TECHNICAL SPECIFICATION FOR MULTIPHASE PUMP PACKAGE (MPP)

PETROCIL ENGINEERS & CONSULTANTS PVT LTD

JO/APC-HC160-SP-M010039

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1. INTRODUCTION

The Humma, Arq, South Fuwaris Future Growth Project will be implemented to address capacity, reliability and operability challenges at SC-20 area. Currently, SC-20 acts as a gathering hub collecting from SC-20, SC-25 and SC-39 with plans to increase production through additional wells and new satellite sub-centers.

The main objective of the Humma, Arq, South Fuwaris Growth Project is to increase SC-20 handling capacity and construct new processing equipment at SC-23. Contractor will install Multiphase Pump (MPP) technology to collect and transfer all well fluids from SC-20 to SC-23 for separation and further tie-in to existing facility. Scope of work includes new trunkline from SC-20 to SC-23 for processing, including new trunkline from SC-23 to MGC. The project scope also includes new facilities installed by Contractor in SC-23 to handle SC-20 production. SC-20 is an existing facility inside partitioned zone in Saudi Arabia side, whereas SC-23 is an existing facility located in Kuwait side.

The following major equipment and systems will be installed in SC-20 and SC-23 as part of this project:

At SC-20:

- Multiphase pumps package with VFD and E-Rooms
- Underground drain tank
- New trunkline between SC-20 and SC-23
- Instrument Air package
- Chemical Injection skids
- PCS, ESD and F&G systems
- Electrical equipment (Transformers, Switchgears, E-SCADA, IRP, UPS etc.)
- Power Control Room (PCR) with Transformers, bus ducts, MV and LV switchgears, Neutral Earthing Resistors (NER), AC and DC UPS, Battery banks, FACP, Distribution boards, Clean Agent System, HVAC, lighting, small power socket system, etc.
- Emergency Diesel Generator with Load banks and Day storage tank
- Tie-in works

At SC-23:

- 2 Phase Production Separator
- Gas Scrubber
- Relocated Gas Scrubber from SC-20
- New trunkline between SC-23 and MGC
- PCS, ESD, F&G and IRP Panels
- Separate Gas and Liquid flow meters
- Chemical Injection skids
- Tie-in works

2. PURPOSE OF THE DOCUMENT

The purpose of this specification is to define the scope, the minimum technical requirements, the design, manufacture, assembly, supply, inspection, factory testing, preservation, packing, Vendor Site Assistance during Erection and Commissioning and Training of O&M Personnel and Vendor documentations of the MultiPhase Pumps package for the Sub Centre 20 upgrade project.

The basic requirements for the Package shall be in accordance with the requirements of this specification, unless superseded by more stringent local regulations. Complying with this specification shall not relieve the Vendor of his responsibility of supplying equipment and accessories of proper design, material and workmanship to meet the specified / required duty conditions / local statutory norms.

The Package along with all its auxiliaries shall be designed, constructed and operated in compliance with all reference codes and standards mentioned in this document. Vendor shall consider and provide all necessary approvals and certification required to meet the same. Vendor to provide deviation lists as required when deviating from requirements of this specification.

3. DEFINITIONS AND ABBREVIATIONS

3.1. DEFINITIONS

NOMENCLATURE	DESCRIPTION
Company	Wafra Joint Operations
Contractor	Alkhorayef Petroleum Company, Kuwait
Consultant	Petrocil Engineers and Consultants Private Ltd (PEC)
Vendor / Supplier	Manufacturer or Supplier of a Particular Equipment/ Package
Project	Humma, Arq, South Fuwaris Future Growth Project

3.2. ABBREVIATIONS

ABBREVIATION	MEANING
APC	Alkhorayef Petroleum Company
API	American Petroleum Institute.
ASME	American Society of Mechanical Engineers.
ANSI	American National Standard Institute.
AISI	American Iron and Steel Institute.
BS	British Standards Institute.
DE	Driver End
ESD	Emergency Shut Down
EN	European Standard
FAT	Factory Acceptance Test

ABBREVIATION	MEANING
FGS	Fire and Gas System
GVF	Gas Volume Fraction
HMI	Human Machine Interface
IEC	International Electro-technical Commission.
ISO	International Organization for Standardization.
IP	Ingress Protection Code.
JB	Junction Box
KGOC	Kuwait Gulf Oil Company
LCP	Local Control Panel
MMS	Machine Monitoring System
MPE	Magnetic Particle Examination
NPT	National Pipe Thread
NDE	Non Driver End
NDT	Non-Destructive Test
PCR	Power Control Room
PFD	Process Flow Diagram
PD	Positive Displacement
PE	Dye Penetrant Examination
PLC	Programmable logic controller.
P&ID	Piping & Instrumentation Diagram.
QA/QC	Quality Assurance and Quality Control.
RMS	Root Mean Square
RTD	Resistance Temperature Detector.
SAC	Saudi Arabian Chevron.
SI	International System of Units
SON	Service Order Notification.
STD	Standard.
UFD	Utility Flow Diagram
UCP	Unit Control Panel
VFD	Variable Frequency Drive
PCS	Process Control System

C

ABBREVIATION	MEANING
PECS	Package Equipment Control System
FACP	Fire Alarm Control Panel
FSP	Fire Suppression System

4. ORDER OF PRECEDENCE

- Project Documents
- JO Standards/Specification and JO standard drawings
- KOC Standards, Specifications, Recommended Practices and KOC Standard Drawings
- Chevron Engineering Standards (CES)
- International Industry Standards

5. CODES AND STANDARDS

5.1. INTERNATIONAL CODES AND STANDARDS

Unless otherwise stated, latest edition is applicable for all the referred international standards.

DOCUMENT NO.	TITLE
API STD 520	Sizing Selection and Installation of Pressure Relieving De-vices in Refineries.
API STD 521	Pressure Relieving and De-pressuring System
API STD 613	Special Purpose Gear Units for Petroleum, Chemical and Gas Industry Services
API STD 614	Lubrication, shaft-sealing, and oil-control systems and auxiliaries
API 670	Machinery Protection System
API STD. 671	Special Purpose Couplings for Petroleum, Chemical, and Gas Industry Services
API STD 676, 3rd Edition :Reaffirmed 2015	Positive Displacement Pumps –Rotary
API STD. 682	Pumps - Shaft Sealing Systems for Centrifugal and Rotary Pumps
API RP 521	Guide for Pressure Relieving & De pressurizing systems
API RP 540	Recommended Practice for Electrical Installations in Petroleum

DOCUMENT NO.	TITLE
	Processing Plants
API RP 551	Process Measurement
ASME Section II-A	Boiler and Pressure Vessel Code (BPVC), Materials - Ferrous Materials Specifications
ASME Section II-B	BPVC, Materials - Nonferrous Materials Specifications
ASME Section II-D	BPVC, Materials - Properties
ASME Section V	BPVC, Non - Destructive Examination
ASME Section VIII Div. 1	BPVC, Rules for Construction of Pressure Vessels
ASME Section IX	BPVC, Welding, Brazing and Fusing Qualifications (Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators Welding and Brazing Qualifications)
ASME B 16.10	Face to Face and End to End Dimension of Valves.
ASME B16.11	Forged Steel Fittings, Socket Welding and Threading.
ASME B 16.20	Metallic Gaskets for Pipe Flanges Ring-Joint, Spiral-Wound and Jacketed
ASME B 16.34	Valves Flanged, Threaded and Welding End
ASME B 16.5	Steel Pipe Flanges and Flanged Fittings (NPS 1/2 Through NPS 24 inch)
ASME B 16.9	Factory-Made Wrought Butt-welding Fittings
ASME B31.3	Process Piping
ASME B40.100	Pressure Gauges and Gauge Attachments
ASME B40.200	Thermometers, Direct Reading and Remote Reading
ASME PTC 19.3 TW	Thermo wells
ANSI /HI 9.1 – 9.5	Pumps - General Guidelines for Types, Applications,

DOCUMENT NO.	TITLE
	Definitions, Sound Measurements, and Documentation
ATEX European Directive 94/9/EC	Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres.
BS EN 10204	Metallic Products- Type Of Inspection Documents.
BS EN 60584/ IEC 60584	Thermocouples
BS EN 60751/ IEC 60751	Industrial Platinum Resistance Thermometers And Platinum Temperature Sensors
BS EN 62444	Cable Glands for Electrical Installations
BS EN 837-1	Pressure Gauges. Bourdon Tube Pressure Gauges. Dimensions, Metrology, Requirements And Testing
BS PD 5304	Guidance on Safe Use of Machinery
IEC 60034	Rotating Electrical Machines
IEC 60079	Electrical Apparatus for Explosive Atmosphere
IEC 60331	Tests for Electric Cables Under Fire Conditions - Circuit Integrity
IEC 60332	Tests on Electric and Optical Fibre Cables Under Fire Conditions
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)
IEC 60534 (All Parts)	Industrial Process Control Valves
IEC 61508 (All Parts)	Functional Safety of Electrical / Electronic/ Programmable Electronic – Safety Related Systems
ISO 15156 / NACE MR0175	Metals for Sulphide Stress Cracking and stress Corrosion Cracking Resistance in Sour Oilfield Environments
ISO 1940	Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State : Part 1 Specifications and Verification of Balance Tolerances
ISO 281	Rolling Bearings- Dynamic Load and Rating Life.

DOCUMENT NO.	TITLE
ISO 9000 / 9001 / 9004	Quality Management System
WRC 297	Local Stresses in Cylindrical Shells Due to External Loadings on Nozzles
WRC 537	Precision Equations and Enhanced Diagrams for Local Stresses in Spherical and Cylindrical Shells Due to External Loadings for Implementation of WRC bulletin 107

5.2. WJO STANDARDS

DOCUMENT NO.	TITLE
JOS-00-01 Rev 1	Plant Design Data
JOS-02-01 Rev 6	Piping – Selection and Design
JOS-02-04 Rev 1	Insert Sleeves for Internally Coated Carbon Steel Pipes
JOS-02-05 Rev 2	Internal Coatings
JOS-FE-HAB-001	Handing Over of Project As-Built
ELC-SC-6028-C	Pre-Fabricated Electrical Power Houses (E-House)

5.3. KOC STANDARDS

DOCUMENT NO.	TITLE
KOC-C-006 Rev 3	KOC Standard for Concrete Work Materials and Construction.
KOC-E-001 Rev 3	KOC Standard for High Voltage Induction Motors
KOC-E-003 (Part 1) Rev 4	KOC Recommended Practices for Design Basis and Selection of Electrical Systems.
KOC-E-003 (Part 2) Rev 2	KOC Recommended Practices for Installation and Testing of Electrical Equipment.
KOC-E-004 (Part 1) Rev 1	KOC Recommended Practices for Selection, Installation and Maintenance of Electrical Equipment in Hazardous areas. General Requirements (Formerly COP-E-001 Part 1)

