KUWAIT OIL COMPANY (K.S.C.)
A subsidiary of Kuwait Petroleum Corporation



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

MUTRIBA REMOTE BOOSTING FACILITY (MRBF) AT NORTH KUWAIT

ANNEXURE -1 TO APPENDIX-12

DATASHEET FOR MULTIPHASE PUMPS
(Doc. # MRBF-DS-M-001)

0	5-Aug-24	Issued for Tender	JS/BS	GMK	Mohd.Saleh
Rev.	Date	Description	Prep.By	Rev. By	App. By

MULTIPHASE PUMP

DOCUMENT TITLE :	**DATASHEET FOR MULTIPHASE PUMPS**
DOCUMENT NO :	**MRBF-DS-M-001** — **REV-0**

APPLICABLE TO: ● PROPOSAL ○ PURCHASE ○ AS BUILT

FOR: MULTIPHASE PUMP FOR MUTRIBA REMOTE BOOSTING FACIL UNIT

SITE: NORTH KUWAIT — TAG NO.: MRBF-G-1101A/B/C

SERVICE: CRUDE+WATER+GAS — NO. REQUIRED: 3 NOS. (2 OPERATION + 1 STANDBY)

MANUFACTURER: — MODEL: — DRIVER: MOTOR WITH VSD

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER ☐ BY MANUFACTURER ☒ BY MANUFACTURER OR PURCHASER

OPERATING CONDITIONS

	MIN	NORMAL	RATED
● CAPACITY: BPD		15000	
○ OTHER CAPACITY: m3/h			Note-2,3
● SUCTION PRESSURE : psig	**200-300**		
● DISCHARGE PRESSURE: psig	**1200**	max	
● DIFFERENTIAL PRESSURE bar			
○ AVAILABLE NPSHA mlc			

○ DUTY CYCLE ● CONTINUOUS ○ INTERMITTENT

PUMPED FLUID

● TYPE OR NAME OF PUMPED FLUID: CRUDE+WATER+GAS

	MIN	NORMAL	RATED
● TEMPERATURE: ºC	-3	40	80
● VAPOR PRESS.: barA	Refer Composition Attachment-1		
● RELATIVE DENSITY (SG):	Refer Composition Attachment-1		
● VISCOSITY: mPa-s	Refer Composition Attachment-1		

○ SPECIFIC HEAT — Cp KJ/Kg ºC

● CORROSIVE/EROSIVE AGENTS: **Sour gas/ Sour Water/ Calcite, Silica and Sand Particles**

● CHLORIDE CONCENTRATION ppm: **350,000**

● H_2S CONCENTRATION ppm: **40%-mole (max) (NOTE-2)**

FLUID ● HAZARDOUS ● FLAMMABLE ○ OTHER —

● EROSIVE ○ CORROSIVE

MULTIPHASE CONDITIONS

● GAS DESCRIPTION: Refer Attachment-1 for inlet composition

● SETTLE OUT PRESSURE: 14.5 barA

○ GAS VOLUME or GVF % MIN 0 MAX 100

● ENTRAINED ● SLUG FLOW ● OTHER —

○ SOLIDS PARTICLE SIZE DISTRIBUTION & MIN/MAX — (µ)

○ CONCENTRATION — ○ HARDNESS —

○ SHAPE

PERFORMANCE

☐ RATED CAPACITY m3/h —

☐ RATED SPEED rpm — —

☐ RATED VOLUMETRIC EFFICIENCY (%) —

☐ RATED PUMP EFFICIENCY (%) —

☐ REQUIRED POWER @ MAXIMUM VISCOSITY BKW —

☐ REQUIRED POWER @ PRESSURE LIMITING BKW —

☐ REQUIRED POWER @ RATED CONDITION BKW —

☐ MAXIMUM ALLOWABLE SPEED rpm

FLUID ANALYSIS

○ FLUID ANALYSIS ○ MOL % —

	Monophasic Fluid-1	Monophasic Fluid-2	REMARKS
N2			
CO2			
H2S			
C1			
C2			
C3			
iC4			
NC4			
iC5			
NC5			
Pseudo C6H14			
Pseudo C7H16			
Pseudo C8H18			**REFER**
Pseudo C9H20			**ATTACHMENT-1**
Pseudo C10H22			
Pseudo C11H24			
C12+(pseudo)			
C7+(pseudo)			
TOTAL			
AVG. MOL. WT.			
Phase Properties			
Molar Mass of C7 +.g/mol			
Molar mass of C12 +.			
Density of C7 +. API			
Density of C12 +. g/cm3			

SUPPLIER WITH UNIT RESPONSIBILITY

● PUMP MANUFACTURER ○ OTHER

APPLICABLE SPECIFICATIONS:

