KUWAIT OIL COMPANY (K.S.C.)

A subsidiary of Kuwait Petroleum Corporation

إحدى شركات مؤسسة البترول الكويتية
A Subsidiary of Kuwait Petroleum Corporation

PRODUCTION & PROJECTS (GAS) GROUP

GAS PROJECTS TEAM - II

Mutriba Remote Boosting Facility (MRBF) at North Kuwait

Appendix-12

Mechanical Equipment and Package Design Criteria

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KUWAIT OIL COMPANY (K.S.C.)
(Register of Commerce No. 21835)

Mutriba Remote Boosting Facility (MRBF), at North Kuwait
Appendix-12

Mechanical Equipment and Package Design Criteria

1.0 PURPOSE

The purpose of this document is to provide Mechanical Design Criteria for Mechanical Equipment that will be required for Mutriba Remote Boosting Facility (MRBF).

The Contractor / Vendor shall carry out detail design of all Mechanical Equipment in accordance with KOC Standards and / or International Codes & Standards as specified in the clauses below. For technical requirement of other disciplines, please refer to respective discipline specifications.

Contractor shall obtain approval of software that will be used for designing of equipment.

2.0 COMPANY STANDARDS

Applicable Company Standards are listed in Appendix No. 8A to technical Specification.

3.0 INTERNATIONAL CODES AND STANDARDS

Applicable international Standards are listed in Appendix No. 8C to technical Specification.

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4.0 ABBREVIATIONS

Some of the abbreviations with Descriptions used in the Mechanical Design Criteria are as follows:

Table: Abbreviations

ABBREVATIONS	DESCRIPTION
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASCE	American Society of Civil Engineers
MBOPD	Million Barrels of Oil Per day
BHN	Brinells Hardness Number
CS	Carbon Steel
EN	Euro Norms
ISO	International Organization for Standardization
PFHE	Plate and Frame Heat Exchanger
HVAC	Heating, Ventilation, & Air Conditioning
MMSCFD	Million Standard Cubic Feet Per Day
NACE	National Association of Corrosion Engineers
RFQ	Request For Quotation
SS	Stainless Steel
STHE	Shell & Tube Heat Exchanger

TEMA	Tubular Exchanger Manufacture Association
UBC	Universal Building Code
BPD	Barrels Per Day
BS&W	Basic Sediment & Water
DPC	Dry Powder Chemical
DCS	Distributed Control System
EWTP	Effluent Water Treatment Plant
F&G	Fire & Gas
FM	Factory Mutual
HIPPS	High Integrity Pressure Protection System
HP	High Pressure
H2S	Hydrogen Sulphide
KEPA	Kuwait Environmental Protection Agency
KOC	Kuwait Oil Company
KOD	Knock Out Drum
LP	Low Pressure
LLP	Low Low Pressure
MMSCFD	Million Standard Cubic Feet Per Day
MP	Medium Pressure
MPFM	Multi-Phase Flow Meter
RH	Relative Humidity
TEG	Tri-Ethylene Glycol
UL	Underwriters Laboratories
BOO	Build Own Operate

5.0 UNITS & DIMENSIONS

Units and dimensions for all calculations, documents and drawings will be in accordance with the following table for the entire project:

Table: Units & Dimensions

DISCIPLINE	CALCULATIONS, DOCUMENTS AND CORRESPONDENCE	SPECIFICATIONS / DATASHEETS	DRAWINGS
Mechanical	Metric with final result also shown in imperial in bracket	Metric	Metric
HVAC	U.S. customary units (English)	U.S. customary units (English)	English with Metric units shown in bracket.

6.0 QUALITY REQUIREMENT

Mechanical Equipment and Package Design Criteria

The Contractor shall develop project specific Quality plan based on Company Specification No. KOC-Q-014 for all the Project quality requirements. This System should cover all the phases of BOO type project.

The stage inspection requirement for each equipment/package shall be addressed in Inspection and Test plan.

Baseline data collection shall be in accordance with Appendix-J of KOC-Q-014. Contractor shall submit "Baseline Data Preparation Procedure" well in advance of the start of the work for company approval.

7.0 SERVICE CONDITION

All service conditions shall confirm to the requirements of latest revision of KOC-C-001 and KOC-G-007.

8.0 EQUIPMENT / PACKAGE DESIGN BASIS

All the materials used for Facility shall be new and in Compliance to ASME Sec II, (Materials). Equipment in Sour Service shall comply with NACE MR-0175/ISO 15156. In addition to this HIC testing shall be performed in accordance with NACE TM 0284 for wetted parts of carbon steel plates, welded pipes and welded fittings.

Welding and NDT shall be per KOC standard KOC-MW-001 and/ or ASME Sec IX, ASME Sec V.

All packaged systems shall consist of Piping, Valves, Electrical, Instrumentation and Controls as per respective Discipline Technical Specifications.

