Karachaganak

Document owner: Engineering & Technical Authority Manager

TITLE: **Functional Specification for the Multiphase Pump at RMS-H**

DOCUMENT No: **KPO-10-MRE-SPC-00003-E**

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Classification (UNRESTRICTED)

Rev	Purpose	Date	Prepared	Checked	Approved
A3	Issued for Quotation	15/11/2024	RP	OA	OA
A2	Issued for Quotation	11/10/2024	PD	RP	OA / AG
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Revision History

Revision	Changes
R1	Issued for Review
A1	Issued for Quotation
A2	Issued for Quotation - Strainer filtration level 400 microns, pump package shall be installed under a shelter with rigid foundation, fire protection, winterization, hoist excluded from pump vendor's scope. Skid dynamic analysis requirement deleted since the pump shall be mounted on a rigid foundation. Area classification is Zone 2, Gas Group IIA, IIB, Temperature Class T3
A3	Issued for Quotation – P&ID revised. International standard for Centrifugal Pumps DELETED Shaft driven lube oil pump replaced with motor driven pump Mechanical seal plan 54. Seal material of construction specified. Material of construction for the pump shaft revised. Added note for materials that are not permitted. International standard for the gears updated to ISO with the corresponding class desired. Rotary Pump test standard HI 3.6 added. Non-skid metal decking added on top of the baseplate covering the walk and work areas. Casing temperature detection deleted.

HOLDS

Number	Description
1	Net Positive Inlet Pressure available (NPIPa)
2	Settle Out Pressure
3	Barrier Fluid – Chevron TEGRA 5 cST or 17 cST

Document Verification

RACIE Record

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1.0 INTRODUCTION

1.1 Project Background

Several initiatives to improve liquid production were studied as part of the COMPANY Wells & Gathering Network Strategy. One of the outcomes identified the use of Multiphase Pumps at the remote manifold stations (RMS). This project builds on opportunity to increase production by lowering selected RMS operating pressure; thus, reducing backpressure on individual wells. As a result, the RMS low-pressure well fluids will require additional pressure boost into the gathering network, units and plant inlet manifolds.

The use of Multiphase pumps has been proposed to deliver this boosting requirement and it is intended to deliver RMS Multiphase Pump installation which can be safely operated and integrated into COMPANY operations framework.

Multiphase pumping technology allows to draw down the flowing wellhead pressure while at the same time boosting the pressure to overcome the downstream backpressure. Low pressure wells and previously shut-in wells can be brought back to production without separation, flaring or venting.

It is essential to COMPANY ongoing business strategy to modify these low production/shut-in wells to overcome network pressure and maintain ongoing future production.

1.2 Purpose and Scope

The purpose of this Functional Specification, in conjunction with all referenced documents, is to define the minimum requirements for the design, materials, fabrication, assembly, inspection, testing, painting and supply of the Multiphase Pump for KPO as part of the Project "***Multiphase Pump at RMS-H***".

MAIN ITEM	SERVICE
1H-1300-PB-01	Multiphase Pump (MPP) at RMS-H

1.3 Definitions

The following definitions are generic to the PROJECT and MAY not be referred to in this document:

COMPANY	Karachaganak Petroleum Operating (KPO) B.V.
CONTRACTOR	The CONTRACTOR is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation/maintenance of a facility.
SUPPLIER	Organization supplying equipment, materials or services.
CONTRACT	The agreement by and between COMPANY and CONTRACTOR constituted by the contract documents

WORK	All the activities, accessories and equipment, necessary to cover the CONTRACTOR's scope of work
MAY	Is used to indicate alternatives, which are equally acceptable, at CONTRACTOR discretion.
SHOULD	Is used to indicate that the provision is preferred.
SHALL	Is used to indicate a mandatory requirement

1.4 Acronyms and Abbreviations

ALARP	As Low as Reasonably Practical
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BL	Battery Limits
BS	British Standard
CW	Cooling Water
EAC	Eurasian Customs
EN	European Norm
ESD	Emergency Shutdown System
FEED	Front-End Engineering Design
FERA	Fire, Explosion & Radiation Assessment
F&G	Fire and Gas Systems
GOST	Gosudarstvennyy Standart
HAZID	Hazard Identification
HAZOP	Hazard and Operability study
HMI	Human Machine Interface
HSE	Health, Safety and Environment
HVAC	Heating, Ventilation & Air-Conditioning
KPC	Karachaganak Processing Complex
KPO	Karachaganak Petroleum Operating B.V.
ICCS	Integrated Control and Safety System
IDS	Inspection Data Sheet
IEC	International Electrotechnical Commission
LCP	Local Control Panel
LV	Low Voltage
MMS	Machine Monitoring System
MCC	Motor Control Centre
MPP	Multiphase Pump
MV	Medium Voltage
NACE	National Association of Corrosion Engineers
NDE	Non-Destructive Examination
NFPA	National Fire Protection Association
NPIPa	Net Positive Inlet Pressure available
O&M	Operation & Maintenance
PDT	Pressure Differential Transmitter
PFP	Passive Fire Protection
PLC	Programmable Logic Controller
P&ID	Piping and Instrumentation Diagram
PMI	Positive Material Identification
PQR	Procedure Qualification Record
PSV	Pressure Safety Valve
PTU	Permit to Use

