

1 Scope of Work

- Client requires One (1) Fresh Water Injection Pump Package complete with one (1) plunger pump system for pumping water from farmer's dugouts through a pipeline system for the use of fracturing of wells.
- This pump will be charged with a river installed centrifugal pump boosting to an estimated 50 psi system.
- The plunger pump shall be capable of delivering a volume of 2180 m³/day (400 gpm) at 4,965 kPag (720.0 psig).
- Electrical classification is Class 1, Division 2.
- Client has revised this from a 250 hp pump design to a 300 hp pump design.

2 Technical Requirements (Design Conditions)

Situation:	Water Injection
Fluids:	Water – Sweet
Solids:	Unknown
H ₂ S Present	No
Chlorides:	Unknown
Medium pH:	Unknown
Volume (Capacity)	2180 m ³ /day (400 gpm)
Actual Operating Pressure:	4,965 kPag (720 psig)
Design Discharge Pressure:	9,929 kPag (1,440 psig) - 600 ANSI
NPSHa:	Unknown
Suction Pressure:	50 psig assumed
Pumping Temperature:	Assume 10°C
Vapour pressure	Unknown
Specific Gravity:	1.0 Assumed
Viscosity (cP):	1 cP (estimated)
Electrical Area Hazard:	Class I, Division 2
Location:	Unknown
Horsepower Required:	187 bhp (400 gpm @ 720.0 psig @ 90% mechanical efficiency)

Please Note:

These design conditions are what you, the client, have provided to us. Please ensure that our product meets these conditions.

3 Reciprocating Pump System

One (1) Only Reciprocating Positive Displacement Plunger Pump (P-101)

Make:	Weatherford
Model:	W300L
Rated BHP:	300 hp @ 400 rpm
Design:	Triplex Plunger Pump
Condition:	New
Stroke:	5 in.
Plunger Size:	4.00 in.
Volume Requirement:	400 gpm
Suction Pressure Required:	Unknown
Discharge Pressure Rating (M.A.W.P) – with 4.00" plunger size:	5,860 kPag (850 psig)
PSV Pressure Setting (in relation to plunger pump design)	5,592 kPag (811 psig)
Capacity:	73.5% @ 400 gpm
Pump Speed:	294 rpm @ 400 gpm @ 100% volumetric efficiency
Brake Horsepower Required:	187 BHP (400 gpm @ 720 psig)
Rated Plunger Load:	10,700 lbs.
Pump Construction:	Cast Iron Power End
Fluid End Material:	Carbon Steel
Plunger Packing Material:	0838 Style Packing
Valve Assemblies:	Stainless Steel Suction & Discharge Abrasive Resistant Valve Assemblies
Trim:	Aluminum Bronze
Crankshaft Extension:	4-7/8" Dia. x 11-11/16" Long
Oil Capacity:	Crankcase: 8 Gallons (30.3 Liters) Splash lubricated power end Minimum speed 200 RPM (to allow for splash lubrication)
Weight – Pump Only:	7,000 lbs.
Suction Connection:	8" ANSI-150 FF
Discharge Connection:	4" API-2000 RJ
Paint:	Traditional pump colours

Details:

- Splash lubricated power end (auxiliary lubrication system only required for operations below 200 rpm).

Please Note:

Weatherford has noted that this carbon steel fluid end is capable of the pumping the fresh water application you have. However, if you wish to use the pump for produced water service – or possibly sour service – you will need to purchase of our duplex stainless steel plunger pumps. This is noted at the end of the quotation.