API 676 POSITIVE DISPLACEMENT ROTARY PUMPS / KOC-ME-006 Part 3

● GOVERNING SPECIFICATION (IF DIFFERENT) **VARIABLE SPEED DRIVE**

● MOTOR **KOC-E-001 &KOC-E-014**

○ NACE MR0103 (6.13.2.13) ● NACE MR0175

● NOISE SOUND LEVEL **85** dB @ **1 m**

LUBE AND SEAL OIL CIRCULATION SYSTEMS (API 614 chapter 3)

● LUBE SYSTEM ● SEAL OIL SYSTEMS ○ OTHER

PAINTING: (8.4.3.1)

○ MANUFACTURER'S STD. ● OTHER KOC-P-001

PREPARE FOR SHIPMENT: (8.4)

○ DOMESTIC ● EXPORT ● EXPORT BOXING REQ'D

● LONG TERM STORAGE FOR **12** MONTHS

NOTES:

1. Pump material selection shall be based on fluid composition and Operating conditions. Max 40Mol% H2S and 2mol%CO2 shall be considered. Vendor to specify the suitable metallurgy accordingly.
2. Vendor shall advice the type multiphase pump suitable for the service.
3. Multiphase pump and piping shall be designed for GOR in the range of 1000-1500 and 25% water cut. Refer Facility Design cases specified in clause 4.1.3 of project Technical Specification-Part A and the pump design shall consider the same.
4. As the field is under development, the flow rate from well will vary. Therefore the pump shall be designed for a turndown capacity of 4000 BOPD with GOR range of 1000-1500 continuously
5. Double filter (2 x 100% configuration) shall be considered for lube oil as well as seal oil filtration system.
6. Seal system shall be reviewed and recommended by Vendor for reliable operation considering Fluid Composition. Double Mechanical seal required.
7. Suction piping rating is 300 # and discharge shall be 900#.
8. Pump design shall consider various blends of well fluids with API in the range of 24-50 °API.

MULTIPHASE PUMP

DOCUMENT TITLE :	**DATASHEET FOR MULTIPHASE PUMPS**
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LOCATION:
- ○ INDOOR ○ HEATED ● UNDER ROOF
- ● OUTDOOR ○ UNHEATED ○ PARTIAL SIDES
- ○ GRADE ○ MEZZANINE ○ _____
- ● ELECTRICAL AREA CLASS ○ NON-HAZARDOUS
- CL _____ GR _____ DIV. _____ TEMP CLASS T3
- ZONE 1 CLASS _____ GROUP IIB
- ○ WINTERIZATION REQ'D. ● TROPICALIZATION REQ'D.

SITE DATA:
- ○ ELEVATION _____ BAROMETER _____
- ○ RANGE OF AMBIENT TEMPS.: (Refer KOC Standard KOC-G-007, Rev-5)

		DRY BULB	WET BULB
SITE RATED	℃		
NORMAL	℃		
MAXIMUM	℃		
MINIMUM	℃		

UNUSUAL CONDITIONS:
- ● DUST ○ FUMES ● SALT ATMOSPHERE
- ○ OTHER _____

UTILITY CONDITIONS: N/A

STEAM		DRIVERS		HEATING	
INLET	MIN.	___ barG	___ (℃)	___ barG	___ (℃)
	NORM	___ barG	___ (℃)	___ barG	___ (℃)
	MAX.	___ barG	___ (℃)	___ barG	___ (℃)
EXHAUST	MIN.	___ barG	___ (℃)	___ barG	___ (℃)
	NORM	___ barG	___ (℃)	___ barG	___ (℃)
	MAX.	___ barG	___ (℃)	___ barG	___ (℃)

ELECTRICITY:

	DRIVERS	HEATING	CONTROL	SHUT-DOWN
VOLTAGE	11 KV	250VAC		
HERTZ	50HZ	50HZ		
PHASE	3	1		

COOLING WATER: NA
- TEMP. INLET _____ (℃) MAX. RETURN _____ (℃)
- PRESS. NORM _____ (barG) DESIGN _____ (barG)
- MIN. RETURN ___ (barG) MAX. ALLOW D P _____ (barA)
- WATER SOURCE _____

INSTRUMENT AIR:
- MAX PRESS 8 (barG) MIN. _____ (barG)

☐ **TOTAL UTILITY CONSUMPTION:**
- COOLING WATER _____ L/min
- STEAM, NORMAL _____ kg/h
- STEAM, MAX _____ kg/h
- INSTRUMENT AIR _____ m3/h
- POWER (DRIVER) _____ kW
- POWER (AUXILIARIES): _____ kW

BASEPLATE (7.4)
- ● COMMON (UNDER PUMP & DRIVER) ○ OTHER _____
- ○ DECKED WITH NON-SKID DECK PLATE (7.4.12) ○ OPEN CONSTR.
- ○ DRIP PAN ○ WITH OPEN DRAIN ○ SUBPLATE
- ● HORIZONTAL ADJUSTING SCREWS FOR EQUIPMENT (7.4.4)
- ● EPOXY GROUT/EPOXY PRIMER