PWHT	Post Weld Heat Treatment
RoK	Republic of Kazakhstan
SDRL	Supplier Document Requirements List
SDV	Shutdown Valve
RMS	Remote Manifold Station
SIL	Safety Integrity Level
SIS	Safety Instrumented System
SLD	Single Line Diagram
SOW	Scope of Work
TDS	Technical Data Sheet / Mechanical Data Sheet
TR CU	Technical Regulation of Customs Union
UCP	Unit Control Panel
UPS	Uninterrupted Power Supply
VFD	Variable Frequency Drive

1.5 Order of Precedence

The order of precedence applicable for use of the Codes, Standards, Specifications and Regulatory requirements in the event of an inconsistency, conflict or discrepancy between any of the Standards, Specifications and Regulations for this project is as follows:

- Legislation and Regulatory Requirements of the Republic of Kazakhstan
- Republic of Kazakhstan Code and Standards (RoK)
- Project Functional Specification
- Project Data Sheets
- Project Specifications
- COMPANY Specifications and Standards
- International Codes and Standards

In the event of an inconsistency, conflict or discrepancy between any of the Standards, Specifications and Regulations, the most stringent and safest requirement applicable to the project SHALL prevail to the extent of the inconsistency, conflict or discrepancy. Any inconsistencies critical to the design SHALL be brought to the attention of the COMPANY for resolution. In all instances, the latest version of each standard SHALL be used.

1.6 Reference Documents

1.6.1 Project Documents

Ref. No.	Doc. Number	Document Title
Ref 1	TBD	Mechanical Data Sheet for Multiphase Pump (MPP) at RMS-H item 1H-1300-PB-01 Document will follow on next project phase

1.6.2 COMPANY Standards

The COMPANY Standards library is mentioned in the following document.

COMPANY Std.	Title
As referenced in this document	

1.6.3 International Standards

The main applicable International Standards are the following.

International Standard	Title
ASME BPVC VIII Div 1	Rules for Construction of Pressure Vessels Division 1
ASME B.16 series	Standards for Piping
ASME B.31 series	Pressure Piping
NACE MR0175 / ISO 15156	Materials for use in H_2S-containing environments in oil and gas production
API 520	Pressure Relief Systems
API 521	Pressure Relief and Depressurizing Systems
API 526	Flanged Safety Relief Valves
API 614	Lubrication, Shaft-Sealing, and Control-Oil Systems and Auxiliaries
VDI 3836	Measurement and Evaluation of Mechanical Vibration of Screw Type Compressors and Roots Blowers
API 670	Machinery Protection Systems
API 671	Special Purpose Couplings
API 676	Positive Displacement Pumps - Rotary
API 682	Pumps – Shaft Sealing Systems for Centrifugal and Rotary Pumps
HI 3.6	Rotary Pump Test
ISO 9000	Quality management systems
ISO 10816 Series	Mechanical Vibration – Evaluation of machine vibration by measurements on non-rotating parts.
ISO 10474	Steel and steel products — Inspection documents
EN 10204	Metallic products
IEC60529	Degrees of Protection Provided by Enclosures
ISO 3746	Acoustics – Determination of sound power levels of noise sources using sound pressure

1.7 Republic of Kazakhstan Codes & Standards

The design, construction and installation of the package shall comply with the relevant RoK Codes and Standards. Where applicable RoK standards do not exist or cannot be applied, other industry recognized international standard and recommended practice, such as those from ASME, API or ISO, may be used following appropriate approval process.

Latest revisions of the current Eurasian Customs Union Technical Regulations are mandatory and shall apply, but are not limited to the following regulations, where applicable:

TR CU 004	Low Voltage
TR CU 010	Machinery Safety
TR CU 012	Safety of Equipment for use within explosive atmospheres
TR CU 020	Electromagnetic Compatibility
TR CU 032	Pressure Equipment

Equipment or design requirements not covered by the TR CU Regulations shall continue to comply with the remaining applicable GOST regulations.

1.8 Language

English and Russian language SHALL be used for all documents and drawings.

2.0 SUPPLIER REQUIREMENTS

2.1 Supply Requirements

The description and the requirements contained in this specification are inevitably concise and cannot cover all the details relating to the supply. It is, however, understood that the supply SHALL include all the necessary accessories required for an industrial continuous operation according to the criteria of good engineering, strictly adhering to the requirements. All items listed in Section 3 SHALL be supplied by SUPPLIER, unless it is specifically reported under the section “Exclusions” (section 3.3).

2.2 Supplier Responsibility

The SUPPLIER SHALL have the sole responsibility for complete scope of supply including all auxiliaries. The goods SHALL be designed (including provision of information and guidance related to preservation, lifting, handling, transportation, installation, pre-commissioning, commissioning, start up, maintenance and repair), manufactured, assembled, inspected, tested, certified, preserved and supplied in compliance with all the attached and referenced documentation, and with the Codes, Standards and Specifications to which they refer. Compliance with this condition SHALL not relieve the SUPPLIER of the responsibility to supply goods which are safe, reliable and fit for the intended purpose.

2.3 Supplier Experience

SUPPLIER SHALL have proven experience of supplying machines and systems for use in similar applications performing satisfactorily. To qualify, the SUPPLIER must have manufactured at least three comparable units:

- similar type, size and specific class
- comparable design pressure and flowrate
- minimum ambient design temperature -45°C.