DOCUMENT NO.	TITLE
KOC-E-004 (Part 2) Rev 2	KOC Recommended Practices for Selection, Installation and Maintenance of Electrical Equipment in Hazardous Areas. (Flameproof Enclosure ‘d’) (Formerly COP-E-001 Part 3)
KOC-E-004 (Part 3) Rev 1	KOC Recommended Practices for Selection, Installation and Maintenance of Electrical Equipment in Hazardous Areas. (Intrinsic Safety 'i') (Formerly COP-E-001 Part 4)
KOC-E-004 (Part 4) Rev 1	KOC Recommended Practices for Selection, Installation and Maintenance of Electrical Equipment in Hazardous Areas. (Increased Safety 'e') (Formerly COP-E-001 Part 6)
KOC-E-004 (Part 5) Rev 2	KOC Recommended Practices for Selection, Installation and Maintenance of Electrical Equipment in Hazardous Areas. (Non –Sparking Type Ex’n)
KOC-E-004 (Part 6) Rev 1	KOC Recommended Practices for Selection, Installation and Maintenance of Electrical Equipment in Hazardous Areas. Oil Immersion “O”
KOC-E-006 Rev 4	KOC Recommended Practice for Power System Studies, Protection and Control.
KOC-E-008 Rev 5	KOC Recommended Practice for Selection and Installation of Electric Cables.
KOC-E-010 Rev 1	KOC Standard for Low Voltage Induction Motors.
KOC-E-013 Rev 2	KOC Standard for Motor Operated Valve Actuators
KOC-E-014 Rev 1	KOC Standard for Variable Speed Drive (VSD) Controller and Soft Starter
KOC-E-017 Rev 4	KOC Recommended Practice for Lighting and Small Power Supply Systems
KOC-E-020 Rev 3	KOC Recommended Practice for Electrical Installations on Package Equipment.
KOC-E-023 Rev 3	KOC Standard for Electric Cables.
KOC-E-024 Rev 2	KOC Recommended Practice for Earthing and Bonding.
KOC-G-002 Rev 6	KOC Standard for Hazardous Area Classification.
KOC-G-004 Rev 1	KOC Standard for Packing, Marking and Documentation.

DOCUMENT NO.	TITLE
KOC-G-007 Rev 5	KOC Standard for Basic Design Data.
KOC-G-009 Rev 1	KOC Standard for Spare Parts and Maintenance Data.
KOC-G-012 Rev 1	KOC Standard for Plant Equipment Identification, Name Plates and Pipeline Markers.
KOC-I-001 Rev 3	KOC Standard for Instrumentation and Control system Design
KOC-I-002 Rev 3	KOC Standard for Instrumentation installation.
KOC-I-004 Rev 3	KOC Standard for Shutdown System.
KOC-I-005 Rev 2	KOC Recommended Practice for Fire & Gas System Panels (Formerly 015-JH-1906)
KOC-I-007 Rev 2	KOC Standard for Telecommunication, Instrumentation and Control system Cabinets.
KOC-I-010 Rev 2	KOC Standard for Control and Shutdown Valves.
KOC-I-011 Rev 3	KOC Standard for Instrument Cables.
KOC-I-017 Rev 2	KOC Recommended Practice for implementation of safety Instrumented Functions (SIF)
KOC-I-026 Rev 0	KOC Standard for Process Flow Measurement.
KOC-L-006 Rev 2	KOC Standard for Fire & Gas Detection Equipment (Super-cedes 015-YH-1001)
KOC-L-009 Rev 6	KOC Standard for Fire Protection Systems & Safety Equipment
KOC-L-020 Rev 1	KOC Standard for Fire Protection in Non-Plant Buildings
KOC-L-024 Rev 3	KOC Recommended Practice for Selection, Design and Installation of Clean Agent Based Fire Extinguishing Systems
KOC-L-030 Rev 1	KOC Standard for Plant /Equipment Noise Control.
KOC-L-036 Rev 1	KOC Recommended Practice for Design, Selection and Location of Fire & Gas Detection System

DOCUMENT NO.	TITLE
KOC-ME-006 Part 3 Rev 1	KOC Standard for Positive Displacement pumps- Rotary
KOC-MH-001 Rev 0	KOC Standard for HVAC System and Equipment: Direct Expansion (DX) Type
KOC-MP-013 Rev 3	KOC Standard for Gate Valves
KOC-MP-014 Rev 2	KOC Standard for Globe
KOC-MP-015 Rev 1	KOC Standard for Check Valves
KOC-MP-016 Rev 2	KOC Standard for Plug Valves
KOC-MP-027 : PART 1 Rev 1	KOC Standard for Pressure Relief Devices: Design and Materials.
KOC-MP-027 : PART 2 Rev 1	KOC Standard for Pressure Relief Devices: Sizing, Selection, Twinning and Installation.
KOC-MP-033 Part 1 Rev 2	KOC Standard for Valves: Part 1-Ball Valves.
KOC-MV-001 Rev 1	KOC Standard for Pressure Vessels.
KOC-P-001 Rev 5	KOC Standard for Painting and Coating of External Metal Surfaces.
KOC-PR-001 Rev 1	KOC Standard for System Isolation
KOC-Q-014 Rev 2	KOC Standard for Project QA/QC General Requirements.
KOC-Q-015 Rev 1	KOC Standard for Positive Material Identification (PMI)
KOC STD 381/02/01	Selection, Qualification and Utilisation of Third party Inspection Services.
KOC STD 381/029	General Specification for Instrument Engineering in Industrial Process Plants
015-JH-1903 Rev 1	General Instruments.
015-JH-1909 Rev 1	Instrumentation for Package Equipment.
015-JH-1910 Rev 1	Mechanical Completion of Instrument Systems

DOCUMENT NO.	TITLE
015-LH-1004 Rev 1	Piping and Equipment Pre-Assembly
015-YH-1004 Rev 1	Emergency Shutdown (ESD) and Depressurizing System Requirements
015-ZH-1002 Rev 1	Reporting Computer Condition Monitoring, Telecommunication and Security System.

6. REFERENCE DOCUMENTS

DOCUMENT NO.	TITLE
JO/APC-HC160-DB-D010001	Process Design Basis & Process Description
JO/APC-HC160-DB-M010038	Mechanical Design Basis
JO/APC-HC160-DB-E010202	Electrical Design Basis
JO/APC-HC160-DB-K010215	Instrumentation & Control Design Basis
JO/APC-HC160-DB-C010287	Civil & Structural Design Basis
JO/APC-HC160-DB-P010072	Piping Design Basis
JO/APC-HC160-DS-M110046	Datasheet for Multiphase Pump Package
JO/APC-HC160-DS-E010226	Datasheet for Motors
JO/APC-HC160-DS-E010144	Datasheet for VFD
JO/APC-HC160-SP-E010162	Specification for VFD
JO/APC-HC160-DS-E010131	Datasheet for Electrical Cables
JO/APC-HC160-SP-E010147	Specification for Cables
JO/APC-HC160-DS-H010028	Datasheet for Fire Fighting And Safety Equipment
JO/APC-HC160-PI -11005	P&ID For Multiphase Pump Suction / Discharge / Manifold -SC20
JO/APC-HC160-PF-10001	PFD for Multiphase Pumps
JO/APC-HC160-SP-P010073	Piping Material Specification

DOCUMENT NO.	TITLE
JO/APC-HC160-SP-P010075	Valve Material Specification
JO/APC-HC160-DS-P010077	Data Sheets For Ball Valve
JO/APC-HC160-DS-P010325	Data Sheets For Gate Valves
JO/APC-HC160-DS-P010326	Data Sheets For Check Valves
JO/APC-HC160-DS-P010327	Data Sheets For Globe Valves
JO/APC-HC160-DS-P010078	Piping Specialty Item Datasheets
JO/APC-HC160-PL-30003	Standard Drawings For Pipe Supports
JO/APC-HC160-EE-50003	Key SLD for Electrical System
JO/APC-HC160-SP-P010074	Specification For Painting
JO/APC-HC160-SP-K010216	Specification For Fire Alarm Control Panel
JO/APC-HC160-SP-K010218	Specification For Packaged Instruments (Including PLC)
JO/APC-HC160-SP-K010219	Specification For Instrument And F&G Cables

7. TECHNICAL REQUIREMENTS

7.1. SCOPE OF SUPPLY

The Vendor shall supply package in compliance with the referenced documents within this specification to satisfy design, engineering, manufacturing, supply, inspection, testing, and operational requirements under the conditions described in this specification and the package equipment data sheet (JO/APC-HC160-DS-M110046) including any items required guaranteeing the equipment performance and safe operation. Vendor to comply Annex G, typical piping and instrumentation diagram for Multiphase Pump (MPP) Skids as per API 676.

The Vendor shall design, supply materials, fabricate and deliver each Package complete with, but not limited to, the following:

- Rotary Screw MPP in accordance with API 676 3rd edition with electrical variable frequency driver.

  Motor shall be provided with multifunctional meter in the switchgear, VFD shall be provided with necessary outputs as required to interface with E-SCADA and UCP / PCS for various control/monitoring.

  VFD shall be in accordance with the requirement of KOC-E-014 rev1 and Datasheet (JO/APC-HC160-DS-E010144).

- Lube oil system and Seal oil system for multiphase operation in conformance with API 614

  Lube-oil system shall be in accordance with API 614, Latest edition.

  Piping / tubing shall be in accordance with API 614 Table 7 or 8

  Single oil reservoir shall be sized for monthly top-up as a minimum and Pump vendor shall indicate retention & working capacity.

  2×100% electric motor driven submersible rotary positive displacement oil pumps (as a minimum constructed of carbon steel) shall be provided.

  All coolers shall be air-cooled heat exchanger.

  Air-cooled heat exchanger shall be provided with two or more fans; the heat exchanger shall be capable of 100% of the duty requirement with one fan out of service.

  Seal oil system shall provide sufficient barrier fluid pressure during an upset condition such as power blackout, e.g. by utilization of a bladder-type accumulator, sized for 72 hours.

  Each seal-oil return line shall be equipped with a Temperature Transmitter / Local Indicator (TIT) for condition monitoring / trending and / or flow meter.

  Supplier shall provide a System Datasheet and a Deviations List to API 614, 6th Edition.

- Double acting mechanical seal meeting the intent of API 682, latest edition.
- DRY RUN of maximum 3 min as a Safety system for gas slugs shall be provided. Methods such as internal re-circulation and or External injection of liquid shall be provided and demonstrated in pump performance test.
- Flexible Coupling shall be designed in accordance with API 671. Non sparking coupling guard shall be provided.
- Pulsation suppression devices (as necessary). A pulsation study shall be performed to validate pulsation suppression requirements.
- Package Equipment Control system (PECS) (including 2x laptop and PLC software) for control, monitoring and shutdown of package electrical drives, pumps, Lube oil / Seal oil system, VFD, valves and instruments
- New Containerized and temperature controlled electrical room to house MPP's VFD and package control systems (PLC, MMS, and HMI etc.)
- All on skid piping including interconnecting piping between the pump skid and auxiliary skids, valves (including relief valves), Special items and piping appurtenances, pipe supports, vents / drains etc. All piping connections to terminate at skid edge connection flanges with isolation valve (Piping shall be designed in line with ASME B31.3).

