Project Title	Project Ref.	Page	File Reference.
MPP Project	**J20679** **F-005-028-15**	**1**	

Functional Specification
Multiphase Pumps at Metering Stations

J20679-MPP-PH2-A-30108

Rev No	Date	Description	Issued By	Checked By	Approved By	Client Approval
G	15. Okt 15	Issued for Review and Comment	SC	IH/ RR	MP	
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REV

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Important: information requested.
Please provide:

1. Budget quote for the MPP specified.
2. Estimated lead time for 1, 4 and 12 MPPs.
3. GVF technical limits for the head needed (40 bar).
4. Any other technical issues/ limits, e.g. solids limits.
5. Transportation issues, etc.
6. Utility requirements.
7. Information requested in Section 7.

1 INTRODUCTION

This document covers the supply of Multiphase Pumps (MPP) for Tengiz, onshore Kazakhstan. The pumps are required to provide pressure boost to well fluids to improve production. The pumps are located at existing metering stations.

Modular design is preferred for construction simplicity. Transportation restrictions are based on standard limits specified below. **Based on capacity, vendor to recommend most economic/ appropriate design and fabrication technique for remote installation.** If due to any limitation, multiple trains are required or recommended, vendor to advise justification.

Vendor to identify large items of equipment that will not fit into shipping containers. Vendor to advise typical lead times.

The pumps are exposed to atmospheric conditions and shall be designed to withstand the extremes of ambient conditions specified on the MPP datasheets.

Vendor to consider options with Electric motor only.

2 SCOPE OF SUPPLY

The following items are to be supplied in addition to Pump and Driver:

a) Internal interconnects between modules and equipment.

b) Tie-in points to existing facilities (piping from tie-in points to existing facilities is out of scope).

c) Instrumentation and control valves with suitable connections for existing DCS systems. (tie-in out of scope).

d) All electrical systems with connections suitable for existing facilities (tie-in out of scope).

e) All relief valves to be supplied. Note: internal relief valves are not acceptable to TCO.

f) Internal structures including ladders and platforms.

g) Internal (self generated) instrument system.

G h) Winterisation of pump skids is required:

G Vendor to provide MPP System Base Plate. As an option vendor to supply skid enclosure.

i) Scope of supply is for [HOLD] number of MPPs

j) Four specifications cases are provided for 2 differential pressures, with 2 inlet temperatures: These are based on a design flow rate of 300,000 actual bpd.
(Note: Vendor to advise pump min flow).

- Base Case with a high inlet temperature (Sheet 7).
- Base Case with a low inlet temperature (Sheet 8).
- High DP (lower inlet pressure) alternative with high inlet temperature (Sheet 9).
- High DP (lower inlet pressure) alternative with low inlet temperature (Sheet 10).

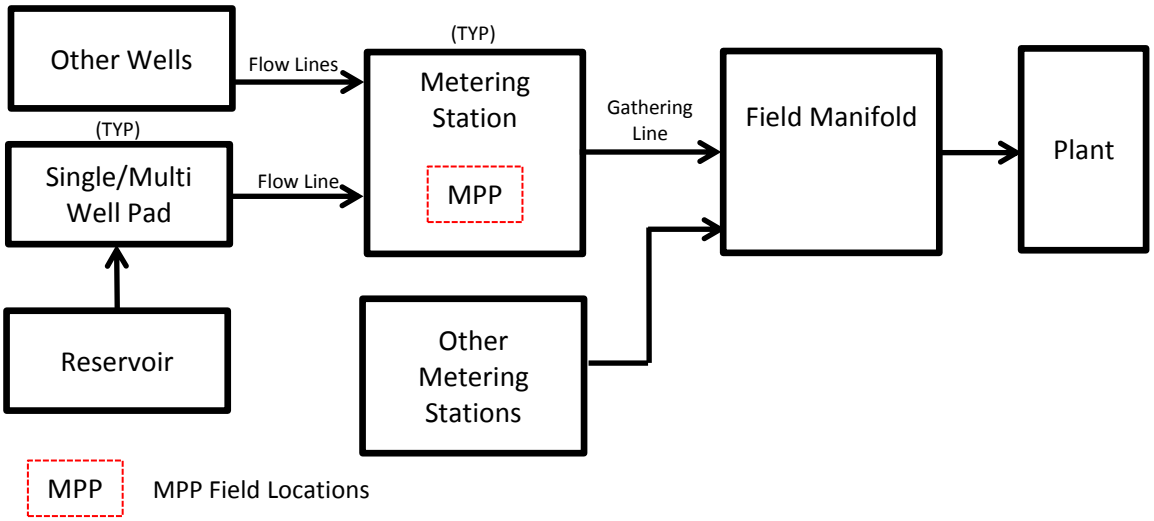
k) Additional operating points are summarised in Section 5. These represent varying inlet pressures and Section 5.2 represents the potential impact of increasing GOR from the reservoir.

3 PROCESS DESCRIPTION

G

Well fluids from single well pads are transferred to the gathering network via metering stations. Multiphase pumps are installed at metering stations.