2.4 Statutory Requirements

SUPPLIER is required to be fully compliant with the local legislations.

SUPPLIER’s requirements to meet specific internationally accepted codes are listed under the appropriate sections of this specification. The SUPPLIER’s proposal SHOULD list other codes and standards to which their proposed equipment complies.

3.0 SCOPE OF SUPPLY

3.1 Basic Design Data and Specifications

No	Parameter	Description
1	Functional requirement	Pump multiphase fluid (oil, gas & water) from the well production to the gathering system or plant destination
2	Pump type	Twin screw pump with external timing gears as per API 676, SMT configuration.
3	Driver	Electric motor with VFD *(spare capacity as per API 676)*
4	Tag Number	1H-1300-PB-01
5	No. required	One (1)
6	Site	KPO RMS-H
7	Location	*The pump package shall be housed in a shelter with climate control (PURCHASER 's Scope).*
8	Winterization	*(By PURCHASER)*
9	Range of ambient temperature	+ 42.3°C to - 43.6°C
10	Climatic conditions	Refer to KPO-00-ENG-PHL-00009
11	Unusual contaminants	Dust, Trace amounts of H2S, SO2, CO, NO and HC
12	Instrument air	Not available on site (Vendor to include the instrument air package if required)
13	Cooling water	Not available.
14	Electrical power	6 kV / 3 phase / 50 Hz Tolerance on voltage and frequency +6 % / -10 / +/ - 5 % Hz
15	Ingress protection for motor	IP 56 – Electrical motor to be suitable for VFD application
16	VFD Application	Yes
17	Hazardous Area Classification (HAC)	- *Pump package in Zone 2, Gas Group IIA, IIB, Temperature Class T3* - Control cabin in non-Hazardous area
18	Duty cycle	Continuous
19	Pumped Fluid	Mixture of oil, gas and water with CO2, H2S, chlorides and solids
20	Process fluid contaminants and corrosion agents	- H2S Content % wt.: 1.58 – 2.2; average 1.9 - Chloride Content mg/l: 1500 – 3200; average 2857.76 - CO2 Content % wt: 1.08 – 1.22; average 1.12 - Wax present - Possibility of slugs.
21	Maximum solids in suspension that pump can handle	Vendor to advice (% by volume)
22	Maximum size of flowing particles that pump can handle	Vendor to advise (microns)
23	Maximum Suction Actual Volume Flow	5000 Am3/h (VTC)
24	Oil Flow rate	3828 to 5964 m3/d (see Attachment 1)
25	Gas flow rate	6.36 to 7.129 MSm3/d (see Attachment 1)

26	Density	Oil/Condensate: 709.4 to 728; Gas: 0.8773 to 0.8736;
27	Heat Capacity	Oil/Condensate: 2.103 to 2.125; Gas: 2.398 to 2.430;
28	Water cut	0 to 20 % max
29	GVF	*100 % liquid to 97% GVF*
30	NPIPa	**HOLD**
31	Suction pressure	60 barG
32	Discharge pressure	87 barG
33	Differential pressure	27 bar
34	Settle out pressure	**HOLD Note 19**
35	Pumping temperature	28 to 36°C
36	Discharge temperature	*40°C Pump design temperature 95°C*
37	Pressure rating	**1500#** Suction shall be rated the same as discharge
38	Pump performance testing tolerances	*Testing as per HI 3.6, tolerances as per API 676*.
39	Suction Strainer	Duplex basket type strainer with PDT and auto–changeover valves. *Strainer shall be 400 microns*
40	Mechanical seals	*Type ES – Cartridge Dual mechanical seals as per API sealing plan 54 complete with closed loop seal oil system.*
41	*Barrier Fluid*	*Chevron TEGRA 5 Cst or 17Cst synthetic oil* ***(HOLD)***
42	Lube Oil	Closed loop lube oil system with tank, *level transmitter* and heater *API 614 Chapter 3*
43	Vibration monitoring system	Hardware as per BN Orbit 60
44	Pulsation and Vibration Control Requirements for Multiphase Pump Skids	*Assessment of any small- bore piping. Refer note-12*
45	Shelter with climate control	*Excluded from scope of supply (By PURCHASER)*
46	Pressure Safety Valve	PSV routed to suction of the pump
47	Coupling	Special purpose coupling with non-sparking coupling guard
48	Balancing class for rotors and coupling	ISO 1940 Grade 2.5
49	Shut Down Valves	Fire safe inlet and outlet SDV's ball valve type (failed closed) Bypass quick opening SDV (from discharge to suction) – failed open
50	Liquid re-cycle	For slug flow possibility. Refer note-17
51	Pump materials	- Min metal design temperature: -45°C - Pump casing Low Temperature Carbon Steel - *Pump shaft Alloy 625 or Alloy 718* - Screws Alloy 625 Silicon carbide coating - Replaceable liner ASTM A439 Silicon carbide coating - Elastomers Elasto-O-Lion 101 (James Walker) - *Mechanical seals HASTEALLOY C276*
52	Timing Gears	*ISO 6336 Class 6 with a minimum SF of 2*
53	Piping Specifications	F11 ref. KPO-00-PIP-SPC-00003-E "Piping Material Classes"