REMARKS 1. SKID SDV SHALL BE DESIGNED AS PER MAXIMUM PIPE RATING AND REQUIRED SIL RATING

■ **CONNECTIONS:**

	SIZE	ANSI RATING	FACING	POSITION
CASING (4.3)				
INLET				
DISCHARGE				
SKID INLET	16"	300#		
SKID OUTLET	16"	900#	RTJ	

☐ **OTHER CONNECTIONS:**

SERVICE:	NO	SIZE	TYPE / ANSI RATING
LUBE OIL OUTLET			
SEAL OIL INLET			
SEAL OIL OUTLET			
CASING DRAINS			
VENTS			
COOLING WATER			
CASE PRESSURE			
TEMPERATURE			
PURGE FOR:			

DRIVER TYPE

● INDUCTION MOTOR ○ STEAM TURBINE ○ GEAR ○ OTHER

DRIVE MECHANISM
- ○ DIRECT-COUPLED ○ ASD ○ OTHER _____
- ◯ COUPLING MANUFACTURER _____
- ◯ COUPLING TYPE **FLEXIBLE METALLIC**
- ☐ RATING (MAX TORQUE) _____ ◯ MODEL _____
- ◯ SPACER LENGTH _____ (IN) ◯ S.F. _____
- ○ COUPLING BALANCED ● MANF STD ● ISO 1940-1 G6.3 (7.2.3)
- ○ COUPLING PER API 671 (7.2.4)
- ○ COUPLING HUB ATTACHMENT ○ TAPERED
- ○ STRAIGHT ○ KEYED ○ HYDRAULIC FIT

COUPLING GUARD TYPE
- ○ STEEL ○ BRASS ○ NON-METALLIC ○ OTHER
- ◯ NON SPARK COUPLING GUARD (7.2.15c) _____

○ MOTOR DRIVER (7.1) (REFER TO MOTOR DATASHEET)
- ○ IEEE 841 ○ API 541 ○ API 546 ○ OTHER
- ○ ASD SUPPLIED BY ○ PURCHASER ○ MOTOR SUPPLIER
- ☐ MANUFACTURER _____ ☐ TYPE _____
- ☐ FRAME _____ ◯ ENCLOSURE _____
- ◯ HORIZONTAL ◯ VERTICAL
- ☐ (kW) _____ (rpm) _____
- ○ VOLTS _____ PHASE ___ HERTZ ___ SERVICE FACTOR ___
- ○ VARIABLE SPEED RANGE _____ (rpm)
- ○ MINIMUM STARTING VOLTAGE (7.1.2.2) _____
- ◯ INSULATION _____ ○ TEMP. RISE _____
- ◯ FULL LOAD AMPS _____
- ◯ LOCKED ROTOR AMPS _____
- ◯ STARTING METHOD _____
- ◯ LUBE _____

DRIVER BEARINGS (TYPE/NUMBER):
- ☐ RADIAL _____ /
- ☐ THRUST _____ /

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1	○ MIN DESIGN METAL TEMP **(-3)** ℃	**REMARKS**
2	☐ **CASING:**	
3	MATERIAL (6.13)	Note: Refer Attachment-2 for other requirements.
4	☐ MAX. ALLOWABLE CASING PRESS. (6.3.1) (barG)	
5	RELIEF VALVE SETTING (6.3.2) (barG)	
6	MARGIN FOR ACCUMULATION (barG)	
7	HYDRO PRESS. (barG)	
8	MAX. ALLOW. TEMP. ℃ MIN. OPER. TEMP. ℃	
9	COOLING / HEATING JACKET ☐ YES ☐ NO **(6.3.6)**	
10	☐ **LINER**	
11	LINER MATERIAL (6.13)	
12	HARD COATING MATERIAL	
13	☐ **BEARING HOUSING MATERIAL**	
14	☐ BEARING HOUSING COOLING	
15	☐ **ROTORS: (6.8.1)**	
16	DIAMETER mm	
17	EROSION HARD COATING	
18	TYPE FABRICATION	
19	MATERIAL (6.13)	
20	BRINELL HARDNESS. MAX. MIN.	
21	ROTOR LENGTH TO DIAMETER RATIO (L/D)	
22	ROTOR CLEARANCE (mm)	
23	MAX. DEFLECTION (mm)	
24	NON-CONTACT DESIGN	
25	**SHAFT:**	
26	MATERIAL (6.13)	
27	DIA @ ROTORS (mm) DIA @ COUPLING (mm)	
28	☐ SHAFT END. ☐ TAPERED ☐ CYLINDRICAL (7.2.9)	
29	☐ **TIMING GEARS: (6.8.2)**	
	◯ **AGMA 11 QUALITY** ● **OTHER QUALITY**	
30	PITCH LINE DIAMETER (mm) TYPE	
31	MATERIAL	
32	**BEARINGS (TYPE/NUMBER):**	
33	☐ RADIAL /	
34	☐ THRUST /	
35	◯ **SHAFT SEALS: (6.9)** ● **Per API 682 (data sheet)**	
36	○ **Seal Code** ● **Flush Plan**	
37	☐ INNER SEAL LEAK GUARANTEE	
38	○ SEAL OIL SYSTEMS (plan 54) ● Per API 614 (Chapter 3)	
39	**BEARING TEMPERATURE DETECTORS:**	
40	○ AF BEARING OUTER RACE ○ OTHER	
41	○ TC TYPE ○ RTD TYPE	
42	**VIBRATION DETECTORS:**	
43	● IN ACCORDANCE WITH: API 670	
44	● OTHER (SPECIFY) VENDOR TO ADVISE (VTA)	
45	● TYPE VTA ■ MODEL **VTA**	
46	● MFR.	
47	● NO. AT EACH BEARING VTA TOTAL NO. VTA	
48	● MONITOR SUPPLIED BY	
49	● LOCATION VTA ENCLOSURE VTA	
50	● MFR. ☐ MODEL VTA	
51	■ SCALE RANGE ● ALARM. ■ SET @ VTA MILS	
52	● SHUTDN: ■ SET @ VTA MILS ● TIME DLY. VTA SEC	
53	● PHASE REFERENCE TRANSDUCER	

