout factor Acceptance test (FAT) at the manufacturing facility prior to shipment of the each package.
b) Upon completion of Factory Acceptance (FAT), copies of all inspection and FAT certificates for all critical equipment, shall be submitted to the Company for verification.

6.0 PRE-COMMISSIONING & COMMISSIONING REQUIREMENTS

Contractor shall ensure availability of a qualified and experienced pre commissioning & commissioning Team to ensure safe and successful pre commissioning and commissioning of MRBF to produce desired capacity requirements of the Contract on consistent basis. Following are minimum requirements in this regard;

a) Vendor documents and data familiarization by commissioning Team
b) Developing the consolidated System/sub system of the unit and mark up the drawings accordingly.
c) Develop a detailed commissioning Plan in the following sequence and obtain the Company approval well in advance;

   i. Critical Utility Systems (like power, fuel gas, inst. Air , Fire System, F&G System, Nitrogen, flare, water) – 2 to 3 months prior to commissioning
   ii. Completion of all utility distribution systems and drain systems
   iii. Inlet commissioning
   iv. Sour fluid system – Heater, multiphase pump ,HP separator and transfer system

d) Field Verification of the above data and coordination with package vendor, detailed engineering and construction Contractors to ensure completeness of each system for ready for pre commissioning
e) Scheduling Punch Listing visits with Company personnel and resolving the Punch List Items expeditiously.
f) Ensuring the availability of critical buildings like Control Room, Substations, Instrument Rooms, Security Rooms, laboratory , chemicals and other resources prior to commissioning
g) Development of integrated Pre commissioning & Commissioning Manuals
h) Development of integrated Start up , Shut down & Standard Operating Procedures
i) Development of integrated Maintenance procedures

j) Ensuring completion or availability of Company HSE compliance requirements like Pre Start Up safety Review (PSSR), Emergency Response Plan requirements, availability of F&G detectors and Fire System.
k) Performing Pre commissioning and commissioning activities in a safe manner by coordination with vendors, Company, Construction Contractors.
l) Performing Start up , Stabilization and feed ramping up activities
m) To ensure submission of "As-Built" documentation, Project Record Books and Manufacturers Record Books to Company.
n) To ensure availability and supply of chemicals, consumables, catalysts & spare parts
o) To coordinate in closing punch list items and requirements related Execution Phase completion as per Contract.

7.0 PERFORMANCE TESTING

Contractor, after successful commissioning and stabilization of the Facility, shall carry out two performance tests of the Facility to demonstrate the guaranteed performance parameters. Given below are the minimum requirements in this regard;

7.1 Comprehensive Performance Test Procedure

7.1.1 Contractor shall develop a Comprehensive Performance Test Procedure for the entire Facility by taking concurrence from concerned Vendors, Packagers, Consultant and vendors prior to submitting to Company. Performance Test Procedure, Data to be collected during Performance Test, Samples to be collected and testing methods shall be submitted for Company's review and approval prior to commencement of Performance Test.

7.2 Performance Tests

Upon commissioning of Jurassic Facility, the Contractor shall carryout one complete performance test based on prevailing conditions immediately after commissioning and stabilization, with a prior approval from Company. The Second performance test shall be conducted as applicable for the other season.

Each test shall be conducted for a period of 96 hours without any interruption or stoppage and shall be carried out in the presence of the Company staff.

7.3 Performance Run Completion and approval

Subsequent to completion of Performance Test, Contractor shall submit the complete performance Test Run report along with supporting documents to Company's Review and approval. Company shall inform in writing to Contractor regarding the acceptance of Performance Test. The second Performance Test will be in O&M Phase in the other season will follow the same procedure.

8.0 CONTRACTOR'S SERVICES - O&M PHASE

7.4 Contractor, after successful completion of commissioning & performance Test Run/(s) as per

Contract, will be allowed to enter into Operations & Maintenance Phase of facility and offplot. Contractor shall provide the following minimum services during O&M phase for MRBF and offplot scope of work as per Technical Specification -Part B:

8.1 Provide adequate no. of qualified and well-trained personnel and ensure safe and reliable Operation, Maintenance and management of Facility and offplot.

8.2 Perform inspection and preventive maintenance services.

8.3 Maintaining stock of essential and critical spare parts, consumables and Personnel Protective Equipment (PPE) and replenishing the same as and when required.

8.4 Periodic Calibration of all measuring instruments, meters and analyser as per Vendor recommendation and ensuring 100% availability of such instruments which are intended to provide measurement of the performance parameters as per the Contract.

8.5 Providing adequate enhancements to the Facility during operation and maintenance stage as may become necessary to overcome any HSSE and performance related deficiencies which may pose any risk to the Contractor and the Company's operations, at no additional cost to the Company.

8.6 Providing all materials, chemicals, lubricant, all consumables and any other item or work required for operations and maintenance of the Facility.

8.7 Ensuring implementation of Maintenance guidelines for Multiphase Pumps, GTGs and other rotating equipment as provided by the Manufacturer.

8.8 Carrying out Lab analysis and Testing requirements as per **Appendix- 11 to this Technical Specification** and submission of Reports to the Company after validation and approval by Contractor/ Lab Testing agencies.

8.9 Providing security and protection of the Facility owned by the Contractor.

8.10 Protect and safeguard the Company's properties and installations from any damage and loss, while performing the Services.

8.11 Keeping the Site tidy and safe, disposing hazardous wastes in a manner acceptable to the Kuwait environment authorities and in accordance with regulatory requirements, tracking and implementing regulatory developments as applicable to environment, safety and product standards.

8.12 Conduct due diligence visits to the Facility along with the Superintendent or Superintendent's Representative or any third party appointed by the Company to investigate and review fitness, health, safety and environment, compliance of the Company and national safety standards issues and to resolve and rectify any deficiencies if found.