4 Electric Motor and Drive System

One (1) Only Electric Motor (M-101)

Type:	Teco Westinghouse
HP Rating:	200 HP
Condition:	New
Design:	Premium Efficiency
Enclosure:	TEFC, Class I, Div. 2
Speed:	1,200 rpm
Frame:	449T
Voltage/Phase/Cycle:	575 VAC / 3PH / 60Hz
Temperature Rise:	Class B
Duty:	Continuous Duty
Bearing:	Roller Bearing
Service Factor:	1.15 SF
Drive:	VFD Capable, Constant Torque
Insulation:	Class F
Mounting:	Horizontal, F-1

One (1) Only Belt & Sheave System

Type:	Sheave & Belt Drive
Ratio:	4.09 :1
Design:	Conventional Sheave
Pump Speed:	294 rpm
Motor Speed:	1,200 rpm
Belt:	V Belt
Horsepower Design:	200 hp
Service Factor:	>1.5

Details:

- Sheave kit and drive system will connect the motor to the pump off one side of pump.
- Appropriate belt tensioning system would be included.
- All applicable safety belt guards will be incorporated on the drive system.
- There will be approximately 30" between pump and motor for maintenance purposes.

One (1) Only Protective Safety Guards – Pump System

- Aluminum Belt Guard
- Non-sparking lightweight design for ease of removal
- Removable front to allow ease of belt change for single operator
- Top inspection door for belt inspection
- Bolted at both ends of guard, bolted to support from sub-skid
- in middle of backing, to prevent mechanical vibration

5 Plunger Packing Lubrication System

One (1) Only Plunger Packing Lubricator

Make:	Lincoln / Premier
Feeds:	5
Gear Ratio:	112.5:1 ratio
Weight:	Estimated 30 lbs
Mounting / Misc.:	Mounting Bracket secures to bearing housing for support. Lubricator sheave Pump crankshaft sheave, Link-Belt Drive guard system Stainless steel lubrication lines run above the plunger pump System designed to be installed above the crankshaft, on top of the pump frame itself. Applicable belt guard will be installed on drive system and secured to the pump and/or mounting brackets.

One (1) Only Packing Lubricator Daytank Assembly (DT-101)

Make:	Kenco
Size:	30 Gallon
Stand Height:	Standard stand
Dimensions:	18 3/8W x 29" L
Location:	Mounted between individual piping runs into the plunger pump.
Misc.:	2" NPT Filter Cap Vent Tube Sight Glass Level 1/2" NPT Shut-Off Valve to each pump Daytank will be piped to lubricator on top of pump via 1/2" SS tubing.
Daytank Level Float Switch:	Kenco 507-L Within Lubricator on top of plunger pump

6 Pulsation Dampener System (Stabilizers)

One (1) Only Suction Stabilizer (S-101)

Make:	Status Flow
Model:	SFTSC1508F600N
Volume:	600 Cubic Inch
Cartridge Material:	SFT482NT 2 Ply Nitrile Rubber Cartridge
Connection:	8" 150 ANSI R.F.
M.A.W.P.:	150 PSI
Certification:	AB CRN

One (1) Only Discharge Stabilizer (S-102)

Make:	Status Flow
Model:	SFTDC14406F600N
Volume:	600 Cubic Inch
Cartridge Material:	SFT486NT 6 Ply Nitrile Rubber Cartridge
Connection:	6" 600 ANSI R.F.
M.A.W.P.:	1,440 psi
Certification:	AB CRN

7 Sub-Skid System

One (1) Only Structural Sub-Skid

Dimensions:	Estimate: 10'-1" x 3'-4"
Design:	W16 @ 40 Wide Flange Beams Support Designed to secure the pump, motor, sheave/kit and belt guard on one unitized based support system. Pump elevated to a good working height.
Paint:	Single coat of Primer. Two coats of Black enamel paint.
Mount:	Electrical motor will be mounted on a slide base behind the pump power end. There will be approx. 30" between pump and motor for maintenance purposes. Sheave kit and drive system will connect motor to pump system off one side of the pump. Sub-skid designed not to interfere with fluid end maintenance procedures.

8 Instrumentation Systems

Tubing & Instrumentation Criteria/Specifications

Instrument Tubing:	316SS seamless tubing
Tubing Fittings:	Swagelok
Valves & Fittings:	316 Stainless Steel

Details:

- All instrument tubing and fittings will be of the above materials unless requested otherwise.

