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## 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 m<sup>3</sup>/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)

<b>Situation:</b>	Water Injection
<b>Fluids:</b>	Water – Sweet
<b>Solids:</b>	Unknown
<b>H<sub>2</sub>S Present</b>	No
<b>Chlorides:</b>	Unknown
<b>Medium pH:</b>	Unknown
<b>Volume (Capacity)</b>	2180 m <sup>3</sup> /day (400 gpm)
<b>Actual Operating Pressure:</b>	4,965 kPag (720 psig)
<b>Design Discharge Pressure:</b>	9,929 kPag (1,440 psig) - 600 ANSI
<b>NPSHa:</b>	Unknown
<b>Suction Pressure:</b>	50 psig assumed
<b>Pumping Temperature:</b>	Assume 10°C
<b>Vapour pressure</b>	Unknown
<b>Specific Gravity:</b>	1.0 Assumed
<b>Viscosity (cP):</b>	1 cP (estimated)
<b>Electrical Area Hazard:</b>	Class I, Division 2
<b>Location:</b>	Unknown
<b>Horsepower Required:</b>	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 check our equipment listing below to ensure that our product offering is acceptable based upon this criterion, or advise if a change is required.

### 3 Reciprocating Pump System

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

<b>Make:</b>	Weatherford
<b>Model:</b>	W300L
<b>Rated BHP:</b>	300 hp @ 400 rpm
<b>Design:</b>	Triplex Plunger Pump
<b>Condition:</b>	New
<b>Stroke:</b>	5 in.
<b>Plunger Size:</b>	4.00 in.
<b>Volume Requirement:</b>	400 gpm
<b>Suction Pressure Required:</b>	Unknown
<b>Discharge Pressure Rating (M.A.W.P) – with 4.00” plunger size:</b>	5,860 kPag (850 psig)
<b>PSV Pressure Setting (in relation to plunger pump design)</b>	5,592 kPag (811 psig)
<b>Capacity:</b>	73.5% @ 400 gpm
<b>Pump Speed:</b>	294 rpm @ 400 gpm @ 100% volumetric efficiency
<b>Brake Horsepower Required:</b>	187 BHP ( 400 gpm @ 720 psig)
<b>Rated Plunger Load:</b>	10,700 lbs.
<b>Pump Construction:</b>	Cast Iron Power End
<b>Fluid End Material:</b>	<b>Carbon Steel</b>
<b>Plunger Packing Material:</b>	0838 Style Packing
<b>Valve Assemblies:</b>	Stainless Steel Suction & Discharge Abrasive Resistant Valve Assemblies
<b>Trim:</b>	Aluminum Bronze
<b>Crankshaft Extension:</b>	4-7/8” Dia. x 11-11/16” Long
<b>Oil Capacity:</b>	Crankcase: 8 Gallons (30.3 Liters) Splash lubricated power end Minimum speed 200 RPM (to allow for splash lubrication)
<b>Weight – Pump Only:</b>	7,000 lbs.
<b>Suction Connection:</b>	8” ANSI-150 FF
<b>Discharge Connection:</b>	4” API-2000 RJ
<b>Paint:</b>	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 utilize this unit in future produced water service – or possibly sour service – you may wish to entertain the purchase of our duplex stainless steel fluid end within the optional section towards the end of the quotation.

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## 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
- Angle iron support at both ends of guard, bolted to support from sub-skid
- Angle iron support located in middle of backing, to prevent mechanical vibration
- Shaft slots enlarged for future sheave increase/decrease

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## 5 Plunger Packing Lubrication System

### One (1) Only Plunger Packing Lubricator

<b>Make:</b>	Lincoln / Premier
<b>Feeds:</b>	5
<b>Gear Ratio:</b>	112.5:1 ratio
<b>Weight:</b>	Estimated 30 lbs
<b>Mounting / Misc.:</b>	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)

<b>Make:</b>	Kenco
<b>Size:</b>	30 Gallon
<b>Stand Height:</b>	Standard stand
<b>Dimensions:</b>	18 3/8W x 29" L
<b>Location:</b>	Mounted between individual piping runs into the plunger pump.
<b>Misc.:</b>	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.
<b>Daytank Level Float Switch:</b>	Kenco 507-L Within Lubricator on top of plunger pump

## 6 Pulsation Dampener System (Stabilizers)

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

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

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

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

## 7 Sub-Skid System

### One (1) Only Structural Sub-Skid

<b>Dimensions:</b>	Estimate: 10'-1" x 3'-4"
<b>Design:</b>	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.
<b>Paint:</b>	Single coat of Primer. Two coats of Black enamel paint.
<b>Mount:</b>	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

<b>Instrument Tubing:</b>	316SS seamless tubing
<b>Tubing Fittings:</b>	Swagelok
<b>Valves &amp; Fittings:</b>	316 Stainless Steel

#### Details:

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

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

<b>Make:</b>	WGI / Wika
<b>Pressure:</b>	0 – 100 psi
<b>Size:</b>	4" x ½"
<b>Mounted:</b>	Suction line / Instrument Air line
<b>Details:</b>	Liquid Filled NACE stainless steel internals & case 1% Accuracy