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VENDOR MUST FURNISH ALL PERTINENT DATA FOR THIS SPECIFICATION SHEET BEFORE RETURNING.

ITEM NO. _____ SERVICE _____ JOB NO. _____

MANUFACTURER _____

LOCAL CONTROL PANEL: TO BE LOCATED IN THE PUMP SKID (ONE PER PUMP)

FURNISHED BY: ● SUPPLIER ○ PURCHASER ○ OTHERS _____

● FREE STANDING ● WEATHERPROOF ○ TOTALLY ENCLOSED ○ EXTRA CUTOUTS

○ VIBRATION ISOLATORS ○ STRIP HEATERS ○ PURGE CONNECTIONS

○ ANNUNCIATOR: FURNISHED BY: ● VENDOR ○ PURCHASER ○ OTHERS _____

● ANNUNCIATOR LOCATED ON ● LOCAL PANEL ● MAIN CONTROL BOARD

○ CUSTOMER CONNECTIONS BROUGHT OUT TO TERMINAL BOXES BY VENDOR FOR INTERFACE WITH CONDITION MONITORING SYSTEM

INSTRUMENT SUPPLIERS:

	MFR.	SIZE & TYPE:
● PRESSURE GAUGES:		
● TEMPERATURE GAUGES:		
● LEVEL GAUGES:		
● DIFF. PRESSURE GAUGES:		
● PRESSURE TRANSMITTERS:		
● DIFF. PRESSURE TRANSMITTERS:		
● TEMPERATURE TRANSMITTERS:		
● LEVEL TRANSMITTER:		
● CONTROL VALVES:		
○ PRESSURE LIMITING VALVES: (7.5)		
○ SIGHT FLOW INDICATORS:		
○ FLOW INDICATOR:		
● VIBRATION EQUIPMENT:		
● SOLENOID VALVES		
● ANNUNCIATOR:		MODEL & NO. POINTS
● OTHER VTA		

PRESSURE GAUGE REQUIREMENTS **NOTE:** □ **SUPPLIED BY VENDOR** ○ **SUPPLIED BY PURCHASER**

FUNCTION	LOCALLY MOUNTED	LOCAL PANEL	
PUMP SUCTION	■ ○	□ ○	VTA
PUMP DISCHARGE	■ ○	□ ○	
LUBE OIL PUMP DISCHARGE	■ ○	□ ○	
LUBE OIL FILTER D P	■ ○	□ ○	
LUBE OIL SUPPLY	■ ○	□ ○	

FUNCTION	LOCALLY MOUNTED	LOCAL PANEL	
SEAL OIL PUMP DISCHARGE	■ ○	□ ○	VTA
SEAL OIL FILTER D P	■ ○	□ ○	
SEAL OIL SUPPLY	■ ○	□ ○	
SEAL OIL DIFFERENTIAL	■ ○	□ ○	
OTHER VTA	■ ○	□ ○	

TEMPERATURE GAUGE REQUIREMENTS:

FUNCTION	LOCALLY MOUNTED	LOCAL PANEL	
LUBE DRAIN @ EA. BRG.	■ ○	□ ○	VTA
PUMP RADIAL BEARING	■ ○	□ ○	
PUMP THRUST BEARING	■ ○	□ ○	
SEAL OIL OUTLET	■ ○	□ ○	
OTHER VTA	■ ○	□ ○	