Delivering Service, Quality and Honesty

Four (4) Only Suction Pressure Indicators (PI-102/103/104/106)

Make:	WGI / Wika
Pressure:	0 - 100 psi
Size:	4" x 1/2"
Mounted:	Suction line / Instrument Air line
Details:	Liquid Filled NACE stainless steel internals & case 1% Accuracy

One (1) Only Differential Pressure Indicators (DPI-101)

Make:	WGI or equal
Model:	TBA
Differential Pressure Range:	0-30 psi
Size:	4.5" Dial 2" x 1/2" NPT Back Connection
Mounted:	Filter vessel
Details:	Liquid Filled NACE stainless steel internals & case 1% Accuracy

One (1) Low Pressure Switch (PSL-101)

Make:	CCS Dualsnap
Model:	6900GZE14
Range:	9 - 75 psi Increasing 3 - 39 psi Decreasing
Set Point:	TBC by Client
Mounting:	Needle Valve off of Discharge Lines
Approximate Deadband:	6 psi
SPDT:	Relay
Wetted Parts:	316 Stainless Steel / Viton
Connection:	1/2" Stainless Steel Port
Classification:	CSA Class I, Groups A,B,C and D; Class II, Groups E,F and G.

One (1) High Pressure Switch (PSH-101)

Make:	CCS Dualsnap/Telematic
Model:	6900GZE20
Range:	300 - 1000 psi Increasing 225 - 925 psi Decreasing
Set Point:	TBC by Client
Mounting:	Needle Valve off of Discharge Lines

Approximate Deadband:	
SPDT:	75 psi
Wetted Parts:	Relay
Connection:	316 Stainless Steel / Viton
Sealing:	1/2" Stainless Steel Port
Classification:	Secondary Seal Approved
	CSA Class I, Groups A,B,C and D; Class II, Groups E,F and G.

One (1) Only Pump Oil Level Safety Shutdown Switch (LSL-101)

Make:	Murphy
Model:	EL-150-EX
Mounting:	Installed / Piped off drain connection of the pump
Classification:	CSA Class 1, Div. 1
Location:	Behind Power End of Plunger Pump

One (1) Only Pump Vibration Safety Shutdown Switch (VSH-101)

Make:	Murphy
Model:	VS-2-EX
Mounting:	On the top of the power end of pump
Classification:	CSA Class 1, Div. 1
Location:	Mounted on plunger pump

One (1) Only Discharge Pressure Indicator (PI-105)

Make:	WGI / Wika
Pressure:	0 - 1000 psi
Size:	4" x 1/2"
Mounted:	Discharge line
	Liquid Filled
	NACE stainless steel internals & case
	1% Accuracy
Details:	

Two (2) Only Needle Valve Assemblies (Standard-Port)

Make:	WGI / Equivalent
Size:	1/2"
Rating:	6000#
Style:	Standard-Port
Body/Trim:	Stainless Steel

Four (4) Only Needle Valve Assemblies (Multi-Port)

Make:	WGI / Equivalent
Size:	1/4" x 1/4"
Rating:	6000#
Style:	Multi-Port
Body/Trim:	Stainless Steel

One (1) Only Emergency Shutdown Valve Actuation Assembly

Make:	KF
Model:	E3766-869G613
Size:	8"
Rating:	150 ANSI
Port:	Floating Ball, Full Port
Construction:	A216 WCB Body, A105N 3 MIL ENP Ball & stem TFM 1700/MPTFE Seat TFE/Graphite Seals
Operator:	Gear
Actuator Construction:	Rack and pinion design ISO mounting to ISO 5211-DIN 3337 Low temp -40°F Pre-lubricated internals +/- 4° open/close adjustment Die cast aluminum cap ends with polyester powder coating Standard phosphated centering springs Namur mount top of pinion Namur solenoid mount, anti-blowout nickel plated pinion, anodized/epoxy coated aluminum body, low friction self lubricating piston guides, die cast aluminum pistons
Standard:	Meets the intent of NACE MR0175 Meets CSA Z245.15, API 6D, API 607 / 608 and B16.34

Note: limit switch is not included.