The elevation of PSV nozzles shall be such that it is located higher than the elevation of Flare Gas Header with a minimum slope of 1:500 of Flare Gas Header connecting line.

All equipment inside the packaged units shall be designed as per respective KOC Standards and / or International Standards as specified in the clauses below.

Safety Ladders, Cage and Gate will be coated with different color, preferably yellow for easy identification.

All equipment and packages shall be suitable and designed for Outdoor Condition.
Package dimensions (LxWxH) shall be designed considering easy transportation of packages /equipment to project site and also minimum site works. .

Wind load and seismic load shall be as per KOC standards KOC-C-001 and KOC-G-007.

Mechanical Equipment and Package Design Criteria

8.1 FIELD ERECTED STORAGE TANKS

Design, materials, fabrication, inspection, and testing shall be in accordance with KOC Specification KOC-MV-007 and / or API 650.

Design for wind load shall be based on API 650 and seismic design shall be carried out as per Appendix E of API 650.

Storage tank Design Calculations shall be performed using TANK latest version (or any other Company approved software) and shall conform to requirements of API 650 and applicable specifications mentioned in this document.

Tanks shall be provided with internal lining as per the requirements specified in Company Standard KOC-P-002 (Part 2).

Cathodic protection system shall be provided in accordance with the requirements specified in the KOC specification, KOC-L-018 and KOC-L-026.

External Painting shall be as per requirements specified in Company Standard KOC-P-001.

8.2 SHOP FABRICATED TANKS

Design, materials, fabrication, inspection, and testing of shop fabricated tank shall be in accordance with Shop API 12F.

Tanks shall be provided with internal lining as per the requirements specified in Company Standard KOC-P-002 (Part 2).

Cathodic protection system shall be provided in accordance with the requirements specified in the KOC specification, KOC-L-018 and KOC-L-026.

External Painting shall be as per requirements specified in Company Standard KOC-P-001.

8.3 PRESSURE VESSELS

Design, materials, fabrication, inspection, testing and stamping shall be as per KOC Standard KOC-MV-001 and ASME Section VIII, Div. 1.

All Pressure Vessels will be with ASME U Stamp Certification.

All pressure vessels shall be designed for Full Vacuum conditions.

Mechanical Equipment and Package Design Criteria

Mechanical Calculations of pressure vessels shall be performed using latest edition of Company approved software and shall be submitted to Company for Information.

Pressure vessels shall be provided with internal lining as per the requirements specified in KOC Specification, KOC-P-002 (Part 3). All internals including corrosion resistant alloys shall be coated as per KOC-L-018 for cathodic protected vessels.

Cathodic protection system shall be provided in accordance with the requirements specified in the KOC specification, KOC-L-018.

All Carbon Steel Pressure vessels intended for sour service shall be Post Weld Heat Treated (PWHT) as per KOC-MV-001.

External Painting shall be as per requirements specified in Company Standard KOC-P-001

Removable internals of all pressure vessels shall be removable through 24" man-way provided on the vessels and sufficient number of man-way shall be provided for all vessels for easy maintenance and inspection and removal of internals.

All such removable internals shall be of SS 316L as a minimum or suitable for process conditions as specified.

Internal sacrificial anodes shall be provided for vessels as per KOC-L-018.

All pressure vessels skirts have to be provided with Manway for accessing piping inside the vessel skirt.
Dissimilar metal internals shall be electrically isolated from vessel as per KOC-L-018.
Insulated vessels have to be provided with inspection ports.

8.4 SHELL & TUBE HEAT EXCHANGERS (STHE)

Design, materials, fabrication, inspection, testing and stamping shall be in accordance with the latest edition of KOC-MV-006 Part 2, KOC-MV-011 and /or API 660, TEMA, ASME VIII Div. 1.

All STHE shall be with ASME U Stamp Certification.

Mechanical Calculations of STHE shall be performed using latest edition of Company approved software and shall be submitted to KOC.

Adequate free space has to be provided around the STHE for easy removal of tubes.

8.5 AIR COOLED HEAT EXCHANGERS (ACHE)

Design, materials, fabrication, inspection, testing and stamping shall be in accordance with the latest edition of KOC-MV-008 and / or API 661, ASME Sec VIII Div. 1

All ACHE shall be with ASME U Stamp certification.

Mechanical Calculations of ACHE shall be performed using latest edition of Company Approved software and shall be submitted to KOC.

Adequate free space has to be provided around the ACHE for free flow of cooling air.

8.6 PLATE & FRAME HEAT EXCHANGERS (PFHE)

Design, materials, fabrication, inspection, testing and stamping shall be in accordance with the latest edition of KOC-MV-006, Part-3, and /or API-662 Part-1, ASME Sec VIII Div 1.