BFD:



REV	BY	CHK'D	APR'D	DATE				
G	SC	IH/ RR	MP	15Okt15	CLIENT:	TENGIZCHEVROIL	PROJECT No.	J20679 / F-005-028-15
F	SC	IH/ RR	MP	14Okt15	PROJECT:	MPP Project	DOC No.	J20679-MPP-PH1-A-30108
E	SC	IH	MP	08Okt15	PFD No.	-		
					SYSTEM:	-		

FUNCTIONAL SPECIFICATION: MULTIPHASE PUMP

EQUIPMENT NAME: Multiphase Pumps at Metering Stations

EQUIPMENT No

GENESIS

4.0 TENGIZ PRODUCTION DATA

4.1 WELL FLUID COMPOSITION 1

The following reservoir fluid composition shall be used to design the MPP system. It is taken from the FGP simulation EF65 Rev L01 (Stream 100).

Component	Wellhead Fluid Composition
	Mole Fraction
H_2O	0,0646
N_2	0,0078
H_2S	0,1191
CO_2	0,0233
Methane	0,4267
Ethane	0,0780
Propane	0,0431
i-Butane	0,0096
n-Butane	0,0227
i-Pentane	0,0112
n-Pentane	0,0126
n-Hexane	0,0099
22-mbutane	0,0099
n-Heptane	0,0207
COS	0,0001
Benzene	0,0006
Toluene	0,0021
M-Mercaptan	0,0002
E-Mercaptan	0,0001
2C3Mercaptan	0,0000
nPMercaptan	0,0000
nBMercaptan	0,0000
NBP[0]116*	0,0224
NBP[0]135_3*	0,0092
NBP[0]150*	0,0100
NBP[0]166*	0,0105
NBP[0]182*	0,0101
NBP[0]198*	0,0094
NBP[0]213*	0,0084
NBP[0]229*	0,0075
NBP[0]253*	0,0124
NBP[0]283*	0,0109
NBP[0]315*	0,0070
NBP[0]348*	0,0050
NBP[0]378*	0,0041
NBP[0]410*	0,0028
NBP[0]470*	0,0054
NBP[0]564*	0,0026
Total	1,00000

4.2 WELL FLUID COMPOSITION 2

The composition in the table below presents an alternative composition band to the design composition. This composition represents the change in well composition over the duration of MPP operation. The composition represents a fluid with a GOR of 3000 SCF/STB [Ref. 12]. Vendor to advise on any issues arising from operating with the non-specification fluid composition. The composition was provided on a dry basis, water was added to achieve a total mol fraction of 1.

Component	Wellhead Fluid Composition
	Mole Fraction
H_2O	0,05041
N_2	0,00803
H_2S	0,12081
CO_2	0,02419
Methane	0,44265
Ethane	0,08084
Propane	0,04457
i-Butane	0,00989
n-Butane	0,02325
i-Pentane	0,01132
n-Pentane	0,01275
n-Hexane	0,01928
22-mbutane	0,00000
n-Heptane	0,01965
COS	0,00000
Benzene	0,00064
Toluene	0,00204
M-Mercaptan	0,00000
E-Mercaptan	0,00000
2C3Mercaptan	0,00000
nPMercaptan	0,00000
nBMercaptan	0,00000
NBP[0]116*	0,02121
NBP[0]135_3*	0,00871
NBP[0]150*	0,00939
NBP[0]166*	0,00982
NBP[0]182*	0,00956
NBP[0]198*	0,00885
NBP[0]213*	0,00789
NBP[0]229*	0,00701
NBP[0]253*	0,01166
NBP[0]283*	0,01017
NBP[0]315*	0,00657
NBP[0]348*	0,00473
NBP[0]378*	0,00386
NBP[0]410*	0,00272
NBP[0]470*	0,00508
NBP[0]564*	0,00245
Total	1,00000

4.3 RESERVOIR FLUIDS PSEUDO COMPONENT DEFINITION

The definition of the pseudo-components is shown in the table below [Ref. 13].

Component	Normal Boiling Point, °C	Molecular Weight	Liquid Density [kg/m^3]	Critical Temp. Tc, °C	Critical Pressure, Pc [kPa]	Critical Volume, Vc [m^3/kmol	Acentric Factor
NBP[0]116	115,604	98,979	777,340	303,118	3237,229	0,386	0,330
NBP[0]135_3	134,602	113,118	747,512	313,067	2663,322	0,468	0,389
NBP[0]150	150,494	121,832	760,649	330,255	2555,740	0,498	0,417
NBP[0]166	166,047	130,602	774,632	347,257	2467,961	0,526	0,443
NBP[0]182	181,802	140,150	786,397	363,715	2366,486	0,557	0,472
NBP[0]198	197,502	150,445	795,922	379,358	2255,803	0,593	0,503
NBP[0]213	213,285	161,545	804,450	394,625	2144,730	0,632	0,535
NBP[0]229	229,118	173,378	812,678	409,699	2038,807	0,673	0,569
NBP[0]253	252,679	192,106	825,605	432,107	1899,089	0,735	0,619
NBP[0]283	282,888	217,940	842,976	460,771	1744,596	0,816	0,684
NBP[0]315	314,796	248,298	858,446	489,736	1584,284	0,914	0,757
NBP[0]348	348,009	283,354	870,942	518,245	1418,447	1,034	0,840
NBP[0]378	378,303	315,446	880,670	543,310	1276,768	1,159	0,920
NBP[0]410	410,460	356,115	890,448	569,394	1141,107	1,308	1,002
NBP[0]470	469,628	444,817	903,666	614,774	912,106	1,655	1,156
NBP[0]564	563,842	557,212	952,953	697,48	727,863	2,166	1,335

4.4 PRODUCED WATER COMPOSITION

The table below shows the detailed formation water analysis [Ref. 13].