9 Suction Piping System

Piping Design Criteria/Specifications

Piping:	
Weld Fittings:	SA-106B
Screwed & Socket Fittings:	SA-234 WPB
Flanges:	SA-105 Grade N
Valves:	SA-105 Grade N, SA-181 Grade 1 or 2
Bolts:	SA-105, SA-216 WCB
Nuts:	SA-193-B7
	SA-194-2H

Details:

- CanDyne Pump Services Inc. will manufacture/fabricate the system design to a minimum of ASME B31.3, Alberta Boilers Safety Association (ABSA) Safety and Quality Control Association (AQP-2822).
- CanDyne Pump Services Inc. has also designed the piping system to CanDyne Pump Services Inc.'s specifications CPS AN01 "AAN" Rev.3.

Suction Piping System

Rating:	150 ANSI
Piping:	Sch. 40
Corrosion Allowance:	1/16"
Size:	8" / 4"
NDE Requirements:	X-Ray: 10% of all butt welds Hydro-Test: 100% PWHT: No MPI: No LPI: No

Details:

- Suction piping inlet header of 8" contains an Emergency shutdown valve and basket strainer. The line reduces through a concentric reducer to 4", passes through a block valve and enters the seven bag filter vessel.
- Pressure gauges and differential pressure gauges are located of the filter vessel.
- Pressure Safety Valve will be located just off the inlet of the vessel for thermal relief.
- After the filter vessel, the line passes through another block valve and increases up to a 8" line immediately.
- The line turns 90 degree and leads into the plunger pump suction inlet.
- A 4" bypass line is set up between suction and discharge line. It contains a 4" 600 ANSI globe valve and check valve.
- Before the pump inlet, there will be a ball valve as well as a low pressure switch and pressure indicator.
- Drain Lines & Systems:

Reference #: S989-W300L-TP-REV1

- We have set up three drain lines off the suction line. All drain lines shall be completed with a 1" block valve and hard piped to the sump system.
- Suction Piping Supports:
 - All supports are mounted on structural skid members
 - All supports are secured by clamp style tie-downs.
- The suction system is designed to manage fluid at nominal conditions
 - 8" Pipe system: 2.57 feet/second for 2180 m³/day (400 gpm)
 - Does not include any frictional losses, restrictions or turns in piping system.
- We have utilized Full Port Valves on the system, which will be satisfactory for the current and future fluid volume of the pump.

One (1) Only Basket Assembly

Make:	Alta/Telford
Size:	8"
Rating:	285 psig @ -20/100F
Construction:	Carbon Steel w/ 304SS basket.
Style:	Flanged
Strainer Location:	Suction Header

One (1) Only Block Valve Assemblies

Make:	KF
Model:	E3766-869G613
Size:	8"
Rating:	150 ANSI
Port:	Split Body Floating Ball, Full Port
Construction:	A216 WCB Body, A105N 3 MIL ENP Ball & stem TFM 1700/MPTFE Seat TFE/Graphite Seals
Operator:	Gear
Standard:	Meets the intent of NACE MR0175 Meets CSA Z245.15, API 6D, API 607 / 608 and B16.34

Two (2) Only Block Valve Assemblies

Make:	KF
Model:	E2156-1922G91
Size:	4"
Rating:	150 ANSI
Port:	Split Body Floating Ball, Full Port

Construction:	
Operator:	A216 WCB Body, A105SS Ball & stem TFE/Graphite Seals
Standard:	Lever Meets the intent of NACE MR0175 Meets CSA Z245.15, API 6D, API 607 / 608 and B16.34