  Non-return check valves, axial non-slam type (to prevent back spinning of the pump) and pressure relief valve shall be installed in the discharge line as per requirement. The discharge non-return valve should be located as close as practical to the pump discharge flange to minimize potential of reverse rotation.

  Multiphase suction strainer (a duplex basket type with SDSS internals) shall be installed for each pump internal component protection. Strainer bypass to be also provided with the system.

  Isolation and shutdown valves as necessary for a failsafe close execution. Valves shall be Motor actuated valves as per KOC-E-013 Rev 2.

Blow down line and valve (routed to underground drain tank)

- All necessary instruments and controls such as level gauge, level transmitter, flow transmitter, pressure gauge, vibration detectors, pressure transmitter, PSV, temperature Gauge, Temperature Transmitter, Control / ESD Valves, pump running feed-back and auto start facility etc. as required for the package. Canopy / Sun-shades shall be provided over all the electronic instruments as a minimum. Instruments shall be as specified within data sheet (JO/APC-HC160-DS-M110046) and/or as required in accordance with specifications and standards for safe and satisfactory operation of the Package equipment as deemed necessary by the Vendor. Double block and bleed valves shall be provided for all PT / PG connections.
- Interconnecting E&I Cable between the Skids of the MPP Package shall be provided by the Vendor whereas the E&I Cables from the PCR Building to the MPP Skid will be provided by the Contractor.
- Each MPP shall have a dedicated UCP / PECS panel with fully redundant PLC and MMS. HMIs (Min 17” monitors, one for PLC and another one for MMS) shall be panel mounted on each UCP / PECS. All the 3 no’s UCP / PECS shall be installed in the common control E room.
- Machine monitoring / Condition monitoring system (pump and motor) as per Company Specification (015-ZH-1002). It is preferred to have Bently Nevada Or-bit 60 or equal for the conditioning monitoring system.
- Local control stations for MPP motor, lube oil pump motor, Seal system motor, heaters, cooler fans motor, MPP motor cooling fan motors, hydraulic power motors.
- Skid Gauge board with sunshade for mounting indicators and transmitters with clear tag description. Gauge boards shall be installed at skid boundary for easy visibility.
- All baseplate mounted electrical and instrumentation cabling (signal segregation philosophy as per Instrumentation & Control Design Basis- JO/APC-HC160-DB-K010215 and applicable KOC standards) via cable trays etc. within the package. Trays shall be made of heavy duty hot dipped galvanized steel. Cable shall be fire proofed as per clause 8.1 of KOC-C-027.
- Junction boxes, signal segregated (signal segregation philosophy as per Instrumentation & Control Design Basis - JO/APC-HC160-DB-K010215 and applicable KOC standards), for instrumentation and electrical connections located at skid edge.
- Common single point lifting arrangement at structural skid (Baseplate) for each skids (Pump, Piping, lube oil / Seal oil etc.). However, lifting arrangement of individual items i.e. pump, motor, Vessels etc. shall also be provided.
- A skid mounted lifting structure to support in site pump maintenance (DE and NDE sides). E.g. bearings/ mechanical seals/coupling change outs or rotor/liner pull-outs.
- Skid design shall include SS316L Drip Tray (sloped drip pan at servicing area with a drain Valve), access ladder (if necessary), service platform and lifting lugs.
- Vents and drains with valves.
- Two earthing bus bars / boss at diagonally opposite side of Package Skid as a minimum

  Complete Earthing with in the package shall be vendor scope and shall be as per the requirement specified in KOC –E-020 and KOC-E-024. Earthing shall be designed for instruments / JBs / UCPs as per KOC-I-002 Appendix-2.

- VFD / UCP electrical container lighting and other accessories shall be part of pump vendor scope including internal wiring.
- Anchor bolts/ foundation Bolts including motor holding down bolts
- All necessary blanks, bolting and gaskets for testing purposes.
- Temporary covers, gaskets and bolting to protect nozzle flange faces during shipment and storage.

Other General / Common Supplies and scope of services includes:

- Commissioning Spares, One year and Two year normal Operation Spares

  Vendor's scope of supply shall include all commissioning spares (mechanical, electrical and instrumentation) for the unit as deemed necessary by Vendor.

  Spare parts shall be in line with Company Specification (Doc # KOC-G-009)

- Insurance spares

  Vendor shall recommend and quote Insurance spares and furnish itemized list with unit prices in the offer. This shall include mechanical, electrical and instrumentation spares also.

- Special tools and Tackles

  The Vendor shall include any special tools required for installation, field testing, operation and maintenance in the basic scope of supply. In addition Vendor shall provide a listing of all special tools required for maintaining equipment.

- Special Vendor supplied lifting devices required for transportation, and installation

  Spreader bars / non-metallic Slings/ Shackles for transportation, The Vendor shall include all special lifting beams and other devices required to lift and move the equipment during transport to site or during installation. Lifting beams shall be proof load tested, marked, and certified to the required safe working load. All lifting devices supplied shall be certified by Company approved third party. All lifting slings, suction and discharge flange surface covers/protectors and shackles shall be included in the Vendor's scope of supply.

- Consumables

  First Fill: The Vendor shall provide details for the first fill of all lubricants, chemicals, catalysts, etc. required to put the equipment into operation. The first fill of lubricants is in Vendor's scope of supply.

  Operational Consumables: The Vendor shall provide the Company / Company Representative with a list stating the specification, quantities, and replacement frequency of all operational consumables required for the equipment for up to 6 months operation after commissioning.

- Nameplates and tagging for all tagged pieced of equipment and instrumentation.
- Inspection and Testing: Vendor shall be responsible for carrying out the minimum requirements stated within the equipment datasheet (JO/APC-HC160-DS-M110046), project specifications and applicable codes and standards including but not limited to Factory Acceptance testing including string testing of at least one MPP package, Site acceptance testing, Inspection and test records, and material test certificates.

All factory testing, instrument calibration and inspection activities shall be witnessed by certified third party inspection authority and company representatives.

- Vendor shall submit documents vendor drawing and data requirement (VDDR) as per API 676 as minimum. Documentation including final As-Built dossiers.
- Pre-assembly

  The package shall be fabricated utilizing maximum shop assembly consistent with shipping requirements and site transportation limits.

  Vendor shall advise the physical size and weight of the major components with the quotation.
- Packing and Shipping to SC 23 Site Store or SC20 in Wafra Kuwait .
- Preservation & Protection

  Preservation shall be as per API 676 and equipment shall be suitably prepared for export in accordance with KOC standard for Packing, marking & documentation (Doc # KOC-G-004).

  Surface preparation, painting, external coating and protective coatings for Piping within the MPP Package shall be in accordance with Company specification (Doc # KOC-P-001).
- Corrosion Protection

  All materials shall be supplied suitably protected from corrosion during transit, storage, after installation and during operation. The Project requirements for protection are included in the documents referenced within this specification.
- Site Services

  The Vendor shall provide site supervision of installation and / or commissioning. These services shall be supplied on a daily rate basis as agreed and detailed in the purchase order.

  Pre-fabrication and Installation of skid mounted items shall be by Vendor
- Training

  The Vendor shall give their proposal for provision of suitably experienced and qualified personnel to train Company's personnel in;

  - Maintenance
  - Operation

  For all supplied MPP packages furnished by the Vendor, training shall be performed at Site. All training and support documentation shall be available from Vendor for this instruction. The language used for training programs shall be English.
- Any additional part, equipment, material, etc. which are not specifically mentioned in this specification, but required to make the supplied equipment / item complete in all respect in accordance with the intent of this specification, statutory requirements, applicable codes / standards and for safe and trouble free operation, shall be deemed to be covered under the scope of this specification.
- Vibration study for Pump skid shall be performed by vendor.

- Sub Vendor

  Vendor shall follow Scope of work Appendix – 11 List of Approved manufacturers / vendors (Doc# JO/HC160/MP23) for the sub Vendor.

8. BASIC DESIGN

8.1. GENERAL

If the Vendor comes across any discrepancy, deficiency, or lack of clarity in any part of this specification or attached documents, they shall notify the same to the Company, along with their offer, with a proposed alternative or additional item and prices for each category thus included. Any items so identified after Order award will not constitute a change and will not be the cause for cost or schedule alteration.

Vendor shall complete all relevant sections of the data sheet (JO/APC-HC160-DS-M110046), and submit the same with his bid / offer.

8.2. DESIGN

The design of package shall be based on inlet and outlet conditions which shall be specified in the datasheet (JO/APC-HC160-DS-M110046) and the same shall be checked by Vendor. The package shall be suitable for unattended, continuous & automatic operation.

All the equipment and auxiliaries within the MPP Package shall conform to the minimum requirements mentioned in this specification, respective datasheet (JO/APC-HC160-DS-M110046) and technical requirements furnished in other referenced documents.

Adequate machine guarding shall be provided for all rotary equipment to prevent personnel injury due to potential contact with moving parts.

For Vessels/Tanks in the package, all internals shall be shop installed inside by the Vendor to check proper fit-up & tolerances. Internals shall be dismantled / removed during the shop hydro testing. Finally, the vessels/Tanks shall be shipped with all internals installed.

All gas vents and pressure relief lines shall be located at safe height. All liquid drain shall be piped to the drain lines. The unit shall be shop assembled to minimize the onsite erection activities.

All motors, electrical components, instrumentation, auxiliaries and its installation shall be suitable for the hazardous area classification specified in the package datasheet (JO/APC-HC160-DS-M110046) / minimum certification requirements (as mentioned in Specification, Reference documents & KOC standards etc.) whichever is stringent and shall be capable to provide automatic unattended operation with minimum maintenance. Package is required to provide sound reliable operation over the specified range of operation.

Vendor shall also be responsible to include all design amendments recommended by the HAZOP study and shall participate for the same.

Following HAZOP recommendation (as part of HAZOP conducted during define stage) shall be incorporated by Vendor.

- MPP vendor to give a suitable safeguard in case of low suction pressure (This is applicable for all the three pumps individually).
- MPP vendor to provide SDV's at the inlet & outlet of the pump.