Formation Water Chemistry (mg/l)	P10	P50	P90	Stdev
Sodium	9692	15023	20354	3241
Potassium	90	197	305	66
Calcium	>0	653	1496	512
Magnesium	31	107	183	46
Barium	>0	68	153	52
Strontium	67	183	299	71
Total Iron	0	2	6	2
Dissolved Iron	0	0	1	0
Chloride	15639	25132	34625	5771
Sulphate mg/l (Dionex)	0	94	217	75
Bicarbonate	875	2927	4980	1248
Carbonate	0	634	1337	427
Boron	46	74	102	17
Aluminium	1	1	1	0
Silicon	39	49	58	6
Phosphorus	0	118	630	311
Lithium	6	12	17	3
pH at 20°C	8	9	10	1
Ammonia mg/l (Chemets)	0	850	2362	919
Iodide mg/l (ICP)	0	138	404	162
Bromide mg/l (Dionex)		65		
Formate mg/l (Dionex)		5		
Acetate mg/l (Dionex)	0	39	83	26
Propionate mg/l (Dionex)	0	204	520	192
Reported TDS	8979	57861	106743	29715
Calculated TDS from total S	9338	51065	92791	25366
Calculated TDS from IC S	29721	44905	60090	9231
Sum Cations (meq)	461	704	948	148
SumAnions (meq)	501	776	1051	167
Charge Balance % -	-11	-5	2	4
Specific gravity at 60°F	1,0253	1,032	1,0387	0,0041
Determined Resistivity (ohm.metre at 60°F)	0,1458	0,1795	0,2132	0,0205

5 MPP INLET CONDITIONS

Sections 5.1 and 5.2 present the fuller operating envelopes of the MPPs.
The 4 selected specification cases are the High DP and Base Case DP. The MPPs could also be required to operate at the Low DP conditions. The cases are based on a MPP design capacity of 300,000 bpd at inlet conditions.

Vendor to advise on any issues arising from operating the non-specification cases.

5.1 MPP INLET CONDITIONS - WELL FLUID COMPOSITION 1 (OPERATING ENVELOPE)

The following MPP differential pressure case conditions are based on Well Fluid Composition 1, taken from the FGP simulation EF65 Rev L01 (Stream 100), see Section 4.1.

High MPP Inlet Temperature (80°C), Design Capacity (300,000 bpd @ inlet conditions)

DP Case	High		Base			Low
Differential Pressure, bar	60	50	40	30	20	10
Inlet Pressure, barg	30	40	50	60	70	80
Discharge Pressure, barg	90	90	90	90	90	90
Inlet Temperature, °C	80	80	80	80	80	80
GVF, %	92,9	89,9	86,6	83,0	79,2	75,2
Oil flow rate (inlet conditions), m3/h	138	197	261	331	405	483
Water flow rate (inlet conditions), m3/h	3	4	6	7	9	10
Gas flow rate (inlet conditions), m3/h	1847	1786	1720	1649	1574	1495
Total flow rate (inlet conditions), m3/h	1987	1987	1987	1987	1987	1987
Oil Viscosity (inlet conditions), cP	0,735	0,656	0,598	0,554	0,517	0,484
Oil density (inlet conditions), kg/m3	727	718	710	701	692	683
Gas density (inlet conditions), kg/m3	29	39	49	59	70	81
Water density (inlet conditions), kg/m3	965	966	966	966	967	967

Low MPP Inlet Temperature (50°C), Design Capacity (300,000 bpd @ inlet conditions)

DP Case	High		Base			Low
Differential Pressure, bar	60	50	40	30	20	10
Inlet Pressure, barg	30	40	50	60	70	80
Discharge Pressure, barg	90	90	90	90	90	90
Inlet Temperature, °C	50	50	50	50	50	50
GVF, %	91,2	87,3	83,1	78,5	73,6	68,5
Oil flow rate (inlet conditions), m3/h	171	246	329	418	514	613
Water flow rate (inlet conditions), m3/h	4	6	7	9	11	13
Gas flow rate (inlet conditions), m3/h	1813	1736	1651	1560	1463	1361
Total flow rate (inlet conditions), m3/h	1987	1987	1987	1987	1987	1987
Oil Viscosity (inlet conditions), cP	0,892	0,778	0,700	0,642	0,593	0,55
Oil density (inlet conditions), kg/m3	743	734	725	716	706	697
Gas density (inlet conditions), kg/m3	31	41	51	62	74	86
Water density (inlet conditions), kg/m3	989	989	990	990	990	991

5.1 MPP INLET CONDITIONS - WELL FLUID COMPOSITION 2 (OPERATING ENVELOPE)

The following MPP differential pressure case conditions are based on Well Fluid Composition 2, taken from the FGP/WPMP Gathering System Steady State Report, see Section 4.2.