Three (3) Only Block Valve Assemblies

Make:	
Model:	Mendian
Size:	MAC2CF
Rating:	1"
Port	2000 WOG Full Port
Construction:	A216 WCB Body, 316SS A351 CF8M Ball R-PTFE Seat / PTFE Seal
Operator:	Lever
Location:	Drain Off of Basket Strainer Drain Off of Filter Drain Off Before Suction inlet of pump
Standard:	Meets the intent of NACE MR0175

10 Suction Filtration System

One (1) Only Bag Suction Filter (F-101)

Make:	Filtrek
Model:	LPA24-712F4
Bags:	7 Bag
Size:	25 Micron Bag – Client to advise otherwise
Materials:	Carbon Steel
Basket:	SA-516-70
Registration:	316 SS retainer basket
Connections:	AB/BC/SK CRN & U stamp
M.A.W.P.:	4" 150 ANSI RF Flanges
Design Temperature:	150 psi
MDMT:	250°F @150 PSIG
Corrosion Allowance:	-20°F @150 PSIG No Corrosion
Non-Destructive Testing:	Hydro-Test: 195 psi Visual Inspection: 100% X-Ray: No PWHT: No UT: None Magnetic Particle: None

Details:	Filters installed on structural members Filter has a 2" NPT drain line with a block valve installed in the bottom of the unit which is hard piped to the sump system. Filter has 1/2" NPT Dirty drain off of Inlet Filter has two 1/4" NPT Instrumentation connections. Filter has 1/2" NPT Vent
Code:	ASME SEC VIII DIV 1, 2010 Edition, 2011 Addenda
Important Note:	A thermal psv will be installed on the suction filter system.

11 Discharge Piping System

Piping Design Criteria/Specifications

Piping:	SA-106B
Weld Fittings:	SA-234 WPB
Screwed & Socket Fittings:	SA-105 Grade N
Flanges:	SA-105 Grade N, SA-181 Grade 1 or 2
Valves:	SA-105, SA-216 WCB
Bolts:	SA-193-B7
Nuts:	SA-194-2H

Details:

- CanDyne Pump Services Inc. will manufacture/fabricate the system design to a minimum of ASME B31.3, Alberta Boilers Safety Association (ABSA) Safety and Quality Control Association (AQP-2822).
- CanDyne Pump Services Inc. has also designed the piping system to CanDyne Pump Services Inc.'s specifications CPS AN01 "CAN" Rev.3.

Discharge Piping System

Rating:	600 ANSI
Piping:	Sch.80
Corrosion Allowance:	1/16"
Size:	6" / 3"
NDE Requirements:	X-Ray: 10% of all butt welds Hydro-Test: 100% PWHT: No MPI: No LPI: No

Details:

- The discharge line exits the plunger pump and increases to a 6" 600 ANSI rated line.
- The discharge stabilizers will be located directly after the plunger pump discharge.
- The PSV and startup bypass valve is located before the discharge header. There will also be a block valve prior to connecting to the discharge header.
- The pressure safety/relief valve and bypass line discharges back to the suction inlet.

- After the discharge line connects to the bypass line from suction contain the globe and check valve and enters a meter. The meter run with an uninterrupted 10 x upstream / 5 x downstream flow criteria. The turbine flow meter will be installed in the field by the client.
- After the meter run, the flow flows through a 6" check and a ball valve, before leaving to skid edge.
- We have set up one drain line / system on the discharge line, which has a 1" block valve and will be hard piped to the sump system.
- Discharge Piping Supports:
 - All supports are mounted on structural skid members
 - All supports are secured by clamp style tie-downs.
- The discharge system is designed to manage fluid at nominal conditions
 - 6" Discharge line: 4.93 feet/second for 400 gpm
- Does not include any frictional losses, restrictions or turns in piping system.
- We have utilized Floating Full Port Block Valves on the system to ensure adequate flow rating of the line/system.