- MPP vendor to provide low and high pressure alarm at suction & discharge and consider tripping the pumps to protect the pump from damage.
- MPP vendor to give a suitable safeguard in case of suction strainer getting plugged. (This is applicable for all the three pumps individually). Consider to provide differential pressure transmitter across the strainer with high alarm.
- MPP vendor to suggest suitable safeguard when one working pump get tripped (since the plant is designed for two pumps continuous operation & one standby pump is available) while the plant is operating at full through put.
- Individual pump discharge shall be provided with low pressure alarm in WCC.
- MPP vendor to give suitable safeguard in case of high bearing temperature. Alarm and Shutdown for high discharge temperature, high differential pressure, high differential temperature.
- MPP vendor to take care of the low ambient temperature with respect to lube oil being considered.
- MPP vendor to choose a suitable seal to avoid leakage.
- MPP vendor to provide suitable safeguard in case of high pressure at the MPP pump discharge header.
- MPP vendor shall review the requirement of auto start of the auxiliaries for MPP pump when the pump restarted remotely after power failure.
- MPP vendor shall take care of the lube oil spec with respect to peak winter in Kuwait.
- MPP vendor shall clearly indicate the consequence in case of IA failure & safeguards available.
- Provision for Nitrogen purging shall be provided on the MPP Package
- MPP vendor shall submit Cause & Effect Diagram with alarm set points prior to MPP Package HAZOP Study.
- Removable spool pieces shall be provided for maintenance purpose on the suction and discharge nozzles of pumps.

8.3. PIPING

Vendor is responsible for all on skid piping work (design, engineering, fabrication, supporting, installation, inspection, testing, commissioning etc.) inside package whether it is skid based or stand-alone. Piping installed shall be as per ASME B31.3.

All piping shall be as per JO/APC-HC160-SP-P010073 Piping Material Specification and the Valves shall be as per JO/APC-HC160-SP-P010075 Valve Material Specification

Vendor shall specify the sizing, rating, facing and X, Y & Z co-ordinates of all piping interfaces.

All the Piping valves, flanges, Instrument connections, and special items shall be accessible from the grade level, if not platform shall be provided for the same. Access requirement as per SID-SU-5016 shall be followed.

External coating of MPP package shall be as per Company's standard KOC-P-001. Color code shall be as per KOC-P-017.

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DSS /Stainless steel shall not be painted / coated except where specified by the relevant data sheet.

Piping connection from skid to customer shall be by flanges, facing for flanges shall be raised face which shall be as per ASME B16.5.

All Piping connection to customers shall be brought to the skid edge at one location, leaving customer connections at different locations within the skid is not acceptable.

Vendor shall provide allowable forces and moments at customer connection, the forces and moments shall be in three directions, FX, FY, FZ, MX, MY, MZ. The nozzle allowable loads shall be in line with API 676 requirements in line with requirements stipulated under Section1 phrase/ clause 6.7.1 of this document.

All vent and drain connection from different points in the skid shall be connected by vendor and customer connection shall be provided at skid edge.

Skid shall be provided with structural steel, grating, hand rails, ladders for operation, maintenance with in the skid. The structural steel provided shall be suitable for use in external environment. Chequered plate shall not be used as per SID-SU-5016.

All piping shall be suitably supported for service and shipment. Piping shall be provided with adequate supports. Detail of pipe supports and design shall be the responsibility of the Vendor.

Piping shall be neatly arranged to provide good operation and to provide adequate access for routine servicing. All valves and instruments shall be accessible for easy maintenance and operation. Valve operation by means of chain wheel is not acceptable. Equipment, structures, platforms, piping and its supports shall be suitably arranged to meet stress analysis calculation requirements, as applicable. Access requirement as per SID-SU-5016 shall be followed.

All piping systems shall be designed so that the loads and moments applied at the flanges of equipment shall not exceed the permissible reactions for the equipment as specified by the manufacturers of the equipment.

Piping shall be sufficiently flexible to absorb the reaction forces and moments imposed by thermal expansion of the piping inside the skid. Pulsation Study shall be carried out by Vendor.

Sufficient supports shall be provided to prevent excessive local stress in the piping, and vibration of the valves.

The Vendor shall anchor (3 way restraint) the package piping at the skid edge within a distance of 3 pipe diameters inside skid from the flanged end. The piping within the package shall be supported and guided, as necessary, by the Vendor to ensure that all thermal expansion of the skid internal piping should be taken within the skid itself.

The piping shall be designed and installed to prevent vibration and damage.

8.4. STRUCTURES

The complete design and supply including structural design of the skid shall be by Vendor.

Single-lift Package on structural skid is envisaged. However, when single skid is not practical for transportation (due to large size) then skid could be separate (subject to agreement with Company); for such cases, each skid shall be preassembled and completely tested for the service.

The package skid shall be designed by Vendor for pre-service (i.e. Lift and transportation) and in-service conditions.

Skid shall be supplied with certified lifting gear for installation/transportation.

The skid shall support all the equipment, controls, control panel and instrumentation necessary to make the equipment operational.

The skid shall be sufficiently rigid to prevent damage to on-skid equipment when handled. The skid shall be designed for a single-point lift. Lifting lugs shall be adequately designed and fully welded with 100% NDT.

Necessary platforms and access ways shall be provided to all major components and instruments, where the areas requiring regular maintenance.

Vendor shall clearly indicate following for foundation design:

- Skid dimensions, anchor bolt / pocket details (i.e. location, diameter)
- Unbalanced dynamic forces (loads and moments) in 3 orthogonal directions
- Static Weight of the package
- Frequency of vibration
- Motor rating in KW
- Static and dynamic Centre of Gravity (COG) in 3 orthogonal directions
- Permissible displacement (translation and rotational) in 3 orthogonal directions

No part of the equipment, piping, instrumentation, etc. shall overhang the edge of the skid.

Skid base plates shall be arranged such that any spillage / rainwater will be contained and allowed to flow to a drain connection without pooling. Skids shall be sloped towards the drain.

If shipped loose, a trial assembly of the structure members shall be done by Vendor at the shop to prove dimensional integrity.

The necessary sub plates, shims and levelling jackscrews shall be provided to allow satisfactory levelling. Shims shall be made of a non-corrosive material such as stainless steel. Provisions shall be made for sufficient field vertical alignment.

8.5. ELECTRICAL

Company will provide Power supply to VFD E room (by Vendor) from New PCR.

MPP Motors will be powered from VFD E room and other auxiliaries directly from new PCR.

Available Power for the MPP Package:

- ✓ 11kV AC, 3Ph 3-Wire, 50 Hz
- ✓ 440V AC ±6%, 3Ph, 4-wire, 50 Hz
- ✓ 110V AC ± 1 %, 1Ph, 2-wire, 50Hz ± 0.5 %

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Vendor shall derive / convert all other Power requirements within the Package from the above stated Electrical Power supply. For the Lighting and Small Power, Vendor shall consider Dry Type Transformer for 440/415V.

All electrical items like local panels, cabling, etc. within package battery limit shall be in Vendor's scope.

VFD / UCP electrical container lighting and other accessories as per KOC requirements shall be part of pump vendor scope including internal wiring.

All small power distribution inside the skid shall be taken care by vendor (Which includes looping cables, cable tray, glanding, termination etc.)

Cable trays for laying of all power cables and control cables along with cable glands and lugs required for termination of cables within the package battery limit shall be provided by Vendor.

Cabling between VFD panels to respective skid MPP motor shall be provided by the Vendor, considering the cable distance. Adequate spacing for cable bending and necessary glanding and termination shall be provided.

Supplied Electrical items inside the package shall be as per Hazardous area classification for the package refer Datasheet (JO/APC-HC160-DS-M110046) for further details.

Skids shall be provided with a minimum of two SS316L earthing bosses mounted at diametrically opposite location. All equipment on the skid should be bonded to the steelwork skid.

All electrical installations inside the skid shall be as per KOC-E-020 (KOC Recommended Practice for Electrical Installations on Packaged Equipment)

Electrical equipment's used inside the skid shall be as per the respective KOC Standards.

8.6. VFD E- ROOMS AND CONTROL E ROOM

VFD for each MPP shall be installed in its dedicated VFD E room (Total 3 VFD E rooms). Dedicated UCP / PCES (PLC and MMS) for each MPP (total 3 Nos. UCP / PCES Panels) shall be installed in a common control E-room. All E Rooms shall be elevated containerized type with redundant HVAC, pressurized and suitable for H2S environment

Design, supply, Installation and commissioning of VFD E-Room and Control E Room will be in MPP Vendor scope. E-room shall be of rigid self-supporting steel structure.

Each of the 3 Nos. VFD E Rooms and Control E-Room shall be equipped with necessary controls and necessary supporting services (HVAC, Lighting and Small power, F&G Detection/Alarm, Fire suppression system i.e. Clean agent System etc.).

F&G Detection/Alarm, Fire suppression system and Clean agent System shall be as per KOC E-003 part 1 section 10.5.4. F&G Detection and Alarm System for VFD rooms and Control E-Room shall be designed as per KOC-L-036 and project document specification for Fire Alarm Control Panel.

HVAC system design shall be as per KOC-MH-001.

Lighting and Small Power shall be as per KOC E- 017.

VFD E-Rooms and Control E Room shall be located within the proximity of MPP Skid. Company will provide necessary power supply to E-Room supporting services (HVAC, Lighting and Small Power, UPS Supply etc.)

Redundant bulk UPS power will be provided to control E- room by Company. Further separate UPS-A and UPS –B power distribution boards, as required within the control E room shall be by Vendor including cabling. UPS power as required for the LCPs, if any shall be sourced from the respective UPS distribution boards at Control E –Room.

8.7. INSTRUMENTATION AND CONTROLS

The Vendor shall be responsible for design and engineering of all instrumentation and control items required for smooth and satisfactory operation of the complete MPP package including, but not limited to Field Transmitters, Gauges, Valves, Vibration Detectors, Local Control Panels, Push buttons, Lamps, Junction boxes, Internal Cabling till skid edge Junction boxes etc.

Additionally, Process shutdown isolation valves shall be in the Vendor's scope supply and shall be mounted on-skid as per Vendor P & ID.

The VENDOR shall provide all the instrumentation required for all monitoring, alarms, shutdowns and MPP controls.

Package Vendor shall provide field junction boxes and gauge boards at skid edge, which is inclusive of all internal, on skid, cabling/installation and terminations. Cable block diagram, loop diagram, cable schedule and JB termination schedule shall be provided by the Vendor for interconnecting skid JBs and gauge boards with the respective UCP/ PECS (PLC and MMS) at control E room.

The Contractor shall specify the minimum required alarms and shutdowns on the MPP's Vendor Data Sheets. VENDOR shall propose, for the Contractor's review, any additional alarms and shutdowns based on past-experience of the offered MPP.

Both alarm and shutdown circuits shall be closed and energized when conditions are normal.

The design of JB shall be as defined in Instrumentation and Control Design basis (JO/APC-HC160-DB-K010215)

Package Equipment Control System (PECS)

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Each MPP shall have a dedicated UCP / PECS panel with fully redundant PLC (Redundant processors, I/Os, Communications, Power Supply) and MMS. HMIs (min 17" monitors - one for PLC and one for MMS) shall be panel mounted on each UCP /PECS. All the 3 no's UCP / PECS shall be installed in the common Control E room.