High MPP Inlet Temperature (80°C), Design Capacity (300,000 bpd @ inlet conditions)

DP Case	High		Base			Low
Differential Pressure, bar	60	50	40	30	20	10
Inlet Pressure, barg	30	40	50	60	70	80
Discharge Pressure, barg	90	90	90	90	90	90
Inlet Temperature, °C	80	80	80	80	80	80
GVF, %	93,6	90,8	87,7	84,4	80,9	77,2
Oil flow rate (inlet conditions), m3/h	126	181	240	305	374	447
Water flow rate (inlet conditions), m3/h	2	3	4	5	6	7
Gas flow rate (inlet conditions), m3/h	1859	1804	1743	1677	1607	1533
Total flow rate (inlet conditions), m3/h	1987	1987	1987	1987	1987	1987
Oil Viscosity (inlet conditions), cP	0,725	0,646	0,588	0,544	0,507	0,474
Oil density (inlet conditions), kg/m3	726	717	708	699	690	681
Gas density (inlet conditions), kg/m3	29	39	49	59	70	81
Water density (inlet conditions), kg/m3	965	966	966	966	967	967

Low MPP Inlet Temperature (50°C), Design Capacity (300,000 bpd @ inlet conditions)

DP Case	High		Base			Low
Differential Pressure, bar	60	50	40	30	20	10
Inlet Pressure, barg	30	40	50	60	70	80
Discharge Pressure, barg	90	90	90	90	90	90
Inlet Temperature, °C	50	50	50	50	50	50
GVF, %	92,0	88,4	84,4	80,1	75,6	70,7
Oil flow rate (inlet conditions), m3/h	157	226	304	388	478	572
Water flow rate (inlet conditions), m3/h	3	4	6	7	8	9
Gas flow rate (inlet conditions), m3/h	1828	1757	1678	1593	1501	1406
Total flow rate (inlet conditions), m3/h	1987	1987	1987	1987	1987	1987
Oil Viscosity (inlet conditions), cP	0,871	0,759	0,680	0,624	0,575	0,533
Oil density (inlet conditions), kg/m3	742	732	723	713	703	693
Gas density (inlet conditions), kg/m3	31	41	52	63	74	87
Water density (inlet conditions), kg/m3	989	989	990	990	990	991

Equipment No.	-					No. Required				One (VTC)
No. Operating	-					No. Standby				0
Pump Type	Twin Screw MPP					Service				Well fluids
Location	Outdoor					**Case**				**Base Case - High Temp**
Rev.										
	Site and Utility Data									
		Units	**Max.**			**Min.**				
	Elevation	m	-23,05			Equivalent North Baltic Datum				
	Barometer	mbarA	1013							
	Ambient Temperature	°C	44			-36				
	Electrical Power		VTA			VTA				
	Instrument Air	barg	VTA			VTA				
	Fuel Gas	barg	VTA			VTA				
	Dust		Yes							
	Salt Atmosphere		Yes							
	Fluid Data (Note 6)									
		Units	Design Capacity			Units	Design Capacity			Rated
	Capacity Oil	BPD	39.458			m3/h	261			VTA
	Capacity Water	BPD	862			m3/h	5,7			VTA
	Capacity Gas	BPD	259.680			m3/h	1.720			VTA
	Capacity Total	BPD	300.000			m3/h	1.987			VTA
	Capacity GVF	%	86,6							VTA
	Fluid Composition		Well Fluid Composition 1			See Section 4.1				
	Relative Density (SG)		0,801			Oil phase at Std conditions				VTA
	Inlet pressure	barg	50							VTA
	Discharge pressure	barg	90							VTA
	Viscosity (Oil)	cP	0.598 (Note 1)							VTA
	Inlet temperature	°C	80							VTA
	H2S	mol%	11,9							
	CO2	mol%	2,3							
	Solids - Particle Size Distribution Max/Min	µ								Note 2
	Pump Performance (Note 7)									
	Diff. pressure	bar	40							
	Max Allowable Speed	rpm	VTA							
	Min Allowable Speed	rpm	VTA							
	Speed at Design Cond	rpm	VTA							
	Hydraulic Power	kW	VTA							
	Abs. power	kW	VTA							
	Power at 0% GVF (Max Power)	kW	VTA							
	Max Allowable Discharge Temp w/o Cooling	°C	VTA							
	Req. Cooler Power	:	VTA							
	Sound Level	dB	VTA							
	Rated Volumetric Efficiency	%	VTA							
	Rated Pump Efficiency	%	VTA							
	Materials of construction									
	Pump casing		VTA			Shafts				VTA
	Liner		VTA			Screws				VTA
	Rotors		VTA			Gaskets				VTA
	Bearing housing		VTA			O-rings & Radial Shaft Seal Rings				VTA
	Timing gears		VTA			Existing Piping				LTCS (900#)
	Flange connections			**Forces and moments**						
			Size - Location - Rating	Fx [lbs]		Fy [lbs]	Fz [lbs]	Mz [lbs ft]		
	Suction flange		TBC - VTA - 900#	VTA		VTA	VTA	VTA		
	Discharge flange		TBC - VTA - 900#	VTA		VTA	VTA	VTA		
	Drains		VTA							
	Casing									
	Direction of rotation		VTA			Location of drive shaft (viewed from motor)				
G	Integral bypass valve		No			Opening pressure (Dp + 10%)				
	Max. Allowable Casing Press (barg)		VTA			Max Allowable Suction Pressure (barg)				VTA
	Mechanical seals									
	Make / Type		VTA			Configuration				VTA
G	API Plan		VTA suitability of API 54 / 53B/C			API Code				VTA
G	Barrier fluid system		VTA			Barrier fluid				VTA
	Pump lubrication									
	D.E.		VTA							
	N.D.E.		VTA							
	Bearing Type(s)									
	VTA									
	Baseplate assembly									
	Material		Fabricated welded carbon steel (VTA)			Coupling guard				VTA
	Design		Lifting lugs			Coupling				VTA
			Oil pan							
			Vertical leveling screws			Alignment screws for pump driver				
	Preliminary motor data									
	Frame size		VTA	Synchronous speed		VTA	Enclosure			VTA
	Shaft power		VTA	Mounting form		VTA	Classification			VTA
	Voltage		6kV (TBC)	Isolation class						
	Hertz		50	Phase		3				
	Pump weight (approx.)			**Dimensions (Approx.)**						
	Pump		VTA	Length		VTA				
	Baseplate		VTA	Height		VTA				
	Motor		VTA	Width		VTA				
	Total weight		VTA	Volume		VTA				