8.13 Maintain data base and store complete and accurate records of the Facility performance data, inspection records, Maintenance records and all other operational and technical data which shall be made accessible to the Company for reference.

8.14 Comply with the Company's target of zero flaring of the hydrocarbon gas.

8.15 Provide necessary supports for internal/external HSSE audits of the facility by the Company.

8.16 Submit to the Company daily and monthly production statement indicating the following;

a) Quantity and characteristics of crude, gas and effluent water produced.
b) Quantity of crude and gas unavoidably lost.
c) Quantity of Natural gas flared and vented.
d) Quantity of fluids exported from MRBF
e) Quantity of utilization of the Company supplied items (Fuel gas, water etc.)
f) Any other information/data and report, which the Superintendent may otherwise direct.

8.17 During the O&M stage, the Contractor shall submit progress report on a daily basis in a Company-approved format, which shall include, as a minimum, the following;

a) MRBF Status and down time records.
b) Production data.
c) Export Crude Quality & Quantity Reports
d) Export Gas Quality & Quantity Reports
e) Well wise Inlet Pressure to Facility
f) Well wise Inlet Temperature to Facility
g) Manpower and equipment status.
h) Chemical consumption records.
~~i)~~ Quantity of effluent water and water cut percentage of fluid
j) The Contractor is required to test Two (2) wells everyday using the multiphase meter installed at the MRBF Facility as part of its scope. Contractor shall report on daily basis the test data.

8.18 Performing all other works necessary for operations, maintenance, health, safety and environment and integrity of the plant, though not specifically stated herein.

8.19 Provide services needed for well testing within the Facility.

8.20 Provide services to Comply with Company HSEMS procedures and guidelines as applicable for Operation Stage. If required, suitable Bridging document shall be developed by Contractor and approved by Company to ensure compliance with Company HSEMS procedures.

8.21 Provide Preventive Maintenance services, as per the approved Maintenance manual and recommended practices by the Original Equipment's Manufactures (OEMs).

8.22 The Contractor shall operate and maintain the Facility from the commencement of the 5 (five) years O& M Services and shall demonstrate to the Company at all times to the Company that all Contract requirements are complied with and shall promptly notify to the Company whenever any shortfalls or deficiencies occurs.

8.23 Contractor responsible for maintaining the facility in the original working condition. The Contractor shall promptly replace at its own cost any damaged and or deficient equipment or component of the Facility regardless of cause of failure or deficiency, at any time during the Contract Period.

8.24 During the 5 (five) years O& M Services and extended period of Contract, if the Facility fail to achieve the specified performance requirements of the Contract in respect to the following, the Superintendent, at its sole discretion, may instruct shutdown of the Facility till such time the Contractor take and complete all remedial measures and demonstrate to the satisfaction of the Superintendent that the Facility can achieve the Contract performance requirements in respect of;

a) Failure to Boost the inlet reservoir fluid to the required delivery conditions at the out let of Facility
b) Failure to achieve emission levels under K-EPA regulations/HSE compliance

8.25 Company reserves the right to permit continuation of Facility operation, at its sole discretion, despite deficiency and deviations in the performance of the Facility for specified period, by applying liquidated damages as per Contract Specifications.

8.26 The Contractor shall make good and rectify at its expense all defects, replace any defective or deficient components and system, rectify process and plant design constraints, rectify abnormal operating conditions causing undesirable and accidental events, mal-operations or malfunctions leading to critical situation for personnel, unit or environment, rectify omissions or faults that arise or become apparent in the Facility during the Execution Stage or any latent deficiencies not identified in the Execution Stage but become apparent during the 5 (five) years O& M Services due to defective engineering or design or to unsatisfactory workmanship or to the use of the Contractor supplied materials or equipment or any other reasons including non-compliance of Contract or due to the neglect or failure by the Contractor to comply with any of its obligations under the Contract.

8.27 As a part of ensuring the consistent performance of Facility following preventive maintenance requirements ensured during O&M Stage operation;

8.28 The first preventive maintenance shutdown (out of service) inspection survey for Facility equipment & piping systems (including pressure/safety relief valves) shall occur at the end of first two (2) years and thereafter at the end of every subsequent two years of "MRBF" operation for a maximum period of Four (4) weeks (to be agreed with the Company).

8.29 The inspection shall be carried out by Contractor through a Company approved third party inspection agency. After completion of inspection and preventive maintenance within the period specified herein, within two (2) weeks, the Contractor shall submit general inspection and maintenance action report for Company review. The Contractor shall propose the plan for inspection survey and preventive maintenance for Company to review and approve well in advance so that the issues can be discussed and finalized. The subsequent years of operation shall commence immediately upon completion of this preventive maintenance shutdown period for inspection survey

8.30 Facility Performance Measurement and Quality Monitoring

Following minimum (but not limited to) online instrumentation facilities for continuous monitoring of the process parameters shall be provided at Facility Control system and simultaneously through KOC network.

a) Online H_2S for export sour liquid / crude and Gas.
b) Well test/operation data from MPFM
c) Temperature transmitter at the flowline
d) ESDV & MOV status of each flowline and trunkline.
e) ESDV & MOV status of each 6" transfer/ export line
f) Online H_2S Analyzer for fuel gas inlet

8.31 Gas/ liquid Measurements

Following metering provisions for the following streams as a minimum, but not limited to;

a) Flow rate of liquid and Gas from HP separator
b) Flow rate of Company supplied fuel gas and Fuel Gas for power generation
c) Flow rate of Gas to HP Flare, Gas to LP Flare to monitor that no flaring is taking place, and to measure in case flaring takes place.
d) Brackish water Flow rate.
e) Any other flashed gas stream.

All flow measurements shall be provided with totalizer to sum up total flow.