		Note that a transition spool must be provided at the MPP suction and discharge since the MPP is only 1500# rated and F11 pipe spec is a 2500# spec.
54	Make of mechanical seal	John Crane / Eagle Burgmann / Flowserve
55	Make of Coupling	John Crane / Flender Graffenstaden
56	Instrumentation	Including and not limited to: Industry Standard Segregated Control & Safety PLCs, Operator LCP/HMI, Laptop and Licenses, control and Safety Field Instrumentation and F&G detection as required to operate the Package in a safe and efficient manner. The instrumentation will include two (2) pressure transmitters on the pump suction and discharge configured in voting logic of 1oo2. Hardwired and Industry Standard Serial Interfaces shall be provided connect into the existing plant ICSS. See section 4.9 for further information. *Clamp on type instrumentation is acceptable for the non-critical circuits.*
57	Pump Testing at works	- *Hydrostatic pressure test as per API 676* - Mechanical running test with *97%* gas for 4 hrs. (witnessed) - Dry running test with 100% gas *as per API 676* (witnessed) - Pump performance test *as per API 676* (witnessed) - Noise and vibration test (witnessed) - Functional acceptance test which includes verification of functionality of instrumentation, control, PLC control logic, alarm and shutdown set points. - Manufacturer standard motor and VFD test as per IEC standards. - The pump shall be tested at speeds within five (5) percentage points of 30, 60, 90 and 100 % of rated speed. - High discharge pressure test to test that the pump does not seize under these conditions. - Factory Acceptance Test *of the complete unit* - Site Acceptance Test *of the complete unit*
58	Welding	KPO-00-ENG-SPC-00005
59	Material inspection	KPO-00-QAC-SPC-00001
60	Flanges	ASME B16.5
61	Electric Motor	Induction motor suitable for variable speed drive.
62	VFD	Included
63	Lifting devices	Third party certified spreader bar and shackles
64	Control System	MPP operation shall be unmanned and remotely controlled from KPC.
65	Special tools	Nitrogen charging kit for the accumulator. Any special tools for maintenance of the pump package
66	Commissioning and start-up Spares	Included
67	Spare Parts for 2 years operation	Quote to be submitted separately
68	*Capital / Insurance spares*	*To be recommended by the pump vendor.*
70	Fire fighting	*Excluded.*
71	*Fluid for Flushing during commissioning*	*Diesel*

72	Certification	BS EN 10204 3.1 / CU-TR
73	Preservation during Transportation and Storage	KPO-00-LGT-SPC-00001
74	*Training*	*Included*

Notes:

1) The pump shall be capable of start-up at settle out conditions.
2) Vendor shall furnish filled in API 676 data sheets.
3) The suction and discharge of the pump shall be designed for the same rating. All connection for auxiliaries shall be suitable for the Max allowable working pressure.
4) The pump vent connection may be omitted if the pump is made self-venting by the arrangement of nozzles.
5) Replaceable liners shall be provided for the pump.
6) The rotor stiffness shall be adequate to prevent contact between the rotor bodies, the casing and gear timed rotor bodies at all the specified conditions.
7) The maximum seal leakage rates for the barrier fluid within the mechanical seal system shall be provided.
8) The pressure lubrication system for lube oil shall conform to API 614.
9) Reduced hardness materials shall be provided for pressure casing, shafting, pressure retaining seal components (excluding seal faces) and wet bolting.
10) ASME BPVC Section VIII Division 1 shall apply for impact-testing requirements.
11) The skid baseplate shall be designed to facilitate the use of optical, laser-based instrument for accurate levelling in the field.
12) Small bore piping shall be gusseted in two orthogonal planes to increase the rigidity of the piped connection.
13) Fit-up and assembly of machine mounted piping shall be completed in the vendor's shop prior to shipment.
14) Air cooler shall be manufacturer standard however the fans shall be in 2 x 100 % configuration.
15) Uptime factor for the pump shall be 0.9 with 25 days field turnaround applied once every 3 years.
16) *The equipment, its auxiliaries and the driven equipment shall be provided to meet the required level of 85 dB(A).*
17) Re-cycle line shall be provided which shall be connected back to suction.
18) Clamp type piping supports shall be used within the pump package.
19) As per the average of discharge high pressure trip (150 barG) and suction high- pressure trip (100 barG), the settle out pressure is estimated to be 125 barG. Bidder to check and

revert back if this causes un-necessary oversizing of the pump driver and integrity issues for pump mechanical seals. **HOLD**

20) *Pump vendor shall indicate the NPSHr for the selected model.*

21) *Strainer upstream of the pump may require steam-out typically 1 bara and 160°C. 2" nozzle shall be provided at the base of the vessel for utility connection.*

22) *The following materials are not permitted for components in contact with sour service. UNS S17400 (17-4 PH Stainless Steel), ASTM A564 Grade 630, UNS S15500 (15-5 PH Stainless Steel), Stainless Steels 304/321/347 grades and other non-Mo containing austenitic grades, Martensitic Stainless Steels (13% Cr, UNS S41426, F6A, CA6NM, UNS S42400, F6NM), UNS S45000 (Custom 450), Austenitic Ferritic Stainless Steel (2205, 2507, F51, 44LN, UNS S31803, UNS S32760), UNS N07750, Nickel Alloy X750, Copper based alloys.*

23) *3D model shall be developed for the package for PURCHASER review after the placement of PO as a deliverable.*

24) *Pump vendor shall review and comment on the purchaser's foundation and piping drawings during the engineering phase after placement of PO.*