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	Rev.	BY	CHKD	APPD	DATE	Document Title	Doc. No.	

Equipment No.	-					No. Required				One (VTC)
No. Operating	-					No. Standby				0
Pump Type	Twin Screw MPP					Service				Well fluids
Location	Outdoor					**Case**				**Base Case - Low Temp**
Rev.										
	Site and Utility Data									
		Units	**Max.**			**Min.**				
	Elevation	m	-23,05			Equivalent North Baltic Datum				
	Barometer	mbarA	1013							
	Ambient Temperature	°C	44			-36				
	Electrical Power		VTA			VTA				
	Instrument Air	barg	VTA			VTA				
	Fuel Gas	barg	VTA			VTA				
	Dust		Yes							
	Salt Atmosphere		Yes							
	Fluid Data (Note 6)									
		Units	Design Capacity			Units	Design Capacity			Rated
	Capacity Oil	BPD	49.621			m3/h	329			VTA
	Capacity Water	BPD	1.122			m3/h	7,4			VTA
	Capacity Gas	BPD	249.257			m3/h	1.651			VTA
	Capacity Total	BPD	300.000			m3/h	1.987			VTA
	Capacity GVF	%	83,1							VTA
	Fluid Composition		Well Fluid Composition 1			See Section 4.1				
	Relative Density (SG)		0,801			Oil phase at Std conditions				VTA
	Inlet pressure	barg	50							VTA
	Discharge pressure	barg	90							VTA
	Viscosity (Oil)	cP	0.700 (Note 1)							VTA
	Inlet temperature	°C	50							VTA
	H2S	mol%	11,9							
	CO2	mol%	2,3							
	Solids - Particle Size Distribution Max/Min	µ								Note 2
	Pump Performance (Note 7)									
	Diff. pressure	bar	40							
	Max Allowable Speed	rpm	VTA							
	Min Allowable Speed	rpm	VTA							
	Speed at Design Cond	rpm	VTA							
	Hydraulic Power	kW	VTA							
	Abs. power	kW	VTA							
	Power at 0% GVF (Max Power)	kW	VTA							
	Max Allowable Discharge Temp w/o Cooling	°C	VTA							
	Req. Cooler Power	:	VTA							
	Sound Level	dB	VTA							
	Rated Volumetric Efficiency	%	VTA							
	Rated Pump Efficiency	%	VTA							
	Materials of construction									
	Pump casing		VTA			Shafts				VTA
	Liner		VTA			Screws				VTA
	Rotors		VTA			Gaskets				VTA
	Bearing housing		VTA			O-rings & Radial Shaft Seal Rings				VTA
	Timing gears		VTA			Existing Piping				LTCS (900#)
	Flange connections			**Forces and moments**						
			Size - Location - Rating	Fx [lbs]		Fy [lbs]	Fz [lbs]	Mz [lbs ft]		
	Suction flange		TBC - VTA - 900#	VTA		VTA	VTA	VTA		
	Discharge flange		TBC - VTA - 900#	VTA		VTA	VTA	VTA		
	Drains		VTA							
	Casing									
	Direction of rotation		VTA			Location of drive shaft (viewed from motor)				
G	Integral bypass valve		No			Opening pressure (Dp + 10%)				
	Max. Allowable Casing Press (barg)		VTA			Max Allowable Suction Pressure (barg)				VTA
	Mechanical seals									
	Make / Type		VTA			Configuration				VTA
G	API Plan		VTA suitability of API 54 / 53B/C			API Code				VTA
G	Barrier fluid system		VTA			Barrier fluid				VTA
	Pump lubrication									
	D.E.		VTA							
	N.D.E.		VTA							
	Bearing Type(s)									
	VTA									
	Baseplate assembly									
	Material		Fabricated welded carbon steel (VTA)			Coupling guard				VTA
	Design		Lifting lugs			Coupling				VTA
			Oil pan							
			Vertical leveling screws			Alignment screws for pump driver				
	Preliminary motor data									
	Frame size		VTA	Synchronous speed		VTA	Enclosure			VTA
	Shaft power		VTA	Mounting form		VTA	Classification			VTA
	Voltage		6kV (TBC)	Isolation class						
	Hertz		50	Phase		3				
	Pump weight (approx.)			**Dimensions (Approx.)**						
	Pump		VTA	Length		VTA				
	Baseplate		VTA	Height		VTA				
	Motor		VTA	Width		VTA				
	Total weight		VTA	Volume		VTA				