All PFHE shall be with ASME U Stamp certification.

Mechanical Calculations of PFHE shall be performed using latest edition of Company Approved software and shall be submitted to KOC.

8.7 CENTRIFUGAL PUMPS

The Criteria for selection of Pumps will be KOC-ME-008 Part 1.

Design, materials, fabrication, inspection and testing of Centrifugal Pump shall be as per KOC-ME-008, Part-2 and/ or API 610.

Based on KOC criteria (KOC-ME-008 Part 1), if ASME pump is selected, then design, materials, fabrication, inspection and testing shall be as per KOC-ME-008 Part 3 and / or ASME B 73.1.

Double mechanical seals required for the pumps handling sour / toxic fluids (>500 ppm H2S).
Mechanical seals and seal flush systems plan shall be in accordance with KOC-ME-008, Part-2 and / or API 682.

Any loop on suction side of pump has to be avoided.
Vibration and noise level of all pumps shall meet the requirements of KOC specifications.

Pumps have to be provided with minimum recirculation lines.

8.8 POSITIVE DISPLACEMENT PUMPS

The Criteria for selection of Pumps will be KOC-ME-008 Part 1.

Design, materials, fabrication, inspection and testing of Positive Displace pumps shall be as follow:

- Metering pump – KOC specification KOC-ME-006, Part 1 and / or API 675
- Reciprocating pumps- KOC specification KOC-ME-006, Part-2 and / or API 674
- Rotary pumps- KOC specification KOC-ME-006, Part-3 and / or API 676

Double mechanical seals required for the pumps handling sour / toxic fluids (>500 ppm H2S).

Vibration and noise level of all positive displacement pumps shall meet the requirements of KOC specifications.

8.9 INSTRUMENT AIR /NITROGEN GENERATION PACKAGES

Major components of Instrument air Package consist of Air compressors, Dryers and Receivers.

Design, materials, fabrication, inspection and testing of Screw Air Compressor and Dryer Package shall be as per KOC standard KOC-ME-015 and / or API 619.

All pressure vessels inside the package will be designed to ASME Sec VIII Div. 1 (U Stamped).
The compressors will be Oil Free Type.

Nitrogen Generation Package along with Nitrogen receiver shall be designed as per standards.

8.10 CHEMICAL INJECTION PACKAGES

Major components of the chemical injection packages includes positive displacement pumps, tanks, pulsation dampeners, calibration columns, filters, strainers and piping.
Design, materials, fabrication, inspection and testing of Positive Displace pumps shall be as per KOC-ME-006, Part 1 and / or API 675.

All pressure vessels inside the package will be designed to ASME Sec VIII Div. 1 (U Stamped).

8.11 GAS TURBINE GENERATOR PACKAGES (GTG)

Design, materials, fabrication, inspection and testing of Gas Turbine Generator Package shall be as per KOC standard KOC-ME-012 and / or API 616.

GTG shall be designed considering fuel gas as combustion fuel.

All pressure vessels inside the package will be designed to ASME Sec VIII Div. 1 (U Stamped).

All auxiliary / utility service pumps and heat exchangers shall be based on OEM design. All hydrocarbon handling equipment shall be based on API standards.

All Exchangers inside the Package shall be designed as per respective International Code and Standard.

8.12 HOT OIL SYSTEM PACKAGE

Design, materials, fabrication, inspection and testing of vessels, tanks, coils in the system shall comply with ASME Sec VIII Div. 1. (U-Stamped),

Design, materials, fabrication, inspection and testing of Fired Heaters shall be as per ASME Sec VIII Div 1, ASME Sec IV and API 560.

All pumps and other equipment inside the Package shall be selected based on vendor recommendation during detailed Engineering. .
Insulation requirements shall be as per KOC-G-006.

8.13 OVERHEAD CRANES AND HOISTS

Electrical Overhead Travelling (EOT) crane or Bridge Crane shall be used where precise three dimensional movements (2 x horizontal and 1 x vertical) of the heavy load is required for the maintenance of large size machinery, indoors or under the shelter. EOT crane shall be provided for shelters housing multiphase Transfer Pumps, Fire water Pumps, Workshop and other equipment as per vendor recommendation.
Design, materials, fabrication, inspection and testing of crane shall be as per KOC standard KOC-ME-005 and / or CMAA, ASME B30.2, BS 466, DIN15018, FEM 9.511.

Manual Monorail Cranes shall be used where precise two dimensional movements (1 x horizontal and 1 x vertical) is required for the maintenance of medium size machinery that is not accessible by mobile lifting equipment. Crane shall comply with KOC standard KOC-ME-005 and / or BS 3243.

8.14 FLARES

Design, materials, fabrication, inspection and testing of all Flares shall be in accordance with API 537.

Flare Tip and Burner Ignition System shall confirm to KOC spec.KOC-ME-021.