FUNCTION	LOCALLY MOUNTED	LOCAL PANEL	
COOLER OIL INLET & OUTLET	■ ○	□ ○	VTA
LUBE OIL RESERVOIR	■ ○	□ ○	
SEAL OIL RESERVOIR	■ ○	□ ○	
PUMP SUCTION	■ ○	□ ○	
PUMP DISCHARGE	■ ○	□ ○	

SWITCH CLOSURES:

ALARM CONTACTS SHALL: ● OPEN ○ CLOSE TO SOUND ALARM AND BE NORMALLY ● ENERGIZED ○ DE-ENERGIZED

SHUTDOWN CONTACTS SHALL: ● OPEN ○ CLOSE TO TRIP AND BE NORMALLY ● ENERGIZED ○ DE-ENERGIZED

NOTE: NORMAL CONDITION IS WHEN MPP IS IN OPERATION.

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ITEM NO. _____ SERVICE _____ JOB NO. _____

MANUFACTURER _____

ALARM & SHUTDOWN:

FUNCTION	ALARM	TRIP
LOW LUBE OIL PRESSURE	Required	Required
HI LUBE OIL FILTER D P	Required	VTA
HI SEAL OIL FILTER D P	Required	VTA
LOW LUBE OIL RESERVOIR LEV.	Required	VTA
LOW SEAL OIL RESERVOIR LEV.	Required	VTA
HI SEAL OIL LEVEL	Required	VTA
LOW SEAL OIL LEVEL	Required	VTA
HI SEAL OIL PRESSURE	Required	
LOW SEAL OIL PRESSURE	Required	VTA
AUX. SEAL OIL PUMP START	VTA	VTA
AUX. LUBE OIL PUMP START	VTA	VTA

FUNCTION	PRE-ALARM	TRIP
PUMP VIBRATION	Required	Required
HI SEAL OIL OUTLET TEMP. (COOLER)	Required	Required
PUMP HI DISCH. TEMP.	Required	Required
HI LUBE OIL OUTLET TEMP. (COOLER)	Required	Required
DRIVER VIBRATION	Required	Required
DRIVER SHUTDOWN	Required	
HI PUMP BRG. TEMP.	Required	Required
HI DRIVER BRG. TEMP.	Required	Required
PUMP D P	Required	VTA
OTHER	VTA	VTA
OTHER		

MISCELLANEOUS INSTRUMENTATION:

- DRIVER START/STOP — LOCAL PANEL — SEPARATE PANEL — MAIN BOARD
- SIGHT FLOW INDICATORS, EACH BEARING HOUSING
- SIGHT FLOW INDICATORS, EACH SEAL OIL RETURN LINE
- VIBRATION DETECTORS
- VIBRATION AND BEARING TEMPERATURE MONITORS
- VIBRATION READOUT LOCATED ON: ☐ LOCAL PANEL — SEPARATE PANEL — MAIN BOARD
- LEVEL GAUGES, LUBE AND/OR SEAL OIL RESERVOIR
- OTHER _____

MISCELLANEOUS:

- INSTRUMENT TAGGING REQUIRED.
- ALARM AND SHUTDOWN TRANSMITTERS SHALL BE SEPARATE.

PURCHASERS ELECTRICAL AND INSTRUMENT CONNECTIONS WITHIN THE CONFINES OF THE BASEPLATE AND CONSOLE SHALL BE:

BROUGHT OUT TO TERMINAL BOXES. ☐ MADE DIRECTLY BY THE PURCHASER.

COMMENTS REGARDING INSTRUMENTATION: _____

PUMP SHOP INSPECTION AND TESTS:

	REQ'D	WITNESS	OBSERVE
SHOP INSPECTION (8.1)	●	○	○
HYDROSTATIC (8.3.2)	●	●	○
MECHANICAL RUN (8.3.5.1)	●	●	○
MECHANICAL RUN SPARE ROTORS	○	○	○
CASING LEAK TEST	●	○	○
PERFORMANCE TEST (GAS) (LIQUID)	●	●	○
COMPLETE UNIT TEST (8.3.7.2)	●	●	○
USE SHOP LUBE & SEAL SYSTEM	○	○	○
USE CONTRACT LUBE & SEAL SYSTEM	●	●	○
USE CONTRACT VIBRATION PROBES, ETC.	●	●	○
USE JOB BEARING VIBRATION AND TEMPERATURE TRANSDUCERS & MONITORS	○	○	○
PRESSURE PUMP TO FULL OPER. PRESS.	○	○	○
DISASSEMBLE-REASSEMBLE PUMP AFTER TEST	○	○	○
INSPECT BEARINGS AFTER TEST	●	●	○
SOUND-LEVEL TEST (8.3.7.3)	●	●	○
AUX. EQUIPMENT (8.3.4.3)	○	○	○
FULL-LOAD STRING TEST	○	○	○
GAS SLUG TEST	●	●	○
_____	○	○	○
_____	○	○	○