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Equipment No.	-					No. Required				One (VTC)
No. Operating	-					No. Standby				0
Pump Type	Twin Screw MPP					Service				Well fluids
Location	Outdoor					**Case**				**High DP - High Temp Alternative**
Rev.										
	Site and Utility Data									
		Units	**Max.**			**Min.**				
	Elevation	m	-23,05			Equivalent North Baltic Datum				
	Barometer	mbarA	1013							
	Ambient Temperature	°C	44			-36				
	Electrical Power		VTA			VTA				
	Instrument Air	barg	VTA			VTA				
	Fuel Gas	barg	VTA			VTA				
	Dust		Yes							
	Salt Atmosphere		Yes							
	Fluid Data (Note 6)									
		Units	Design Capacity			Units	Design Capacity			Rated
	Capacity Oil	BPD	20.764			m3/h	138			VTA
	Capacity Water	BPD	452			m3/h	3,0			VTA
	Capacity Gas	BPD	278.784			m3/h	1.847			VTA
	Capacity Total	BPD	300.000			m3/h	1.987			VTA
	Capacity GVF	%	92,9							VTA
	Fluid Composition		Well Fluid Composition 1			See Section 4.1				
	Relative Density (SG)		0,801			Oil phase at Std conditions				VTA
	Inlet pressure	barg	30							VTA
	Discharge pressure	barg	90							VTA
	Viscosity (Oil)	cP	0.735 (Note 1)							VTA
	Inlet temperature	°C	80							VTA
	H2S	mol%	11,9							
	CO2	mol%	2,3							
	Solids - Particle Size Distribution Max/Min	µ								Note 2
	Pump Performance (Note 7)									
	Diff. pressure	bar	60							
	Max Allowable Speed	rpm	VTA							
	Min Allowable Speed	rpm	VTA							
	Speed at Design Cond	rpm	VTA							
	Hydraulic Power	kW	VTA							
	Abs. power	kW	VTA							
	Power at 0% GVF (Max Power)	kW	VTA							
	Max Allowable Discharge Temp w/o Cooling	°C	VTA							
	Req. Cooler Power	:	VTA							
	Sound Level	dB	VTA							
	Rated Volumetric Efficiency	%	VTA							
	Rated Pump Efficiency	%	VTA							
	Materials of construction									
	Pump casing	VTA				Shafts				VTA
	Liner	VTA				Screws				VTA
	Rotors	VTA				Gaskets				VTA
	Bearing housing	VTA				O-rings & Radial Shaft Seal Rings				VTA
	Timing gears	VTA				Existing Piping				LTCS (900#)
	Flange connections			**Forces and moments**						
		Size - Location - Rating		Fx [lbs]		Fy [lbs]	Fz [lbs]	Mz [lbs ft]		
	Suction flange	TBC - VTA - 900#		VTA		VTA	VTA	VTA		
	Discharge flange	TBC - VTA - 900#		VTA		VTA	VTA	VTA		
	Drains	VTA								
	Casing									
	Direction of rotation	VTA				Location of drive shaft (viewed from motor)				
G	Integral bypass valve	No				Opening pressure (Dp + 10%)				
	Max. Allowable Casing Press (barg)	VTA				Max Allowable Suction Pressure (barg)				VTA
	Mechanical seals									
	Make / Type	VTA				Configuration				VTA
G	API Plan	VTA suitability of API 54 / 53B/C				API Code				VTA
G	Barrier fluid system	VTA				Barrier fluid				VTA
	Pump lubrication									
	D.E.	VTA								
	N.D.E.	VTA								
	Bearing Type(s)									
	VTA									
	Baseplate assembly									
	Material	Fabricated welded carbon steel (VTA)				Coupling guard				VTA
	Design	Lifting lugs				Coupling				VTA
		Oil pan								
		Vertical leveling screws				Alignment screws for pump driver				
	Preliminary motor data									
	Frame size	VTA	Synchronous speed		VTA		Enclosure			VTA
	Shaft power	VTA	Mounting form		VTA		Classification			VTA
	Voltage	6kV (TBC)	Isolation class							
	Hertz	50	Phase		3					
	Pump weight (approx.)		**Dimensions (Approx.)**							
	Pump	VTA	Length		VTA					
	Baseplate	VTA	Height		VTA					
	Motor	VTA	Width		VTA					
	Total weight	VTA	Volume		VTA					