The provided MPP Programmable Logic Controller (PLC / PECS) shall perform all the process control, safeguarding and sequencing functions of the package equipment. Package Equipment Control System (PECS) programming and configuration shall be by the MPP Vendor. The package PLC shall perform real-time execution of package equipment control functions, orderly start-up and shutdown of the package during normal operation, or following an ESD trip. The package PLC shall control , monitor and safeguard package electrical drives, pumps, Lube oil / Seal oil system, VFD, valves and instruments status and generate alarms for out of limit process variables within the package, as applicable. FGS devices, if provided for each MPP skid shall be wired to dedicated FGS skid JB for further integration to facility FGS at new PCR.

Panel Design shall comply with KOC-I-007

Each package PLC to Plant Control System (PCS) interface shall be Modbus via redundant fiber optic cables. Vendor shall provide the necessary media converters/switches (MOXA or equivalent) at both ends.

Cables shall comply with the requirements specified in JO/APC-HC160-SP-K010219-SPECIFICATION FOR INSTRUMENT AND F&G CABLES.

Design of the Package PLC shall be in line with the requirements defined in this Specification, Instrumentation & Control Design Basis (JO/APC-HC160-DB-K010215), Specification for package instruments including PLC (JO/APC-HC160-SP-K010218), KOC Standard for Instrumentation and control system (KOC-I-001), KOC Standard for Shutdown System (KOC-I-004) and other reference documents mentioned in this Specification.

Each UCP / PECS shall be provided with individual UPS A , UPS B and 24 VDC fail alarms, Fan fail alarm and panel temperature high alarms wired to respective PLC.

Panels shall be provided with panel mounted lamps with following lamp description- UPS power failure, 24 VDC failure, fan failure and panel temperature high indications. Alarm lamps shall be in red colour.

Document holder shall be provided for each panel. Fan shall be provided with quick disconnect cable and Fan shall be removable. Transparent acrylic cover shall be applied for all power distribution.

Circuit Breaker no. & Service tag shall be provided for each Circuit Breaker with voltage level 110V AC (UPS), 24V DC, etc. Circuit Breakers and ELCB shall be from reputed, proven & reliable make.

As per KOC-I-004 clause 10.2.2, PLC based systems shall be designed for performing the functions in accordance with IEC-61508 to meet the safety integrity level-3 (SIL-3).

Panel lighting with on/off/auto switch shall be provided. Any lighting and small power requirements inside VFD E-room and Control E-room, shall be through Dry type transformer 440/415 V installed inside E-room. Separate feeders for each Dry type transformers shall be provided from MCC in PCR room.

Panels shall have Front and Rear doors. All I/O Cards shall be provided with individual I/O status indication. All PLC modules shall be conformal quoted. Wire jumpers shall not be used. Insulated comb shall be used for power distribution. Cross-ferruling shall be provided for all panel wiring including signal, power, grounding. Communication, etc. with source / destination details. Safety and clean earthing shall be provided as per KOC-I-002.

Machine Monitoring / Condition Monitoring System

The Machine Monitoring / Condition Monitoring System (MMS) (separate from the package PLC system) shall be in the scope of the VENDOR.

The Machine Monitoring / condition monitoring requirements for the MPP shall be in accordance with the Project MPP Data Sheets as well as Condition Monitoring Strategy as defined in applicable KOC and International Standards including 015-ZH-1002.

Machine monitoring system shall be installed on the rear side of respective UCP/PECS. HMI for machine monitoring shall be panel mounted on the front side of UCP/PECS, below the HMI for PLC. MMS system shall be integrated to PLC system for monitoring and alarm. MMS trips shall be hardwired to PLC.

The following minimum Machine monitoring / condition monitoring requirements shall apply:

- For pump, refer to Section 14 paragraph 7.8.4
- Bearing housings shall be prepared by Vendor for permanently mounting vibration transducers, which shall be part of VENDOR scope.
- Anti-friction bearing motor shall be fitted with the following:
  - 3 temperature sensors for each phase of motor winding
  - 2 temperature sensors for each DE and NDE bearing
  - 2 vibration sensors for each DE and NDE bearing
  - 1 vibration sensor for motor casing

  If a hydrodynamic bearing motor is selected, API 670 Figure H.4 applies

- Monitors shall be provided by the VENDOR and shall be in accordance with the KOC/Chevron Approved Vendor List.
- JBs for machine monitoring shall be separate and segregated

Selection of Field Instruments:

All instrumentation, Junction boxes, Local Control Panel and control equipment must be suitable for use in the environment in which the package is to be located and certified for the electrical hazardous area in which it is installed

All instruments shall have wetted materials of min. SS316. Hastelloy wetted materials shall be used for H2S rich services. All electronic transmitters shall be SMART type, 4-20mA with HART Protocol.

As a general rule, Alarm and shut down devices shall be transmitters. Switches are not acceptable.

The package Vendor shall specify all the utility requirements (pneumatic supply, power consumption etc.) for the package.

Vendor shall comply with the latest issue of the documents, standards and codes referenced in this Specification.

The make of all offered instruments and accessories shall be in accordance with the Approved Vendor list.

Package Vendor shall also be responsible to supply all required bulk materials as per reference documents mentioned in Section-5 and 6 of this specification.

If package instrumentation requires instrument air / pneumatic air / hydraulic tubing, they shall have piping / tubing fully routed and connected to each user on the skid. Only a single point tubing / piping at battery limit of the skid shall be provided for air supply. All further connections to individual instrument to be taken care by Vendor.

Refer Instrumentation & Control Design Basis JO/APC-HC160-DB-K010215, Specification For Packaged Instruments (including PLC)- JO/APC-HC160-SP-K010218, Instrumentation for Package Equipment (015-JH-1909) for further details regarding Instrument selection / design requirements.

Local Control Panel:

Local control panel shall be provided on the package skid with hardwired switches, push buttons for local start / stop / emergency stop, lamps for indication of alarms, shutdown, local annunciation panels, etc.

Local panel shall be weather proof to IP-65 as a minimum. Local Panel shall be suitable for installation in the hazardous area as per the applicable area classification. Sunshades/weather hoods shall be provided over local panels.

All instrumentation installed inside the local panel shall be selected such that they will properly function under the ambient climatic conditions and the temperature rise inside the Panel.

LCP shall be furnished completely wired and terminated at terminal strips. Power, process control, safety and IS wiring shall be separately routed and terminated within the panel. Detailed Signal segregation shall be as per KOC Specification.

3 Nos. VFD –E rooms and 1 No Control E Room shall be provided with building FGS complete with devices and interlocks including provision for integration to the facility FGS at new PCR. FACP and FSP shall comply with the requirements specified in the SPECIFICATION FOR FIRE ALARM CONTROL PANEL- JO/APC-HC160-SP-K010216. Building HVAC and clean agent alarm / trip shall be wired to respective PLC at UCP / PECS.

Package Interfaces shall include redundant serial communication with plant PCS and MMS, hardwired interfaces with MCC, HVAC, Fire suppression, ESD, FGS, VFD, etc.

Vendor shall include hardwired interface between VFD and respective UCP via IRP Panel. IRP Panel shall be supplied by MPP Vendor and installed in Control E-Room.

8.8. NOISE LIMIT

Noise levels of all equipment (within the package) under normal operation shall not exceed 85 dB (A) at 1 meter in all directions.

The specified noise level should be attained without the use of orifices, mufflers, diffusers and/or credit for thermal or acoustic insulation where practical.

Noise attenuating enclosure is generally not preferred and shall be avoided. However, if used (subject to approval of Company) shall be designed to provide full access to the equipment for maintenance and operation.

8.9. MATERIAL OF CONSTRUCTION

Material of construction for all components within the package shall be selected by Vendor and in compliance with Company specification (Doc # (KOC-ME-006 Part-3), considering compatibility with the service, operating conditions, environmental conditions and material grade availability. Vendor shall be overall responsible for the correct metallurgy selection.

Vendor shall submit detailed material of construction list for various components of the package as part of the bid. Asbestos products shall not be used.

9. QA/QC, INSPECTION & TESTING

Vendor/ Sub-vendor shall maintain a Quality Management System based on ISO 9001 or equivalent to control the work. Contractor shall reserve the right to audit the Vendor/ Sub-Vendor's quality system.

All quality, inspection and testing requirements shall be in accordance with this specification, API 676, data sheets, project technical specifications, International codes and standards specified and also in accordance with Vendor's standard inspection and testing requirements. All manufacturing procedures and ITP's shall be submitted for the Company's review and approval prior to manufacturing.

Factory testing / inspection activities shall be witnessed by certified third party inspection authority and / or Contractor /Company representatives. The Contractor, Company and / or its representatives (Third Party Inspection Agency) shall have free access to all manufacturing facilities.

The Vendor/ Sub-Vendor shall assign sufficient full time personnel to the Project to ensure the Quality Assurance / Quality Control System, documented in a Quality Assurance / Control Manual, is maintained and kept up-to-date during vendor engineering, procurement, manufacturing and delivery. Vendor and Sub-vendor personnel for NDT, Positive Material Identification, and welding shall be qualified in accordance with a nationally recognized program and shall be reviewed by Contractor. Vendor/ Sub-Vendor shall organize a prefabrication / inspection meeting with the Contractor.

Manufacturing and test reports shall be submitted, which provide sufficient information to establish that the equipment or item has passed all the tests and inspections against specified contract criteria. The Contractor shall review these records prior to issuing the inspection and / or shipping release.

All materials and equipment in sour service shall be manufactured, tested and certified in accordance with the related Company /International standards and NACE MR0175 / ISO 15156. Material certificates per EN 10204 Type 3.2 or equivalent shall be provided for pressure containing parts and Company Specification KOC-Q-014 shall be followed for general Inspection requirements.

Non-conformances shall be identified, reported and resolved as per Vendor's approved Quality Management System and Project Quality Plan.

After completion of manufacturing, Quality Records shall be compiled as Manufacturing Record Book (MRB) in accordance with Appendix-F to KOC-Q-014.

10. VENDOR DATA

- As a minimum Vendor Data and documents shall be as specified in Datasheet (JO/APC-HC160-DS-M110046) and section 13 of this document.
- All documents/drawings of Vendor and Sub - Vendor shall be in English.
- All drawings and data shall show the name and other necessary details of the Vendor, name of project, Company and Company representative.
- Note that review or approval of Vendor's drawings, design calculations and other document does not relieve Vendor of any responsibility for correctness of such drawings, calculation or other documents.
- Vendor shall prepare Manufacturing Record Book (MRB) during the course of the manufacturing program. The MRB shall represent the product in the As–Built condition and shall be submitted to the Contractor and KOC for review and approval upon completion of all Manufacturing and testing activities.

11. PACKING, PRESERVATION AND PREPARATION FOR SHIPMENT

The Vendor shall be responsible for preparation for shipment including packing, protection, preservation, labelling and marking of all items. Load test certificates shall be shipped with all lifting equipment, spreader bars, slings, davit and shackles. One copy of installation and operation manual shall be shipped with each equipment package. All items which will require field assembly shall be assembled at shop prior to shipment.

Packing, Marking and Documentation shall be in line with Company specification (Doc# KOC-G-004).