MISCELLANEOUS:

- ☐ RECOMMEND STRAIGHT RUN OF PIPE DIA. BEFORE SUCTION
- ● VENDOR'S REVIEW & COMMENTS ON PURCHASER'S PIPING & FOUNDATION (7.8.2.d NOTE 4)
- ● VENDOR REPRESENTATIVE OBSERVATION AT THE SITE
- ○ SPARE PARTS TO BE SUPPLIED
  - ○ ROTOR ASSEMBLY ● BEARINGS ● SEALS
  - ○ 2 YEARS SUPPLY ○ GASKETS, O-RINGS
  - ● START-UP/COMMISSIONING ○ OTHER

☐ **WEIGHTS:** Kg

PUMP _____ DRIVER _____ BASEPLATE _____

ROTORS: PUMP _____ DRIVER _____

LUBE OIL CONSOLE _____

SEAL OIL CONSOLE _____

MAX. FOR MAINTENANCE (IDENTIFY) _____

TOTAL SHIPPING WEIGHT _____

☐ **SPACE REQUIREMENTS:** mm

	L	W	H
COMPLETE UNIT			
LUBE OIL CONSOLE			
SEAL OIL CONSOLE			

Attachment-1

WELL COMPOSITION (DRY BASIS):

	Well-1	Well-2	Well-3	Well-4
H2S	0.110308865	0.351636613	0.181784602	0
CO2	1.63E-02	1.54E-02	1.24E-02	6.19E-03
Nitrogen	5.01E-04	1.12E-03	6.65E-04	7.99E-04
Methane	0.309366225	0.195872357	0.208151625	0.406811826
Ethane	0.116225431	6.79E-02	7.00E-02	0.142828606
Propane	7.38E-02	5.09E-02	5.03E-02	8.46E-02
i-Butane	1.11E-02	7.51E-03	0.009031967	1.24E-02
n-Butane	3.73E-02	2.71E-02	3.16E-02	4.04E-02
i-Pentane	0.015443241	1.06E-02	1.43E-02	1.81E-02
n-Pentane	0.023164862	1.71E-02	2.23E-02	2.62E-02
n-Hexane	3.85E-02	2.51E-02	3.52E-02	4.69E-02
n-Heptane	2.66E-02	2.57E-02	3.58E-02	3.00E-02
n-Octane	2.41E-02	2.89E-02	3.68E-02	2.45E-02
n-Nonane	2.45E-02	2.45E-02	3.34E-02	2.15E-02
n-Decane	2.20E-02	2.28E-02	2.75E-02	1.82E-02
n-C11	2.03E-02	1.85E-02	0.023830609	1.68E-02
n-C12	1.60E-02	1.50E-02	2.03E-02	1.34E-02
n-C13	1.27E-02	1.29E-02	1.79E-02	1.05E-02
n-C14	1.03E-02	1.06E-02	1.57E-02	8.49E-03
n-C15	9.23E-03	9.49E-03	1.46E-02	7.49E-03
n-C16	7.62E-03	7.85E-03	1.28E-02	6.39E-03
n-C17	6.12E-03	6.64E-03	1.12E-02	5.19E-03
n-C18	5.31E-03	5.78E-03	1.03E-02	4.39E-03
n-C19	5.11E-03	5.69E-03	1.03E-02	4.19E-03
n-C20	4.61E-03	5.00E-03	9.42E-03	3.60E-03
n-C21	3.71E-03	4.23E-03	8.13E-03	3.00E-03
n-C22	3.31E-03	3.80E-03	7.25E-03	2.90E-03
n-C23	2.81E-03	3.02E-03	6.24E-03	2.40E-03
n-C24	2.41E-03	2.67E-03	5.35E-03	2.00E-03
n-C25	2.11E-03	2.33E-03	5.03E-03	1.80E-03
n-C26	1.91E-03	1.98E-03	4.31E-03	1.50E-03
n-C27	1.60E-03	1.98E-03	4.15E-03	1.40E-03
n-C28	1.50E-03	1.55E-03	3.70E-03	1.30E-03
n-C29	1.40E-03	1.47E-03	3.22E-03	1.20E-03
n-C30	1.98E-02	7.25E-03	3.72E-02	1.29E-02
Benzene	4.01E-04	0	0	4.00E-04
Toluene	3.21E-03	0	0	2.60E-03
m-Xylene	6.92E-03	0	0	4.79E-03
o-Xylene	2.41E-03	0	0	2.20E-03

Well-2 **Attachment-1**

Sulfur Species Analysis (in ppm mole) for Recombined Sample in 15670IB (RSS-01)