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Equipment No.	-					No. Required			One (VTC)
No. Operating	-					No. Standby			0
Pump Type	Twin Screw MPP					Service			Well fluids
Location	Outdoor					**Case**			**High DP - Low Temp Alternative**
Rev.									
	Site and Utility Data								
		Units	**Max.**			**Min.**			
	Elevation	m	-23,05			Equivalent North Baltic Datum			
	Barometer	mbarA	1013						
	Ambient Temperature	°C	44			-36			
	Electrical Power		VTA			VTA			
	Instrument Air	barg	VTA			VTA			
	Fuel Gas	barg	VTA			VTA			
	Dust		Yes						
	Salt Atmosphere		Yes						
	Fluid Data (Note 6)								
			Units	Design Capacity			Units	Design Capacity		Rated
	Capacity	Oil	BPD	25.758			m3/h	171		VTA
		Water	BPD	621			m3/h	4,1		VTA
		Gas	BPD	273.621			m3/h	1.813		VTA
		Total	BPD	300.000			m3/h	1.987		VTA
		GVF	%	91,2						VTA
	Fluid Composition			Well Fluid Composition 1			See Section 4.1			
	Relative Density (SG)			0,801			Oil phase at Std conditions			VTA
	Inlet pressure	barg	30							VTA
	Discharge pressure	barg	90							VTA
	Viscosity (Oil)	cP	0.892 (Note 1)							VTA
	Inlet temperature	°C	50							VTA
	H2S	mol%	11,9							
	CO2	mol%	2,3							
	Solids - Particle Size Distribution Max/Min	µ								Note 2
	Pump Performance (Note 7)									
	Diff. pressure	bar	60							
	Max Allowable Speed	rpm	VTA							
	Min Allowable Speed	rpm	VTA							
	Speed at Design Cond	rpm	VTA							
	Hydraulic Power	kW	VTA							
	Abs. power	kW	VTA							
	Power at 0% GVF (Max Power)	kW	VTA							
	Max Allowable Discharge Temp w/o Cooling	°C	VTA							
	Req. Cooler Power	.	VTA							
	Sound Level	dB	VTA							
	Rated Volumetric Efficiency	%	VTA							
	Rated Pump Efficiency	%	VTA							
	Materials of construction									
	Pump casing	VTA				Shafts			VTA	
	Liner	VTA				Screws			VTA	
	Rotors	VTA				Gaskets			VTA	
	Bearing housing	VTA				O-rings & Radial Shaft Seal Rings			VTA	
	Timing gears	VTA				Existing Piping			LTCS (900#)	
	Flange connections			**Forces and moments**						
		Size - Location - Rating		Fx [lbs]		Fy [lbs]	Fz [lbs]	Mz [lbs ft]		
	Suction flange	TBC - VTA - 900#		VTA		VTA	VTA	VTA		
	Discharge flange	TBC - VTA - 900#		VTA		VTA	VTA	VTA		
	Drains	VTA								
	Casing									
	Direction of rotation	VTA				Location of drive shaft (viewed from motor)				
G	Integral bypass valve	No				Opening pressure (Dp + 10%)				
	Max. Allowable Casing Press (barg)	VTA				Max Allowable Suction Pressure (barg)			VTA	
	Mechanical seals									
	Make / Type	VTA				Configuration			VTA	
G	API Plan	VTA suitability of API 54 / 53B/C				API Code			VTA	
G	Barrier fluid system	VTA				Barrier fluid			VTA	
	Pump lubrication									
	D.E.	VTA								
	N.D.E.	VTA								
	Bearing Type(s)									
	VTA									
	Baseplate assembly									
	Material	Fabricated welded carbon steel (VTA)				Coupling guard			VTA	
	Design	Lifting lugs				Coupling			VTA	
		Oil pan								
		Vertical leveling screws				Alignment screws for pump driver				
	Preliminary motor data									
	Frame size	VTA	Synchronous speed		VTA	Enclosure		VTA		
	Shaft power	VTA	Mounting form		VTA	Classification		VTA		
	Voltage	6kV (TBC)	Isolation class							
	Hertz	50	Phase		3					
	Pump weight (approx.)		**Dimensions (Approx.)**							
	Pump	VTA	Length		VTA					
	Baseplate	VTA	Height		VTA					
	Motor	VTA	Width		VTA					
	Total weight	VTA	Volume		VTA					

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7 DESIGN DETAILS

G 7.1 General

G The following TCO Standards and Specifications shall be implemented:

A-ST-2025 Pump passport
G-ST-2001 Centrifugal pumps
G-ST-2002 Metering pumps
G-ST-2004 Centrifugal pumps-utility (non-SPI)
G-ST-2006 Lubrication, shaft sealing and control oil systems
G-ST-2007 Pump seal system selection philosophy
G-ST-2009 Pump lubrication philosophy
W-ST-2004 Rev 1 & T-41458 Materials in wet H_2S service
W-ST-2023 Material selection philosophy
W-ST-2024 Kazakh materials for fabricated equipment

7.2 Pumps

G Twin Screw pumps shall be designed to API 676 3rd Edition. Vendor to advise on API 676 exceptions.
Materials of construction (MOC) shall be in accordance with category A8 under API 610, except by agreement.
All materials used for process wetted components shall be in compliance with NACE MR0175/ISO15156.