11.1. PACKING

The equipment shall be securely packed for shipment from Vendor's location to the actual equipment destination. All items must be protected from handling damage. The unit must be capable of withstanding normal shipping and handling shocks. All preparation, protection and packing methods shall be adequate to protect the equipment from damage due to atmospheric corrosion. All equipment shall be packaged and weather protected for export shipment overseas. Prior to transportation, all instrumentation and other equipment vulnerable to damage shall be disassembled and tagged. Equipment packaging shall be adequate to withstand at least 12 months storage at construction site prior to installation. Weights and "center of gravity" diagrams should be marked for each package and clearly identified on all packages.

11.2. PRESERVATION

All equipment shall be thoroughly cleaned internally and packaged free of loose foreign materials. Vendor shall provide a detailed preservation specification for sea transportation and long duration storage (at least 12 months) covering limit flanges, location of desiccants, end shaft locking and protection, bearings, bearing housing and seals protection, valve position, nitrogen blanketing etc. Vendor shall also indicate the preservation requirements of the installed equipment during the period after installation till start up. All openings shall be covered or

capped to protect the inside from dust, rust and moisture. Flanged openings shall be provided with gaskets and metal closures securely fastened with bolts.

11.3. MARKING

The Vendor shall attach a packing list, in a waterproof enclosure, to the outside of the package. In addition to any specific requirements identified via the documentation referenced within this specification, the packing list shall clearly show as a minimum. For marking template refer company specification (Doc# KOC-G-004).

- Name
- Address
- Project Name
- Name and Address of Vendor
- Purchase order number
- Purchase order item number
- Partial or complete delivery for each order number
- Description of contents
- Number of packages. The Vendor shall also provide a list, within the packing list, showing all rust preventatives used. The rust preventatives list shall give instructions for removal of preventatives where required, and also necessary procedure to be imposed during storage.

Vendor shall provide delivery specification, which shall describe all loose items furnished. Delivery specification must clearly indicate order number and item number for each loose item shipped by the Vendor.

12. AMMENDMENT FOR KOC-ME-006 PART 3

Following are the amendments to the existing clauses of KOC Standard (KOC-ME-006 Part-3). The clause numbers mentioned here corresponds to the existing clause numbers in the standard. The clause numbers which do not appear here remain unchanged.

Terminology

Abbreviation	Explanation
(Add)	Adds the requirement following this term to the referenced Company Specification requirement. An addition does not change the specification requirement.
(Substitute)	Changes the Company Specification requirement to that which follows the term. All parts of the Standard / Specification requirement which are not addressed remain applicable.
(Decision)	Provides direction for choices which are specified by the Company specification.

4.3.1 (Add)

Refer Section 5 of this specification for additional National/ international standards applicable.

4.3.2 (Substitute)

Refer Section 6 & 7 of this specification for all applicable Company standards and project specifications.

5 (Substitute)

Refer Civil & Structural Design Basis (JO/APC-HC160-DB-C010287) for environmental conditions.

8.1.1 (Add)

Refer Section 8 of this specification for scope of supply.

8.2 (Decision)

Vendor shall design the equipment in line with API 676 (Third Edition November 2009 - Reaffirmed, March 2015).

Amendments provided in Company Spec is for API 676 1994 edition. (Its Vendors responsibility to crosscheck and comply all the requirements specified to be in line with the latest edition, In case of any deviations the same shall be subject to approval from Company / Company Representative).

Refer Section 13 of this specification for additional amendments to API 676.

9 (Add)

Refer Section 9 of this specification for Inspection and testing additional requirements.

13. AMENDMENT TO POSITIVE DISPLACEMENT ROTARY SCREW PUMPS (API STD. 676)

Following are the amendments to the existing clauses of API Standard (API 676 Third edition, November 2009 – Reaffirmed, March 2015). Updates in the Fourth Edition 2022 have been deemed as not applicable to this project. The clause numbers mentioned here corresponds to the existing clause numbers in the standard. The clause numbers which do not appear here remain unchanged.

Terminology

ABBREVIATION	EXPLANATION
(addition)	adds the requirement following this term to the referenced API Standard requirement. An addition does not change the API Standard requirement.
(modification)	changes the API Standard requirement to that which follows the term. All parts of the API Standard requirement which are not addressed remain applicable.
(decision)	provides direction for choices which are specified by the Company specification.

ABBREVIATION	EXPLANATION
(clarification)	indicates interpretation of paragraph in the API Standard.
(new)	Indicates a new paragraph that is added to API standard.

4 General

4.2 Governing Requirements and Units of Measurement

4.2.2 (decision)

The SI system of measurement shall be used exclusively in all technical documents, drawings, calculation sheets with the exception of ASME flanges and National Pipe Thread (NPT) tapered threading.

6 Basic Design

6.1 General

6.1.2 (addition)

Supplier to state with bid the pump's minimum and maximum speeds and the limiting factors in determining the minimum and maximum speeds.

6.1.3 (addition)

The Vendor may be requested to undertake material pumping trials prior to a firm order placement to ensure that the proposed pump material handling characteristics are suitable to the process liquid service as specified on the datasheet (JO/APC-HC160-DS-M110046).

6.1.4 (modification)

The noise levels for the entire pump set shall comply with the requirements of Company standard (Doc # KOC-L-030). The unit shall be equipped with suitable and proper device if the noise level exceeds the limits mentioned in datasheet (JO/APC-HC160-DS-M110046)

6.1.10 (modification)

Motors, electrical components and installations shall be suitable for the area classification (zone, gas group and temperature class) specified in the datasheet (JO/APC-HC160-DS-M110046), as well as local codes, regulations, ordinances and rules.

The Vendor shall provide a complete system of electrical equipment and accessories for MPP Skid and other associated equipment in package in compliance with Company Specification (KOC-E-001, KOC-E-010, KOC-E-003, KOC-E-020, KOC-E-004, and KOC-E-023 & KOC-E-024).

6.1.12 (addition)

The pump shall be designed such that bearings, mechanical seals, liners and rotors can be removed and installed without removing the suction or discharge piping or removing motor or having to remove the pump off the base plate or foundation.

Necessary maintenance spacing (2 x rotor length min on NDE side) for axial removal of rotors shall be provided and incorporated in the pump package design by Vendor. Piping skid under vendor scope shall be suitably placed complying these requirement.

6.1.13.1 (decision)

MPP shall be capable to start at all specified operating cases in datasheet (JO/APC-HC160-DS-M110046). Settle out pressure shall be specified by Vendor.

6.1.14 (modification)

Unless otherwise specified in the datasheet, equipment shall be suitable for outdoor, unheated location. Refer to Civil & Structural Design Basis (JO/APC-HC160-DB-C010287) for site and environmental conditions.

6.1.18 (modification)

Pump and Motor Mounting Surfaces

6.1.18.1 (modification)

The pump and motor mounting surfaces shall meet the following criteria.

6.3 Pressure Containing and Pressure Retaining Parts

6.3.2 (addition)

The maximum allowable working pressure of the entire pump, suction and discharge shall be at least equal to the discharge pressure limiting valve (PLV) set pressure plus 10% (i.e. PLV accumulation pressure).

6.3.3.1 (modification with decision)

The entire fluid end of pumps, including the suction flange, shall have a pressure rating equal to the discharge flange pressure rating.

6.3.3.2 (decision)

Pumps shall be designed and selected to ensure that suction pressure casing zones can be subjected to discharge pressure side hydrostatic test pressure.

6.4 Casing Connections

6.4.2 (addition)

All drains, vents and other small connections shall be welded to the casing and shall be either flanged or socket welded

Casing vents shall be provided with a gate valve. All valve vent and drain connections shall be suitably braced.

6.4.2.1 (modification)

If the pump cannot be completely drained for geometrical reasons, several suitably located drain connections shall be installed to ensure full drainage of the pump.

6.4.2.3 (addition)

Vendor shall install a thermo-well in the discharge portion of the multiphase pump casing, immediately after and as close as possible to the screw‘s outlet. The thermo-well should extend to the center of the flow area.

Vendor shall supply Duplex RTD for a high temperature alarm and shut-down. Additionally, Vendor shall supply a fusible element switch within the thermo-well that will shut down the pump in the event of high dis-charge temperature.

6.4.4 Suction and Discharge Nozzles

6.4.4.1 (modification)

Unless specified otherwise, inlet and outlet connections shall be flanged. The ANSI permissible hydrostatic test pressure of suction flanges shall be equal to or greater than the pump casing hydrostatic test pressure. Threaded connections require specific approval by Company / Company representative.

6.4.4.2 (modification)

All connections shall be suitable for Maximum Allowable Casing Pressure (MACP).

6.5.2 (modification)

For NPS 1 1/2" and below, piping shall be gusseted in two orthogonal planes to increase the rigidity of the piped connection.

6.5.4.2 (modification)

All connections shall be suitable for hydrostatic test pressure of the casing.

6.6 Flanges

6.6.1 (decision)

ASME flanges shall be provided.

6.6.1.5 (modification)

The Vendor shall provide the mating flange, gasket, studs and nuts for non-standard connections.

6.7.1 (addition)

For 150# and 300# minimum nozzle loads 2 x Table 2.

For 600# minimum nozzle loads 3 x Table 2.

6.7.2 Casing liner

6.7.2.1 (decision)

The pump shall be provided with a replaceable liner.

6.8 Rotating Elements

6.8.1 Rotors

6.8.1.2 (decision)

For twin screw pumps, rotor stiffness shall be adequate to prevent contact between the rotor bodies and the casing and between gear-timed rotor bodies at the most unfavourable specified conditions.

(addition)

To obtain satisfactory seal performance, the shaft stiffness shall limit the total deflection under the most severe dynamic conditions over the allowable operating range of the pump to 0.1 mm for shaft diameters < 100 mm and 0.2 mm > 100 mm at the primary seal faces.

6.8.1.3 (decision)

Calculation for Maximum allowable rotor deflection for MPP shall be submitted for review and approval by Company / Company representative.

6.8.1.9 (addition)

Holes drilled radially into the tips of the screws, as in the balancing procedure of the rotor, are not acceptable. Supplier shall balance using another method that does not groove (e.g. create open holes) or otherwise disfigure the OD of the screw tips

6.8.2.1 (modification)

Timing gears shall be herringbone type.

6.8.2.3 (modification)

The gear enclosing chamber shall not be subject to contact with the process fluid.

6.9 Mechanical Shaft Seals

6.9.2 (addition)

Mechanical seal rotating face shall be designed to rotate in either direction without damaging the seal.

Pump shall be designed with a self-locking system to stop counter rotation (shaft wise), the same shall be confirmed by Vendor

6.9.4 (decision)

Type of mechanical seal shall meet the intent of API Std. 682. All components of the mechanical seal (including the seal gland plate) shall be furnished by the seal Vendor. Vendor shall confirm suitability of the seal selected.

6.9.18 (addition)

The service mechanical seal shall be installed in the pump during all phases of testing and installed in the pump prior to shipment.