Table 29: Sulfur Species Analysis (in ppm mole) for recombined sample in 15670IB (RSS-01)

Components - Sulfur Species	Mole Weight (g/mole)	Flashed Liquid from RSS (ppm mole)	Flashed gas from RSS (ppm mole)	Mono-phasic RSS (ppm mole)
		as Component	as Component	as Component
Hydrogen Sulfide	34.06	23308.4	352000.0	253554.5
Carbonyl Sulfide	60.08	343.0	47.6	136.1
Methyl mercaptan	48.11	343.8	360.2	355.3
Ethyl mercaptan	62.13	282.4	74.8	137.0
Di methyl sulfide	62.13	0.0	0.9	0.6
Carbon Disulfide	76.17	48.1	21.8	29.7
i-Propyl mercaptan	76.17	190.9	22.1	72.6
Tert.butyl mercaptan	90.19	33.1	1.2	10.8
Ethyl methyl Sulfide	76.16	0.0	0.0	0.0
n-propyl mercaptan	76.17	105.4	4.4	34.6
Thiophene	84.14	0.0	0.0	0.0
Sec-butyl mercaptan	90.19	299.2	4.3	92.7
i-butyl mercaptan	90.19	20.5	0.3	6.3
Diethyl sulfide	89.09	9.1	0.0	2.7
n-butyl mercaptan	90.19	61.3	0.4	18.6
2-methyl-2-Butanethiol	104.22	33.8	0.0	10.1
Thiophene-2-ethyl	112.21	0.0	0.0	0.0
Di methyl disulfide	92.21	0.0	0.0	0.0
Thiophene-2-methyl	98.17	56.9	0.0	17.0
i-pentyl mercaptan	104.22	10.1	0.0	3.0
1-butanethiol_2-methyl (Amyl)	104.22	19.1	0.0	5.7
n-pentyl mercaptan	104.22	38.0	0.0	11.4
Thiophene-2,5-Dimethyl	112.21	0.0	0.0	0.0
Di propyl Sulfide	118.24	13.1	0.0	3.9
Ditert.Butyl Sulfide	146.10	0.0	0.0	0.0
n-Hexyl mercaptan	118.24	48.1	0.0	14.4
Di-Sec.butyl Sulfide	146.12	0.0	0.0	0.0
n-Heptyl mercaptan	132.27	9.8	0.0	2.9
Di Butyl Sulfide	120.25	0.0	0.0	0.0
n-Octyl mercaptan	146.30	24.0	0.0	7.2
n-Nonyl mercaptan	160.33	0.0	0.0	0.0
Unidentified Sulfur Components	-	27811.7	19.6	8343.5
Total sulfur (ppm Mole)		53109.8	352557.5	262870.8
STL Density @ 60°F		0.812		
Molecular weight		172.0	32.8	74.5
Gas gravity (Air=1)			1.133	
Molar ratio		0.2995	0.7005	1.0000
GLR (Scf/stb)				1469

Note: The minimum representative detectability limit for GC-SCD is 1ppm (mole)

Attachment-1

Well-3					
Component		Boiling	Molar	Sulfur compound	
Name [*Synonym*]		Point (°C)	ppm	sulfur, $mg.kg^{-1}$	
Sulfides					
hydrogen sulfide		-60	306000	337890	
carbonyl sulfide [*sulfanylidenemethanone*]		-50	<0.10	<0.11	
dimethyl sulfide [*methylsulfanylmethane*]		38	0.98	1.08	
carbon disulfide [*methanedithione*]		46	<0.05	<0.11	
ethyl methyl sulfide [*methylsulfanylethane*]		67	<0.10	<0.11	
diethyl sulfide *[ethylsulfanylethane]*		92	<0.10	<0.11	
tert butyl methyl sulfide [*2-methyl-2-methylsulfanyl-propane*]		100	0.5	0.55	
dimethyl disulfide [*methyldisulfanylmethane*]		110	<0.05	<0.11	
dipropyl sulfide [*1-propylsulfanylpropane*]		142	<0.10	<0.11	
diethyl disulfide [*ethyldisulfanylethane*]		154	<0.05	<0.11	
di-sec butyl sulfide [*2-butan-2-ylsulfanylbutane*]		165	<0.10	<0.11	
dibutyl sulfide [*1-butylsulfanylbutane*]		189	<0.10	<0.11	
			306000	337890	
Thiols (Mercaptans)					
methanethiol		6	51.9	57.3	
ethanethiol		36	36.5	40.3	
propane-2-thiol		55	15.8	17.5	
2-methylpropane-2-thiol		64	9.46	10.4	
propane-1-thiol		68	4.37	4.82	
butane-2-thiol [*1-methyl-1-propanethiol*]		85	<0.10	<0.11	
2-methylpropane-1-thiol		88	1.71	1.88	
butane-1-thiol		98	0.76	0.84	
3-methylbutane-1-thiol		118	<0.10	<0.11	
2-methylbutane-1-thiol		119	<0.10	<0.11	
pentane-1-thiol / tetrahydrothiophene*		126	0.14	0.15	
hexane-1-thiol		153	<0.10	<0.11	
heptane-1-thiol		177	<0.10	<0.11	
octane-1-thiol		199	<0.10	<0.11	
nonane-1-thiol		220	<0.10	<0.11	
			121	133	
Thiophenes					
thiophene		84	5.13	5.66	
2-methylthiophene		113	<0.10	<0.11	
3-methylthiophene		115	<0.10	<0.11	
tetrahydrothiophene / pentane-1-thiol* [*thiolane*]		120	0.14	0.15	
2-ethylthiophene		134	0.27	0.3	
2,5-dimethylthiophene		137	<0.10	<0.11	
2-propylthiophene		158	<0.10	<0.11	
2-butylthiophene		182	<0.10	<0.11	
3-butylthiophene		182	<0.10	<0.11	
1-benzothiophene		221	<0.10	<0.11	
			5.54	6.11	
Other unidentified sulfur compounds by approximate boiling range					
bounded by n-thiol compounds					
propane-1-thiol to butane-1-thiol		68 to 98	0.44	0.49	
butane-1-thiol to pentane-1-thiol		98 to 126	1.59	1.76	
pentane-1-thiol to hexane-1-thiol		126 to 153	1.04	1.14	
hexane-1-thiol to heptane-1-thiol		153 to 177	<0.10	<0.11	
heptane-1-thiol to octane-1-thiol		177 to 199	<0.10	<0.11	
octane-1-thiol to nonane-1-thiol		199 to 220	<0.10	<0.11	
			3.07	3.39	