25) *Transmitters for machinery protection shall be distinct and separate from instruments for machinery diagnostics and monitoring.*

26) *Non-skid metal decking covering all walk and work areas shall be provided on the top of the baseplate.*

3.2 Scope of Supply

The Multiphase Pump package scope of supply SHALL mainly consist of, but not limited to:

- 1 (one) multiphase twin screw pump with external timing gears according to API 676.
- MPP electric motor.
- Variable frequency drive system (VFD).
- Flexible coupling with non-sparking guard.
- Lube oil / Seal oil system for pump and electric motor.
  - *Two (1 working + 1 standby) auxiliary electric motor-driven oil pumps*.
  - One lube oil electric heater with thermostat.
  - Lube oil air cooler with *redundancy in number of fans*.
  - One oil twin filter with separate transfer valves.
  - One PCV in Lube Oil console, which control outlet pressure by bypassing extra flow back to the crankcase.
  - Flow transmitter
  - Level transmitter.

  - Temperature and pressure transmitters
- Vents and drains piped up to skid edge, provided with valves and flanges.
- 316L stainless-steel lube oil piping upstream and downstream oil filters.
- Suction strainer in duplex configuration with spool pieces.
- Double mechanical seal.
- *Liquid Injection Skid (Vendor to confirm).*
- *Skids* for multiphase pump, motor and lubricating system with drip pan including a flanged and valved drain, anchor bolts design and template, shim packs for vertical alignment or vertical jack screws for the installation.
- Separate baseplate for piping skid. Suction and discharge piping to the skid edge, including:
  - FSC (Fail Safe Close) Shut Down Ball Valves with spring return electro / hydraulic actuators.
  - Pressure Safety Valve
  - Check Valve in the discharge piping.
  - Monitoring and Control Instrumentations including wiring to the junction boxes on the piping skid.
- The counter-flanges on the battery limits with the existing facilities shall match 2500# class.
- Process and auxiliaries interconnecting piping between the equipment inside the skid and any auxiliary skids, including thermal expansion joints, valves, supports and brackets, etc.
- Bulk materials necessary for the complete installation at site of the equipment, including but not limited to manual valves, fittings, flanges & blind flanges, gaskets, bolts and tie rods, vents & drain assemblies, supports, fixing systems during transport.
- All the necessary instrumentation with vibration monitoring.
- Electrical components.
- Electrical cables and instrument cables inside the skid until the junction box within the machinery/equipment battery limits.
- Cable tray, conduit, and Junction Boxes with interface terminal strips inside the skid. Junction boxes SHALL be segregated in function of signal type and working voltages and located at skid battery limits.
- *Certified spreader bar with slings for lifting of the heavy components*.
- Unit Control Panel (UCP); Type P3 PLC-based, redundant type, included in a dedicated Container, complying with KPO-00-INS-SPC-00017-E – Instrument Cabinet Specification section 5.

- Complete Machine Monitoring System (MMS) and relevant probe(s) for detection and monitoring of vibration/temperature for the pump and motor bearings and for winding temperature, compliant with KPO-00-INS-SPC-00016-E – Machine Condition Monitoring System Specification.
- Stair, ladders and service platform for cabinet access (if required).
- Provision for heat tracing installation on supplied items.
- Special tools and wrenches.
- Certified Lifting lugs.
- Painting of piping / equipment / steel structure.
- Commissioning and Start Up spare parts (included).
- Two (2) years spare parts (listed)
- Capital spare parts (listed)
- Engineering services as required in the relevant paragraphs;
- Technical documentation as per dedicated section of this document.
- Inspection and test as per dedicated section of this document.
- Packing, preparation for shipment and transportation
- Anchor bolts and packing for all foundation connections.
- Template for anchor bolt-holes.
- Equipment tagging and colour coding.

3.3 Exclusions

The followings are excluded from SUPPLIER scope of supply:

- Motor Control Centre (MCC)
- Civil works
- Foundations
- Pipe-work between package edge flanges and any separately installed equipment
- External piping outside package defined boundary.
- External power cables outside package defined boundary
- Erection and Installation.
- Shelter with climate control.
- *Active fire protection.*
- *Electrically operated travelling hoist within the shelter.*

3.4 Battery Limits

For piping, the battery limit will be limited to the extension of the skid's baseplate.

The SUPPLIER SHALL include in its bid an outline drawing showing the battery limits of the supply in its scope. Minor adjustments of the battery limits during the PROJECT engineering

phase SHALL not affect the supply. Any adjustments of the battery limits SHALL be, in any case, subject to COMPANY Approval and SHALL not affect the scope of supply.

Piping connection at the battery limit of the skid SHALL be in accordance with PROJECT Piping Material Class Specification KPO-00-PIP-SPC-00003-E.

3.5 Assembly Degree

The equipment SHALL be delivered pre-assembled to the maximum extent possible, ready for installation at the interface flanges. In case of more skids, the pipes between them SHALL be supplied in prefabricated spools duly tagged.

Finish coats, where required, SHALL be applied at the workshop before shipment.