6.9.19 (addition)

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The seal Vendor and the pump Vendor shall establish the requirement of a sealing medium for double mechanical seals. The complete sealing medium system shall be supplied by the pump/seal Vendor(s). All piping for external fluid supply or fluid to drain shall terminate at the edge of the baseplate.

In dual seal applications, the maximum seal leakage to atmosphere at the specified operating conditions shall be provided. For pressurized seal pot, hand pump shall be provided to fill the seal pot during operation.

6.9.20 (addition)

Easily removable solid shield guards shall be installed around mechanical seals to contain fluid sprays due to seal failure and channel the fluids to a safe location.

6.9.21 (addition)

Each barrier fluid return line shall be equipped with a temperature transmitter and / or flow transmitter for mechanical seal protection and condition monitoring.

6.10 Bearings and Bearing Housing

6.10.1 (addition)

A pump with external bearings and timing gear shall be supplied, with a separate lubrication (as necessary) by the Vendor to comply Note 2 requirements of clause 6.10.1.

6.10.3 (addition)

The recommended oil level shall be clearly marked on the outside of the bearing housing.

6.10.3.1 (addition)

Bearing housing closures shall be either labyrinth-type slingers or double lip-type seals. Each bearing housing shall be equipped with a "bull's eye" to detect oil level inside the pump bearing housings, if a level is maintained in the housing. Each "bull's eye" shall be located to allow easy viewing from the side of the pump.

6.10.6 (new)

The bearings shall be arranged so that minimum dismantling is required to renew mechanical seals. The design of pumps that incorporate timing gears shall be such that correct meshing of the gears is ensured when they are replaced after being removed to renew a mechanical seal.

6.10.7 (new)

Each bearing in the pump shall be fitted with an RTD. The RTD shall be located at the outer race of an anti-friction bearing.

6.11.2 (modification)

The overall vibration on test and in operation shall not exceed a velocity of 5.5 mm per second RMS (0.22 inches/sec RMS) for full liquid or any GVF. Vibration readings shall include horizontal, vertical, and axial measurements taken on each bearing housing or on the casing near each bearing location.

Variable speed pumps shall operate over their specified speed range without exceeding the vibration limits of this standard.

6.12 Lubrication

6.13 Materials

6.13.2.1 (addition)

Cast-iron shall not be used for pressure containing parts that handle flammable or toxic fluids.

6.13.2.2 (addition)

The materials of selection for the wetted parts shall be reviewed and approved in writing by Company.

6.13.2.4 (decision)

Copper or copper alloys shall not be used for parts which are in contact with process fluids. Nickel-copper alloys (UNS NW 4400 or UNS NO4400), bearing Babbitt, and copper-containing precipitation-hardened stainless steels are excluded from this requirement.

6.13.2.8 (decision)

The details of erosive or corrosive agents in process liquid shall be as specified on the datasheet (JO/APC-HC160-DS-M110046). Vendor shall consider the same as material selection basis.

6.13.2.10 (decision)

Supplier shall furnish material certificates that include chemical analysis and mechanical properties for the heats from which the material is supplied for pressure containing castings, forgings, shafts, piping nipples, auxiliary piping components, and bolting.

6.13.2.12 (modification)

Material in contact H2S shall comply with the requirements of NACE MR0175.

6.13.2.13 (decision)

The requirement of reduced hardness materials shall be as specified on the datasheet (JO/APC-HC160-DS-M110046).

6.13.2.19 (new)

Asbestos shall not be used in any form which, from the results of normal working practices or service, can result in free asbestos becoming a health hazard. The use of Polychlorinated Biphenyl (PCB's) is not acceptable. All equipment and component materials shall be new and unused.

6.13.3 Castings

6.13.3.4 (a) (addition)

Repairs to weldable grades of steel castings shall be in accordance with ASTM A 488

(c) (new)

Weld procedures for all major repair welding on pressure containing parts shall be submitted to Company / Company representative for approval prior to commencement of the repair work.

The criteria for defining a "major" repair shall be as specified in ASTM A 744 paragraph 9 regardless of the metallurgy of manufacturing method of the part.

6.13.3.6 (decision) (addition)

Castings shall not be filled or charged with plastic, sodium silicate, or other similar material in order to mask porosity or casting defects. Casting repairs of any kind shall not be undertaken without prior written consent of Contractor.

6.13.5 Welding

6.13.5.1 (addition)

For each weld, the following documents shall be submitted to Company / Company representative for review:

- Welding Procedure Specification (WPS) including repair procedures as per ASME Section IX.
- Procedure Qualification Record (PQR), Weld Procedure Qualification Test (WPQT).
- Welding map with reference for identification of welds and parts to be welded.

Full details shall be included (weld design, sizes, materials, pre-heat and post-heat treatments, etc.).

All root weld seams of piping systems shall be welded with shield gas.

All piping welds shall have full penetration.

6.13.5.2 (addition)

Weld procedures for major repair welding on pressure-containing parts shall be submitted to Company / Company Representative for approval prior to commencement of repair work.

The criteria for defining a "major" repair shall be as specified in ASTM A 744, paragraph 9,

regardless of the metallurgy or manufacturing method of the part.

6.13.5.4 (decision)

Proposed connection design shall be submitted for Company / Company representative approval.

6.13.6 Low-Temperature Service

6.13.6.1 (decision)

Unless more stringent requirements are indicated in the pump datasheet (JO/APC-HC160-DS-M110046), Vendor shall apply minimum design ambient temperature as minimum design metal temperature.

6.13.6.4 (decision)

ASME BPVC Section VIII, Division 1, shall apply with regard to impact-testing requirements.

6.13.6.5 (modification) – for first sentence only

If ASME BPVC Section VIII, Division 1 is specified (see 6.13.6.4), the following shall apply:

6.14 Nameplates and Rotation Arrows

6.14.1 (addition)

Name plates shall be in line with Company specification (Doc# KOC-G-012).

Unless otherwise specified, nameplate shall be in English Language. Nameplates shall be of stainless steel 316. Rotation arrows shall be either cast in or permanently attached to all rotating equipment at a readily visible location. Rotation arrows shall be of stainless steel 316, if permanently attached. Nameplate shall be at least 3 mm thick and lettering shall have minimum height of 4 mm. The nameplate shall also consist of 4 holes for rivets.

Nameplate shall cover following details as a minimum:

- Company Name,
- Purchase order number,
- Vendor’s Name,
- Equipment Name,
- Package’s Serial number,
- Item Tag Number,
- Year of Manufacture,
- Material of Construction,
- Size, Model, Type,
- Country of Origin,
- Operating Condition (pressure, temperature, flow),
- Design Condition (pressure, temperature, flow),
- Maximum Allowable Pressure.
- Hydrostatic test pressure,
- Service Name and Capacity,

- Weight.

7 Accessories

7.1 Drivers

7.1.1 General

7.1.1.1 (decision)

The driver type shall be specified on the datasheets. Gas slug flow conditions as specified in datasheet (JO/APC-HC160-DS-M110046) shall be also considered for driver selection.

7.1.2 Motors

7.1.2.1 (addition)

Electric motors shall comply with the requirements of Company specification (KOC-E-001, KOC-E-010 and KOC-E-014) respectively, as applicable.

Rotary screw pump motors shall have nameplate power ratings. Motors shall be designed in accordance with IEC-60034. Motor class shall be selected and advised by motor vendor to suit operation of varying mechanical loads and speeds, at least equal to the power required for continuous pump operation with total flow through PLV and a 10% accumulation when handling liquid with the highest specified viscosity, whichever is maximum.

7.1.2.2 (decision)

The type, characteristics, accessories of motor and the electrical power supplies shall be as specified on the datasheet (JO/APC-HC160-DS-M110046).

7.1.2.3 (addition)

A driven equipment multi speed torque curve superimposed on the motor driver starting torque curve shall be submitted for approval by Contractor.

7.2 Couplings and Guards

7.2.2 (addition)

The couplings shall be flexible, non-lubricated, all-metal construction, fail-safe type with multiple parallel stainless steel discs at each end of spacer.

(g) (addition)

The coupling hubs and fasteners shall be properly coated to be suitable for site environment.

7.2.14 (addition)

For limited end float couplings, the resulting thrust shall be carried by the pump. The pump shall be designed to carry the thrust in addition to normal, start up and shutdown loads.

7.2.15 (c) (decision)

Couplings guards shall be of non-sparking material. Guards shall be properly ventilated to prevent excessive heat build-up.

7.2.16 (new)

The coupling service factor shall not be less than 2 over the driver rating as a minimum.

7.2.3. (modification)

The coupling shall be balanced according to ISO 21940-11 G. 2.5

7.3 Belt Drives

7.3.1 (decision)

The use of belt drive is not permissible.

7.4 Baseplates

7.4.4 (modification)

All baseplates with pump and driver mounted and having a weight exceeding 1000kg, shall have four-point lift lugs.

7.4.7 (addition)

Driver shall be fixed on the baseplate directly on mounting pads. Slotted holes for driver hold down bolts are not acceptable.

7.4.11 (modification)

A drain rim type baseplate shall be furnished, unless specified otherwise.

7.4.23 (addition)

Baseplate upper surface shall be either coated with non-slip paint or provided with grating

7.5 Pressure Limiting Valves (PLVs)

7.5.2.1 (decision)

The Vendor shall supply an external pressure limiting valve for each positive displacement rotary pump in his supply.

7.5.4 (new)

When fully open, PLVs shall be able to handle the rated capacity with pressure accumulation of not more than 10% above the set pressure.

7.6 Controls and Instrumentation

7.6.1 (addition)

Instrumentation and controls shall, as a minimum be, as indicated on the data sheets and the corresponding P&IDs. All Instrumentation and Controls shall be in accordance with relevant Company Standards listed under Section 7 as well as the Instrumentation & Control Design Basis (JO/APC-HC160-DB-K010215).

7.7 Auxiliary Piping

7.7.1 (addition)

All piping shall meet the requirements of Piping Design Basis, PMS, and Company Specifications (Doc # KOC-MP-010, JOS-02-01) and Project specification (JO/APC-HC160-DB-P010072).

7.7.4 (new)

Pipe joining and connections shall be flanged, socket-welded or seal-welded screwed piping. The connection to the mechanical seal end plates shall not be seal-welded. A socket-weld union shall be provided for seal end plate removal. Flanged connections provided with the pump shall not show misalignment when disconnected after initial assembly.

7.7.5 (new)

All auxiliary piping shall be terminated with valve and flanged at the edge of the base plate. Valves

and flanges shall be as per applicable piping class.

7.8 Pulsation and Vibration Control Requirements

7.8.2 (decision)

d) Dynamic simulation of the pumping system across the specified operating condition as per datasheet (JO/APC-HC160-DS-M110046) shall be carried out by Company approved third party entity.

7.8.3 (new)

Pulsation suppression devices shall be supplied by the Vendor.