Two (2) Only Block Valve Assemblies

Make:	KF
Model:	M317-199S6AG3
Size:	6"
Rating:	600 ANSI - RF
Port:	Floating Ball, Full Port
Construction:	A216 LF2Body. A105N LF2 3 MIL ENP Ball & stem Devlon Seat HNBR Seals
Operator:	Lever
Standard:	Meets the intent of NACE MR0175 Meets CSA Z245.15, API 6D, API 607 / 608 and B16.34

One (1) Only Globe Valve Assembly

Make:	KF
Model:	GL06011RU
Size:	4"
Rating:	600 ANSI - RF
Port:	Globe Valve, Full Port
Construction:	A216 LF2Body. Bonnet, Trim 5 Graphite Packing w/ CORR INHIB 316 Graphite Gasket Braided end/Die formed inner rings
Operator:	Lever
Standard:	Meets BS1873, API 600 intent and B16.5

Two (2) Only Check Valves

Make:	Durabla
Model:	WLC-9061X
Size:	6"
Rating:	600 ANSI
Style:	Spring assisted wafer style
Body:	Carbon Steel
Wetted Parts:	316 Stainless Steel
Spring:	Inconel X-750
Design:	Non Slam

Please Note:

CanDyne has offered this more expensive centerpost piston style check to alleviate any significant fluid oscillation/cavitation which can happen with swing style check valves. Various companies will erroneously offer the swing style which will possibly pound out within a short period of time.

One (1) Only Block Valve Assembly

Make:	Meridian
Model:	MAC2CF
Size:	1"
Rating:	2000 WOG
Port	Full Port
Construction:	A216 WCB Body, 316SS A351 CF8M Ball
Operator:	R-PTFE Seat / PTFE Seal
Location:	Lever
Standard:	Drain off of Pump outlet Meets the intent of NACE MR0175

12 PSV & Bypass Piping System

Piping Design Criteria/Specifications

Piping:	SA-106B
Weld Fittings:	SA-234 WPB
Screwed & Socket Fittings:	SA-105 Grade N
Flanges:	SA-105 Grade N, SA-181
Valves:	Grade 1 or 2
Bolts:	SA-105, SA-216 WCB
Nuts:	SA-193-B7
	SA-194-2H

NDE Requirements:

X-Ray: 10% of all butt welds
Hydro-Test: 100%
PWHT: No
MPI: No
LPI: No

Details:

- CanDyne Pump Services Inc. will manufacture/fabricate the system design to a minimum of ASME B31.3, Alberta Boilers Safety Association (ABSA) Safety and Quality Control Association (AQP-2822).
- CanDyne Pump Services Inc. has also designed the piping system to CanDyne Pump Services Inc.'s specifications CPS AN01 "AAN/CAN" Rev.2.

PSV & Bypass Piping System

Rating:	600 ANSI / 150 ANSI
Piping:	Sch. 80/40
Corrosion Allowance:	1/8"
Size:	3"

Details:

- A discharge PSV is located right after the discharge stabilizers. We have utilized threaded PSV's. They have a 1-1/2" MNPT inlet and a 2-1/2" FNPT outlet that feeds into the 3" bypass line. Flange connections will be added to this PSV for ease in maintenance and removal.
- A 3" 600 ANSI startup / bypass control line is set up after the PSV's. The outlets return back to the common bypass header.
- Thermal Relief PSV is located off of a filter vessel inlet. We have utilized a threaded PSV. It has a 1" MNPT inlet and a 1" FNPT outlet. It will be connected to the drainage system and discharge to the open sump.

One (1) Only Discharge Pressure Relief Valve (PSV-101)

Make:	Farris
Size:	27GA46-M20/00
Set Pressure:	811 psig
Inlet Connection:	1-1/2" MNPT
Outlet Connection:	2-1/2" FNPT
	316SST base, disc, disc insert, CS cylinder
	SST spring
	NACE, MR-01-75 in the Primary Zone
	Blocked Flow

Trim:

Standard:

Delivering Service, Quality and Honesty