4.0 TECHNICAL REQUIREMENTS

4.1 Design Requirement

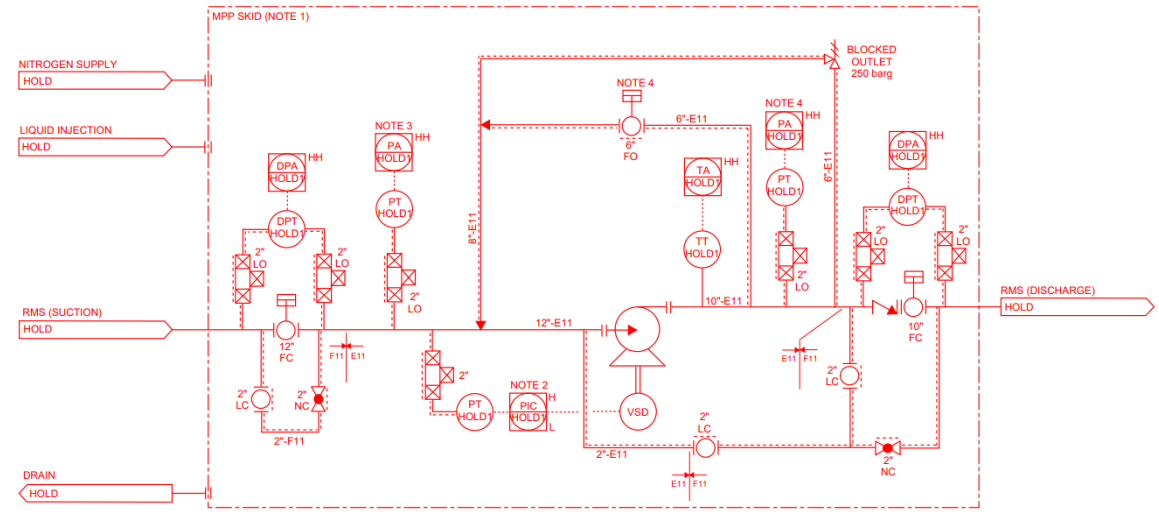
The equipment SHALL be designed for reliability, maintainability and operating life as specified in this document.

Package design SHALL be able to guarantee its continued integrity and ability to perform its required functions effectively and efficiently to achieve the business objectives, whilst safeguarding people, the environment and the COMPANY reputation for the entire lifecycle.

4.2 Process Description

Process Engineering Design Criteria (KPO-00-ENG-PHL-00010) must be adhered to for MPP design.

Below is the preliminary P&ID of MPP for **informational purposes only**.



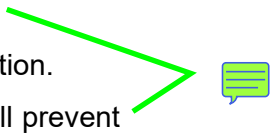
NOTES:
1. MPP SKID (BETWEEN THE SUCTION AND DISCHARGE XVs MUST BE SHELTERED TO ENSURE THERMAL EXPANSION IS NOT A CREDIBLE CASE FOR MPP OVERPRESSURE.
2. SUCTION PIC CONTROLS THE SUCTION PRESSURE BY ADJUSTING THE MPP SPEED.
3. MPP SUCTION PAHH PREVENTS THE MPP TO START SHOULD THE PRESSURE EXCEED 100 BARG (HOLD) TO ENSURE THE BACKPRESSURE ON THE MPP DISCHARGE RELIEF VALVE DOES NOT EXCEED 40% OF THE RELIEF VALVE SET PRESSURE TO ENSURE THE RELIEF VALVE CAN ADEQUATELY RELIEF IF REQUIRED.
4. MPP DISCHARGE PAHH ACTIVATES THE OPENING OF THE MPP BYPASS XV ALLOWING TO QUICKLY DISCHARGE THE MPP DISCHARGE BACK INTO THE SUCTION.

At the suction:

- A main ESDV is provided with a bypass allowing equalisation. A DPAHH will prevent the main ESDV to be open requiring the operator to open the bypass to equalise pressure and clearing DPAHH to open the main suction ESDV.
- A PAHH preventing the MPP to start if the suction pressure is too high. This effectively allows the discharge PSV to adequately protect the MPP discharge pipework by reducing the backpressure on the PSV when relief is initiated.
- A PIC controlling the MPP speed to maintain a pre-determined set point in the suction of the MPP.

At the discharge:

- A TAHH shutting the MPP down if excessive temperature is reached at the MPP discharge.
- A PAHH shutting the MPP down if excessive pressure is reached at the MPP discharge.
- A PSV to protect the MPP discharge pipework in a blocked outlet scenario.
- A check valve minimising the likelihood for reverse flow during normal operation.
- A main ESDV is provided with a bypass allowing equalisation. A DPAHH will prevent the main ESDV to be open requiring the operator to open the bypass to equalise pressure and clearing DPAHH to open the main suction ESDV.



4.3 Mechanical Description and Requirements

The equipment SHALL meet the design parameters as stated in the section 3.1 “Basic Design Data and Specifications” and COMPANY Technical Standards.

Auxiliary piping carrying external services and drains SHALL terminate at the package skid-edge. A common terminal point complete with block valve SHALL be provided for each type of service.

All equipment SHALL be designed to withstand the external forces and moments. Equipment nozzle loading and connecting piping stress requirements SHALL be in accordance with Piping Stress Analysis Procedure KPO-00-PIP-PRO-00001-ER.

All piping interface terminations shall be anchored at the skid edge. The anchors shall absorb the piping continuation loads.

Auxiliary pumps within the MPP package shall be rotary positive displacement type driven by electrical motors.