7.8.4 (new)

The machine monitoring system for this package shall be provided as per Company Specification (015-ZH-1002) and in accordance with API 670 requirements. With the following additional requirements as a minimum:

- Three radial vibration sensors on NDE and DE bearing housing/cover, at 9, 12 and 3 o'clock positions
- One axial sensor on DE and NDE bearing housing

7.10 Electrical

(new)

All Electrical Installations in the skid shall be as per the KOC Recommended practice for Electrical Installations on Packaged equipment (KOC-E-020)

8 Inspection, Testing and Preparation for Shipment

8.1 General

8.1.1 (decision)

Vendor shall provide an inspection and testing plan. This shall cover extend of inspections and the same shall be subject to approval from Company / Company representative.

8.1.2 (decision)

Annexure C - Inspector's checklist of API Std. 676 shall be completed.

8.1.3 (addition)

When shop inspection is specified, the Vendor shall provide a plan showing the proposed programme of inspection and testing and which items are to be witnessed or observed. This plan will be available to Company / Company representative who may advise any required amendments. When required, the Vendor shall provide a copy of his quality control procedures for Company / Company representative's review.

8.1.5 (decision)

The Vendor shall provide their detailed Inspection and Test Plan (ITP) to the Company / Company representative for review and approval.

8.1.8 (decision)

Preliminary test are not preferred prior to witness tests.

8.2 Inspection

8.2.1 General

8.2.1.1 (f)(decision)

Final assembly, maintenance and running clearance data shall be made available and also be included in the installation and operating manuals.

8.2.1.3 (b)(modification)

Company / Company representative shall specify the parts and surfaces to be inspected, but, as a minimum, pressure castings shall be given magnetic particle inspection (dye penetrant shall be used with Company / Company representative approval). All pressure welds to pressure containing components shall be given 100% radiography. Ultrasonic shall not be used in lieu of radiography.

All welded piping shall be inspected as follows:

As a minimum, 5% of all circumferential butt welds, selected at random, shall be radiographed in accordance with ANSI B31.3.

All accessible external surfaces of welds, including welded external attachments, shall be inspected by magnetic particle method.

All connection welds to pressure containing components shall be 100% radiographed. If radiography is not feasible, magnetic particle inspection shall be performed instead.

8.2.2 Material Inspection

(addition)

Material certificates shall be provided by Vendor.

8.2.2.1 General

8.2.2.1.1 (addition)

Ultrasonic shall not be used in lieu of radiography.

8.2.3 Mechanical Inspection

8.2.3.2 (decision)

Cleanliness inspection of all pressurised oil systems shall be required.

8.2.3.3 (decision)

Cleanliness inspection of all the equipment, piping and appurtenances shall be carried out.

8.2.3.4 (decision)

Material hardness checks in heat-affected zones after welding shall be carried out.

8.2.3.5 (new)

Company / Company representative shall be informed of any defects noticed during manufacture. The Vendor shall inform Company / Company representative and obtain his permission before proceeding with any re-pairs which may affect equipment operation, integrity or interchangeability. Repair procedures shall be approved by Company / Company representative before rectification. The procedures shall include a sketch showing the size and location of the defect, the post weld heat treatment and non-destructive tests to be carried out. Rejection by Company / Company

representative shall be final.

8.2.3.6 (new)

The scope of Company / Company representative's inspection, as a minimum, shall include suborders, materials, welding, heat treatment, non-destructive testing of materials and welds, repairs, and, if applicable, dimensional check, hydrostatic and running tests, internal check after testing and final inspection prior to shipping.

8.2.4 Positive Material Identification

8.2.4.5 (new)

Positive material identification (PMI) shall be in accordance with Company specification (KOC-Q-015).

8.3 Testing

8.3.1 General

(addition)

The extent and type of test to be witnessed and/or observed will be indicated on pump datasheet (JO/APC-HC160-DS-M110046) Detail ITP shall be prepared by Vendor and subject to approval from Company / Company representative.

The pump tests (performance, mechanical run and string tests) shall be performed with a multiphase fluid at contract GVF and pressurized suction (rated suction pressure) to observe pump pressure ratio impact and limit.

8.3.1.2 (addition) (decision)

The vendor shall submit to the Contractor, for review and comment, detailed procedures and acceptance criteria for all required tests. The time period between submittal of the documents and the running test shall be at least twelve weeks, unless otherwise agreed

Mechanical run test and performance test reports shall be submitted to Company / Company representative for approval before shipment.

8.3.2 Hydrostatic Test

8.3.2.1 (addition)

Gaskets used during hydrostatic testing shall be identical to those supplied with the pump. Leakage from gasketed areas shall not be acceptable.

8.3.4 Performance Test

8.3.4.1 (addition)

The performance test shall include:

- Hydraulic performance test.
- Dry run test (8.3.8.2). The test shall be performed prior or subsequent to the performance test
- High Discharge pressure test (8.3.7.4). The pump will be operated at the PLV set pressure or equivalent DP at the maximum flow rate speed to confirm that the pump does not seize under these conditions.

8.3.4.2 (modification)

Each pump shall be tested at speeds within five percentage points of the (1) rated speed, (2)

minimum speed, (3 – 6) 25, 50, 75, and 100% of the maximum speed from 0 to 150 psi or the maximum attainable DP at given speed at 25 psi increments.

8.3.5 Mechanical Run Test

8.3.5.2 (modification)

Each pump shall be mechanically run at rated operating condition for four hours or until bearing and lube oil temperature stabilizes, which ever greater.

This test can be performed as part of the performance test or string test if the pump package is designated to undergo a string test.

During testing, all parts of the pump shall operate without excessive heating of bearings or glands, vibration or display of other unfavourable characteristics. If after shop test any modifications to the internals (bearings, seals, gears) of the pump are required, the test shall be repeated. A retest is also required when modification to non-internal components may affect pump performance.

8.3.5.3 (decision)

The contract shaft seals, bearings, lube oil and seal oil systems shall be used in the machine for the performance and mechanical run tests.

8.3.7.2 (modification)

Complete Unit (String) Test

- Complete Unit Test shall be completed, at minimum, with job mechanical seals, motor, ASD, coupling, seal-oil system, lube-oil system, condition monitoring system and probes
- The string test for selected pump package shall include:

  Speed test within five percentage points of the (1)rated speed, (2) minimum speed, (3 – 6) 25, 50, 75, and 100% of the maximum speed at rated suction pressure and DP or the maximum attainable DP at given speed.

  Mechanical run test under rated operating conditions for 4 hours or until bearing and lube oil temperatures stabilize, whichever greater.

  Full load test

  Full speed test

Test stand conditions, data recording and acceptance criteria shall be mutually agreed between the supplier and Contractor. The supplier shall provide a recommended test procedure as part of the proposal.

8.3.7.3 (modification)

Sound level (Noise) test.

The sound level test shall be performed in accordance with ISO 3744. This can be performed as part of the performance and mechanical run tests or string test if the unit is designated to undergo a string test.

8.3.8.3 (decision) (addition)

Controls and instrumentation shall undergo a functional acceptance test, which includes verification of functionality of instrumentation, control, PLC control logic, and alarm and shutdown set points.

After the FAT, the timing gears tooth contact shall be measured using layout blue, the minimum

contact area shall not be less than 80%

Vendor to highlight any concerns with concluding this test.

8.3.9 Test Data

(modification)

All pumps shall be supplied with certified performance data.

8.4 Preparation for Shipment

8.4.1 (modification)

The preparation for shipment and the type and mode of shipment shall be in accordance with the Purchase Order and subject to Company / Company representative approval.

8.4.2 (modification)

The paint for all exterior surfaces shall be suitable for the environment specified. The paint, preparation and painting procedure shall be approved by Company / Company representative.

Surface preparation, painting, preservation and protective coatings shall be in accordance with Company specification (Doc # KOC-P-001).

9.2.3 (addition)

Supplier shall provide the following design data including, but not limited to:

1. Sections of API 676 and this specification that do not apply and/or that cannot be met by Supplier.

2. P&ID of the pump, circulating lube oil and barrier fluid systems.

3. Cross sectional drawing of the pump and mechanical seals showing the number of screw chambers. a parts list. Material identification etc.

4. Pump minimum and maximum speeds and the limiting factors.

5. Method and calculations used to determine the shaft power and size the electric motor.

6. Multi-speed torque curves of motor and pump from minimum to maximum speeds.

7. Utility list (power consumption of the complete pump package including auxiliaries).

8. Coupling selection and calculation/method.

9. Pump test procedures and location of testing.

9.3.1 General

9.3.1.1 (addition)

Supplier shall submit the following document as part of VDDR (Annex D):

1- Updated version of documents listed under 9.2.2 and 9.2.3

2. A curve showing the slip velocities between screws and liner from minimum to maximum speeds.

3. Expected clearances between screw tips and the liner internal diameter.

4. Details of the bearing housing closures (lip seals).

5. Pressure limiting valve sizing calculations

6. Axial and radial thermal growth calculations of the driver and pump

7. Accurate shaft cold coupling alignment data

8. VFD natural frequencies and excitation harmonics to be evaluated against pump response.

9. Detailed bearing design calculations including L10 with mini-mum/maximum load ratings. The bearing shall be capable of operating reliably at minimum and maximum suction to discharge differentials without any sign of bearing skidding

10. Minimum and maximum flow rates of bearings and timing gears and recommended oil viscosity in the assembly drawings and commissioning procedures. Minimum and maximum start-up temperatures should also be stated.

9.3.1.5 (addition)

Supplier shall disclose to Contractor each proposed design, manufacturing procedure, material, component, or assembly that does not have at least 2 years satisfactory field operating experience in similar service. Field experience shall be at least as severe as the proposed conditions as determined by comparing the following:

1. Maximum operating discharge pressure temperature, speed, horse-power, materials, gas volume fraction and flow rate.

2-Hazardous and corrosive process fluid characteristics.

9.3.1.6 (addition)

Supplier shall disclose details of any of the following items to Contractor, and acceptance of such items shall be obtained from Contractor before orders are placed:

1. All items (except standard fasteners and other small items covered by internationally recognized standards) not of Supplier's own manufacture.

2. Any Sub Supplier components.

Contractor reserves the right to hold direct technical discussions with Sub-Suppliers in Supplier's presence to ensure that Sub-Supplier's equipment meets the requirements of this specification. This provision in no way relieves Supplier of its contractual responsibilities for engineering and quality control.

9.3.2 Drawing and Technical Data

9.3.5 Data Manuals

10 Guarantee and Warranty

(new)

Vendor shall guarantee that the equipment shall be safe and reliable, all parts and accessories provided are suitable to perform the duty specified on the data sheets and the requirements of this technical standard. Mechanical and performance guarantees shall be provided by the Vendor. Guarantee and warranty shall be as follows:

Mechanical

The Guarantee and Warranty shall be in accordance with the Purchase Order.

Performance

Unless exception is recorded by the Vendor in his proposal, the equipment shall be guaranteed for satisfactory performance at all operating conditions (start-up, normal operation, upset condition and shutdown) specified on the data sheet.