G MPP System shall be designed for gas slug flow, vendor to advise design limits. MPPs are required to run dry at 100% GVF for a period of 10 minutes.

7.3 Pipework

Piping designs shall comply with ANSI B31.3.
Auxiliary piping shall be in accordance with the appropriate part of API 614.
All designs shall make provision for expansion/contractions, vibrations and pressure surges.
All pipework shall be adequately supported, clamped and anchored.
Isolation valving around meters shall be high integrity double block and bleed.
All on-skid piping to be flanged and arranged to facilitate replacement of eroded/corroded sections.
All piping connections to and from the skid must terminate in a flange.

G A double basket strainer is required on the MPP suction line. VTA on strainer material of construction.
A pressure restriction shall not be installed near the pumps discharge flange to prevent pressure surges during slug flow.

7.4 Electrical

Electrical installation shall comply with IEC 60079, or NFPA 70, API 500, and NEC as specified in API 676
Instrument cabling shall terminate at a single location in a signal segregated terminal box located at the instrument board or control panel. Generally, cable entry shall be bottom entry, glanded with NPT threads. Cable core shall be identified at all locations by numbered sleeve ferrules.
Terminal boxes to be certified Eex'e'.

G Separate boxes shall be provided for signals with different voltage levels, generally as follows:

- Control and status signals
- Analogue signals
- Power distribution signals

Cables in flame retardant type to IEC 332 and installed in heavy duty galvanised cable trays, complete with covers. Cable outer sheath colours shall comply with:

- I.S. Instrument System - Blue
- Non I.S. Instrument System - grey
- MOV/Power cable - Black

G 3-phase power to MOV actuators shall be distributed via a Low Voltage (LV) 380V distribution board.

G Hazardous Area Classification - Division: Zone 1, Group: IIA/B, Temperature Code: T3

7.5 Construction

Modules shall be built on heavy duty structural skids to enable them to be moved and installed with
G only the minimum assembly and interconnection. Baseplate design shall comply with API 676.
G Module baseframes shall be designed for the operating and transport movement stresses and shall include attachments to enable them to be lifted by crane. (Lifting hooks and slings are not included in the supply). On arrival at site modules and equipment will be placed on pre-prepared foundations.

7.6 Transport

Where the design allows, due cognisance to the limitations of transportation shall be made.
It is desirable to size equipment such that it can fit within a standard 40 ft (12.2m) long x 8 ft (2.4m) wide x 9 ft (2.7m) high standard shipping container.
It is acknowledged that some major equipment and materials can not fit into a shipping container and so needs to be delivered by barge.

7.7 Mechanical Seals and Lubrication

G Double mechanical seals as minimum shall be as per API 682 4th Ed
G VTA on type of barrier fluid for mechanical seal.
Lubrication systems shall conform to Chapter 3 of API 614.
G Materials of construction are in accordance with category A8 under API 610, except by agreement.

7.8 Sparing Philosophy

Large items of main processing equipment should not be spared.
Filters shall have installed spare, minimum 2 x 100%.

8 NOTES

1. Vendor to advise maximum viscosity beyond which pump will not operate as designed.
2. Vendor to advise upper limit of solids acceptable without affecting pump performance and life.
3. Vendor to provide pump curves for the recommended pumps. Note that the intended application varies the pump dP with varying inlet pressure to achieve a fixed discharge pressure.
4. Vendor to advise of a typical maintenance plan.
5. Vendor to provide reliability data including expected run life, mean time for failure etc.
6. Fluid at MPP inlet conditions.
7. Design Temperature and Pressure for 900# LTCS Piping:
   NGGS MS: T = -46 / 120°C, P = 132 barg
   Base GS MS: T = -46 / 90°C, P = 134 barg

9 REFERENCES

1. BEDD, 040-0000-BBB-DES-000-000-00001-00 (A-ST-2008-05908)
2. Chevron Engineering Design Manual PMP-EN-600
3. API Standard 614, Lubrication, Shaft-sealing, and Control-oil Systems and Auxiliaries
4. API Standard 682, Pumps—Shaft Sealing Systems for Centrifugal and Rotary Pumps
5. API Standard 676, Positive Displacement Pumps—Rotary
6. API Standard 610, Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
7. API RP 500, Classification of Locations for Electrical Installations at Petroleum Facilities
8. ANSI B31.3, Process Piping
9. NFPA 70, National Electrical Code
10. NFPA 70, National Electrical Code
11. IEC 60079, Explosive Atmospheres
12. FGP/WPMP Gathering System Steady State Report, 040-0000-LLP-RPT-000-000-00006-00_H03
13. FGP Integrated Basis of Design, 040-0000-AAA-DES-FGP-000-00002-00_B03