4.4 Material Requirements

The pump will operate in an H_2S environment. Materials selection shall be made based on the reference list relating to machines manufactured and operating under identical or similar services.

Materials, Welding and Non-Destructive Examination (NDE) of piping elements shall comply with requirements of Company Specifications nos. KPO-00-QAC-SPC-00001, "Supplier Welding Procedure Approval & Welding Quality Requirements", KPO-00-PIP-SPC-00008, "Specification for Piping, Forgings, Castings and Plate for Sour Service" and KPO-00-ENG-SPC-00005, "Welding, PWHT and NDE of Plant Piping and Equipment (Including Form 167)".

Materials used for Mechanical Equipment and Piping shall comply with COMPANY specification: SUPPLIER / VENDOR may propose alternative materials as an option (as part of the package) provided that the materials are of suitable for process and/or of higher "grade" and offer an equivalent or better life. Any alternative material proposed is subject to specific approval by the COMPANY.

Minimum requirements have been set in the Section 3.1 “Basic Design Data and Specifications”.

4.5 Piping and Layout

All piping materials shall be in accordance with COMPANY specification KPO-00-PIP-SPC-00003- E “Piping Material Classes". Piping layout, design and flexibility analysis shall conform to COMPANY document no: KPO-00-ENG-SPC-00031 “Piping Design and Plant Layout”. The layout of piping shall take into account access and egress, constructability, simultaneous Operation (SIMOPS). Ease of access to all equipment and controls and escape routes shall be an integral part of the design.

4.6 Pipe Stress Analysis Requirements

SUPPLIER / VENDOR shall carry out stress analysis of on-skid piping in accordance with ASME B31.3, `Process Piping' code requirements and KPO Specification number KPO-00-PIP-PRO-00001 Piping Stress Analysis Procedure.

SUPPLIER / VENDOR shall ensure the piping loads on equipment nozzles shall meet the nozzle load criteria detailed in the *relevant Company Specification and API 676*.

All piping interface terminations shall be anchored at the skid edge by SUPPLIER / VENDOR. The Anchors shall absorb the piping continuation loads.

If applicable, small-bore connections shall be designed in accordance with COMPANY specification KPO-AL-PIA-GLS-00003, "Guidelines for assessment of vibration induced fatigue of process piping".

4.7 Materials, Welding and NDE requirements

Materials, Welding and Non-Destructive Examination (NDE) of piping elements shall comply with requirements of Company Specifications nos. KPO-00-QAC-SPC-00001, "Supplier Welding Procedure Approval & Welding Quality Requirements", KPO-00-PIP-SPC-00008, "Specification for Piping, Forgings, Castings and Plate for Sour Service" and KPO-00-ENG-SPC-00005, "Welding, PWHT and NDE of Plant Piping and Equipment (Including Form 167)".

Materials used for Mechanical Equipment and Piping shall comply with COMPANY specification: SUPPLIER / VENDOR may propose alternative materials as an option (as part of the package) provided that the materials are of suitable for process and/or of higher "grade" and offer an equivalent or better life. Any alternative material proposed is subject to specific approval by the COMPANY.

4.8 Pressure Vessels

Design, fabrication and testing of vessels and columns shall be in accordance with ASME VIII Div. 1 as amended by COMPANY document KPO-00-MVE-SPC-00001-E “Pressure Vessels”.

SUPPLIER shall determine pressure vessel maximum allowable working pressure (MAWP) by calculation in accordance with ASME VIII Div. 1 Para. UG-98. The MAWP at design temperature shall be shown on the pressure vessel nameplate.

4.9 Air-Cooled Heat Exchangers

All air-cooled heat exchangers shall be designed, fabricated and tested by the SUPPLIER to manufacturer standard*, however the fans shall be in 2 x 100 % configuration.*

4.10 Structures

The Supplier SHALL provide all necessary structural steel (e.g., base frames) and all necessary platforms, handrails, and ladders to facilitate operation and maintenance, in accordance with the requirements of the following specifications:

- “Specification. Basic Civil Engineering Design Data”, doc. nr. KPO-00-CVS-SPC-00006, to be used as basic civil and structural design criteria and input data;
- Specification for Materials, Fabrication & Erection of Structural Steelwork doc. nr. KPO-00-CVS-SPC-00005-ER.

4.11 Instrumentation Requirements

Instrumentation, Control and safeguarding SHALL be in accordance with C&I Specifications and philosophies KPO-00-INS-SPC-00009-E, KPO-00-INS-PHL-00002 & KPO-00-INS-PHL-00003 and documents cross-referenced therein.

The MPP control system shall be based upon Allen Bradley SIL 2 redundant PLC with redundant Power supply and communication modules; as the number of I/O is minimum inclusive of F&G detectors, a Hybrid solution is envisaged where PCS and ESD/F&G can be combined in one PLC.

Safeguarding functions shall be implemented in accordance with IEC 61511/61508. The control and safety systems shall provide hardwired and serial interfaces (Modbus TCP/IP) via FO link to allow connection to the main plant DCS, ESD and F&G Systems.

A door mounted colour 19" HMI for monitoring and controls shall be provided in the control panel. The PLC control panel shall be installed inside a shelter HVAC controlled; adjacent shall be the panel for the VFD 6 Kv rated to control the MPP.