The Maximum noise levels shall be per KOC-HE-006 Appendix 2 (Production area, fan rooms, compressor rooms-etc.)

Location of flame front generator panel shall be such that the pilot flame is visible from it. The panel should preferably be 50 to 100 meter from the stack.

The flame front generator panel shall be suitable for outdoor location. Suitable weather hood shall be provided. The flame front generator shall be gas –electric type suitable for manual ignition unless otherwise specified.

9.0 HVAC

The HVAC installation shall be in accordance with NFPA 90A, CIBSE and ASHRAE codes. Also design shall consider the requirements of KOC Standard KOC-MH-001 for HVAC Equipment and Installation. HVAC is required for control room, Lab, Field operator rest room, Electrical Substation, battery room, work shop building offices, and Guard room.

The Maximum noise levels shall be per KOC-HE-006 Appendix 2 (Production area, fan rooms, compressor rooms-etc.). Also the occupied areas noise level shall be considered based on the noise rating specified in Project specifications.

The design of the HVAC system shall be based on the following external environmental conditions:

For dry bulb and wet bulb temperatures for all DX (Direct Expansion) Air Conditioning units refer KOC standard KOC-MH-001.

Summer:-	125° F (51.7° C) Dry Bulb Temperature 84° F (28.9° C) Wet Bulb Temperature 25° F (14° C) Daily Range
Winter: -	45° F (7°C) Dry Bulb Temperature 50% RH

Mechanical Equipment and Package Design Criteria

The HVAC equipment shall perform to the design parameters based on the above external ambient conditions and expected to run with a reduced performances up to 52°C db (dry bulb) and in extremely humid environment of 100% RH without failure.
Heat gain from occupants of a room shall be based upon the recommendations of CIBSE or ASHRAE related to occupant density and metabolic rate for latent and sensible heat given off by body.

Lighting heat gain shall be considered based upon the approved lighting layout or specified lighting fittings. 16W/m2 shall be used for the lighting load unless the actual is higher by calculation. Internal heat gains dissipation from electrical/instrument equipment shall be considered based upon the actual electrical/instrument equipment to be installed in the relevant room.

All sealed buildings shall be maintained under positive pressure of one (1) full air change per hour fresh air supply based upon the full building volume and allowing for extract rates such as for Battery Rooms, WC's etc.

The fresh air considered for the Human occupancy area shall be as per ASHRAE 62.1.

Air intake shall be considered accordance with the hazard-based classification of the area and any potential source of contamination. Air intakes shall be considered in accordance with prevailing wind & located away from source of pollution such as motors or generators and located at a high level above the risk zone where hydrocarbon may be present.

10.0 FIRE FIGHTING SYSTEM

Firefighting system shall be designed in compete compliance to all KOC standards as well as NFPA standards. Deviations, if any has to be brought to attention of KOC through deviation request.

Fire Water Pumps shall be supplied as per KOC-ME-009, KOC Standard for Stationary Firewater Pumpsets.

Fire Protection Systems and Safety Equipment shall be designed as per KOC-L-009, KOC Standard for Fire Protection Systems and Safety Equipment

Fluoroprotein Foam Liquid Concentrate shall be in compliance to KOC-L-008 - KOC Standard for Fluoroprotein Foam Liquid Concentrate for Fire Fighting.

Fire hydrants other than on fire water network (sectional line) shall not exceed as per KOC-L-009.

Deluge system shall be considered on all Equipments as per section 7.3.1 (a) of KOC-L-009.

Fire & Gas System shall be supplied as per KOC-L-006, KOC Standard for Fire & Gas Detection Equipment.

Fire Protection & Fire Suppression System shall be provided for electrical substation as per KOC Standard KOC-E-003 Part 1.

Passive fire proofing shall be provided as per KOC-C-027.

11.0 EQUIPMENT / PACKAGE PIPING SPECIFICATIONS

For Equipment / Package Piping Specifications, please refer to Appendix-9: Piping Technical Specifications.

12.0 EQUIPMENT / PACKAGE ELECTRICAL SPECIFICATIONS

For Equipment / Package Electrical Specifications, please refer to Electrical Specifications and Drawings.

13.0 EQUIPMENT / PACKAGE INSTRUMENTATION SPECIFICATIONS

For Equipment / Package Instrument Specifications, please refer to Instrument Specifications & Drawings.

14.0 EQUIPMENT / PACKAGE CIVIL & STRUCTURAL SPECIFICATIONS

For Equipment / Package Civil & Structural Specifications, please refer to Civil, Structural Specifications & Drawings.

15.0 ANNEXURES

Following data sheets are attached as Annexures to this document.

Annexure-1	Data Sheet for Multiphase Pumps
Annexure-2	Data Sheet for HP Separator
Annexure-3	Data Sheet for Fire Water Tanks