Attachment-1

FORMATION WATER ANALYSIS:

Sl No.	**Parameters**	**Unit**	**Sample-1**
1	Salinity Or TDS	mg/l	339607
2	Sp. Gravity		1.22
3	p H		5.68 @ 25deg C
4	Resistivity @ 25deg C	Ohm-m	0.0418
5	Conductivity	Ms/cm	253.4
6	Sodium	mg/l	86497
7	Calcium	mg/l	34293
8	Magnesium	mg/l	1921
9	Iron	mg/l	25
10	Barium	mg/l	25
11	Potassium	mg/l	5411
12	Strontium	mg/l	2058
13	Chloride	mg/l	350000
14	Sulphate	mg/l	303
15	Bicarbonate	mg/l	123

Attachment-2

DOCUMENT TITLE : DATASHEET FOR MULTIPHASE PUMPS

	OTHER TECHNICAL REQUIREMENTS
1	The type of multiphase pump suitable for the service shall be advised by Pump vendor. The pump shall be with variable frequency drive motor.
2	Pumps shall be suitable for outdoor installation.
3	Mechanical seals and seal flush systems plan shall be in accordance with API 682. Combination of seal plan 53 & 54 shall be used.
4	Double mechanical seal (pressurized), shall be used considering high H2S concentration.
5	Seal system shall be at higher pressure to ensure that, there will not be any leakage of process fluid to atmosphere.
6	Seal system shall be suitable for reliable operation in Hazardous area.
7	Effective lubrication plan for bearings, seal system shall be considered. Vendor shall advice and provide the details of lube oil & seal oil system accordingly.
8	Bypass valve shall be provided to enable to operate pumps with minimum speed during start up.
9	Filters selection shall ensure that, there is no downtime for filters replacement.
10	Pressure relief valves shall be provided on seal system to safeguard the seal system from high pressure during operation.
11	Vendor to advise the condition monitoring (vibration and temperature) system requirement and provide accordingly together with detectors, transmitters, control unit, and all components and accessories.
12	The trip signal shall be hard wired to LCP/ESD as applicable and serail communication to DCS/LCP to be provided for monitoring.
13	Vendor to provide the local control panel (LCP) for safe operating and monitoring of pump.
14	The LCP shall be provided with SIL-2 rated PLC based control system, HMI, push button, switches lamp and all accessories as required.
15	Vendor to provide all documentation related to instrument and LCP
16	Vendor to provide the utility requirement for the instrument system function
17	Motor and other electrical equipment/devices shall be suitable for Zone 1 with minimum hazardous area classification EEx “d” IIB T3.
18	All equipment shall be suitable for site & environmental condition as per KOC Standard KOC-G-007.
19	Pump and motor assembly along with all associated utility system shall be supplied as a skid unit.
20	Mechanical run test, pump along with motor performance test shall be carried out at skid vendor facility.
21	Pump skid piping, valve material requirements shall be as per project drawings and specifications (Refer KOC standard KOC-MP-010 & project addendum).
22	All components of unit shall be guaranteed, by the Packager, against defective materials, design, workmanship and performance.