Interface between the PLC and VFD shall be hardwired and or Serial link TCP/IP Mod-bus. VFD data shall be available at the PLC HMI and eventually in the main control room at the plant via FO cable.

Standard control functions such local/remote, auto/manual are envisaged features, yet full philosophy shall be developed during detailed design.

Instrumentation shall be based upon well know manufactures such as Emerson, Fisher Rosemount and ABB. All instrument must be registered for use in Kazakhstan metrology system and have EAC and CU TR certificates.

hardwired and serial interfaces to allow connection to the main plant DCS, ESD and F&G Systems. An HMI and controls shall be provided in the package container to allow local operation when required. A local/remote switch shall be provided to allow for switching between local and remote operation.

For additional safeguarding, refer to the following table:

S No	Machine Parameter	Alarm	Trip
1	Discharge Pressure	High	High High (2oo2 voting logic)
2	Suction Pressure	Low	Low Low (2oo2 voting logic)
3	Discharge temperature	High	High High (2oo2 voting logic)
4	*Suction temperature*	*High*	*High High (2oo2 voting logic)*
5	Pressure Differential across the suction strainer	High	
6	Pressure Differential across the suction SDV	High	High High
7	Pressure Differential across the discharge SDV	High	High High
8	Pump and Motor High Radial Vibration	High	High High
9	Pump and Motor Bearing Temperature	High	
10	Loss of Barrier Pressure for API Plan 53/54	High	
11	Lube Oil Pressure for pump and Motor	Low	
12	Lube Oil / *barrier fluid* Tank Temperature	High	
13	Lube Oil Tank / *barrier fluid* Level	Low	
14	*Lube Oil / barrier fluid flow*	*Low*	
15	Motor Winding Temperature	High	
16	Seal Oil Tank Level	Low	
17	Seal Oil Pressure	Low	
18	Fin-Fan Cooler Vibration	High	High High
19	Fire and Gas detection	X	X

4.12 Electrical Requirements

For electrical requirements, refer to Technical Specification for electrical plants included in package supplies, Doc. No KPO-00-ELT-SPC-00018 and to Electrical Design Criteria, Doc. No. KPO-00-ELT-BOD-00001.

4.13 Technical Safety Requirements

For safety requirements, refer to Loss Prevention Basis of Design (KPO-00-ENG-PHL-00012-E Rev A2). Any TSE deliverable produced shall be in accordance with KPO Risk Management Requirements (RMR) and shall be discussed and approved by the PED TSE Lead.

The SUPPLIER SHALL participate in a HAZOP and SIL studies for the equipment within their scope. The study will be conducted in accordance with KPO procedures.

The SUPPLIER is responsible for resolving / implementing ACTIONS resulting from the workshop relating to equipment in their scope. A follow-up review SHALL be performed to verify satisfactory completion.

4.14 Painting and Coating

Piping, equipment and structures SHALL be prepared, primed and finish painted in accordance with COMPANY Painting & Coating Specification, doc no. KPO-00-ENG-SPC-00035.

4.15 Insulation

Insulation SHALL be provided in accordance with COMPANY Hot & Cold Insulation Specifications: KPO-00-PIP-SPC-00019 Specification for Cold Service Insulation and KPO-00-PIP-SPC-00020 Hot Insulation for Piping, Tanks, Vessels and Equipment

Personnel protection SHALL be provided for any surfaces that exceed 60°C. Where this is not reasonably practical it SHALL be identified to COMPANY during detailed engineering for approval.

5.0 GUARANTEED PERFORMANCES

The equipment shall meet the guaranteed operating conditions/cases specified in Mechanical Data Sheet for Multiphase Pump (MPP) at RMS-H (Document will follow on next project phase).

Performance test shall be executed at CONTRACTOR / VENDOR facility in presence of COMPANY or of its representative. Procedures for all tests shall be submitted by CONTRACTOR for review and approval by COMPANY as part of the proposal.

A Multiphase Fluid Mechanical Test (as per API 676) will ascertain the guaranteed performance. A fluid of defined GVF of 97%, simulating multiphase conditions, shall be introduced into the pumping system inlet during the test. Test stand conditions and acceptance criteria shall be agreed between CONTRACTOR/VENDOR and COMPANY at Technical Bid Evaluation (TBE) phase.

A Dry Run Test (as per API 676) will confirm the performance when the GVF will rapidly change from 30% to 100% at pumping system inlet. Test stand conditions and acceptance criteria shall be agreed between CONTRACTOR/VENDOR and COMPANY at Technical Bid Evaluation (TBE) phase.

6.0 SUPPLIER DATA REQUIREMENTS LIST (SDRL)

SUPPLIER is requested to submit the following document list with bid.

a) Filled in API 676 data sheet with torque-speed curves.
b) Motor and VFD Data Sheet
c) Noise Data Sheet
d) Suction strainer data sheet and specifications.
e) General Arrangement drawing with equipment weights including MTO list.
f) Interface and Connection Schedule
g) Utility / Effluent / Chemical Consumption List
h) Flow diagram or sample P&ID
i) Fabrication/Production Schedule
j) Typical Quality Plan
k) Spare Parts List
l) Sub-vendor list
m) List of exclusions
n) Standard deviation list to international standards
o) Experience list where three (3) similar units have been supplied and operating satisfactorily.

7.0 ATTACHMENT

A. Process Data for Pump Sizing



Process Data for Pump Sizing v2.xlsx