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

<b>Make:</b>	WGI or equal
<b>Model:</b>	TBA
<b>Differential Pressure Range:</b>	0-30 psi
<b>Size:</b>	4.5" Dial 2" x ½" NPT Back Connection
<b>Mounted:</b>	Filter vessel
<b>Details:</b>	Liquid Filled NACE stainless steel internals & case 1% Accuracy

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

<b>Make:</b>	CCS Dualsnap
<b>Model:</b>	6900GZE14
<b>Range:</b>	9 - 75 psi Increasing 3 - 39 psi Decreasing
<b>Set Point:</b>	TBC by Client
<b>Mounting:</b>	Needle Valve off of Discharge Lines
<b>Approximate Deadband:</b>	6 psi
<b>SPDT:</b>	Relay
<b>Wetted Parts:</b>	316 Stainless Steel / Viton
<b>Connection:</b>	½" Stainless Steel Port
<b>Classification:</b>	CSA Class I , Groups A,B,C and D; Class II, Groups E,F and G.

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

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

<b>Approximate Deadband:</b>	75 psi
<b>SPDT:</b>	Relay
<b>Wetted Parts:</b>	316 Stainless Steel / Viton
<b>Connection:</b>	½" Stainless Steel Port
<b>Sealing:</b>	Secondary Seal Approved
<b>Classification:</b>	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)**

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

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

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

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

<b>Make:</b>	WGI / Wika
<b>Pressure:</b>	0 – 1000 psi
<b>Size:</b>	4" x ½"
<b>Mounted:</b>	Discharge line
<b>Details:</b>	Liquid Filled NACE stainless steel internals & case 1% Accuracy

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

<b>Make:</b>	WGI / Equivalent
<b>Size:</b>	½"
<b>Rating:</b>	6000#
<b>Style:</b>	Standard-Port
<b>Body/Trim:</b>	Stainless Steel



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

<b>Make:</b>	WGI / Equivalent
<b>Size:</b>	3/4" x 1/2"
<b>Rating:</b>	6000#
<b>Style:</b>	Multi-Port
<b>Body/Trim:</b>	Stainless Steel

**One (1) Only Emergency Shutdown Valve Actuation Assembly**

<b>Make:</b>	KF
<b>Model:</b>	E3766-869G613
<b>Size:</b>	8"
<b>Rating:</b>	150 ANSI
<b>Port:</b>	Floating Ball, Full Port
<b>Construction:</b>	A216 WCB Body, A105N 3 MIL ENP Ball & stem TFM 1700/MPTFE Seat TFE/Graphite Seals
<b>Operator:</b>	Gear
<b>Actuator Construction:</b>	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
<b>Standard:</b>	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

<b>Piping:</b>	SA-106B
<b>Weld Fittings:</b>	SA-234 WPB
<b>Screwed &amp; Socket Fittings:</b>	SA-105 Grade N
<b>Flanges:</b>	SA-105 Grade N, SA-181 Grade 1 or 2
<b>Valves:</b>	SA-105, SA-216 WCB
<b>Bolts:</b>	SA-193-B7
<b>Nuts:</b>	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

<b>Rating:</b>	150 ANSI
<b>Piping:</b>	Sch. 40
<b>Corrosion Allowance:</b>	1/16"
<b>Size:</b>	8" / 4"
<b>NDE Requirements:</b>	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:

- 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 m<sup>3</sup>/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

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

### One (1) Only Block Valve Assemblies

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

### Two (2) Only Block Valve Assemblies

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

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

### Three (3) Only Block Valve Assemblies

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

### 10 Suction Filtration System

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

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

<b>Details:</b>	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 1/2" NPT Instrumentation connections. Filter has 1/2" NPT Vent
<b>Code:</b>	ASME SEC VIII DIV 1, 2010 Edition, 2011 Addenda
<b>Important Note:</b>	A thermal psv will be installed on the suction filter system.

## 11 Discharge Piping System

### Piping Design Criteria/Specifications

<b>Piping:</b>	SA-106B
<b>Weld Fittings:</b>	SA-234 WPB
<b>Screwed &amp; Socket Fittings:</b>	SA-105 Grade N
<b>Flanges:</b>	SA-105 Grade N, SA-181 Grade 1 or 2
<b>Valves:</b>	SA-105, SA-216 WCB
<b>Bolts:</b>	SA-193-B7
<b>Nuts:</b>	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

<b>Rating:</b>	600 ANSI
<b>Piping:</b>	Sch.80
<b>Corrosion Allowance:</b>	1/16"
<b>Size:</b>	6" / 3"
<b>NDE Requirements:</b>	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.

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- 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

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

#### One (1) Only Globe Valve Assembly

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

### Two (2) Only Check Valves

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

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

## 12 PSV & Bypass Piping System

### Piping Design Criteria/Specifications

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

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<b>NDE Requirements:</b>	X-Ray: 10% of all butt welds Hydro-Test: 100% PWHT: No MPI: No LPI: No
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**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**

<b>Rating:</b>	600 ANSI / 150 ANSI
<b>Piping:</b>	Sch. 80/40
<b>Corrosion Allowance:</b>	1/8"
<b>Size:</b>	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)**

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

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### One (1) Only Manual Bypass Valve Assembly

<b>Make:</b>	KF
<b>Model:</b>	E2604-8929G21
<b>Size:</b>	3"
<b>Rating:</b>	600 ANSI – RF
<b>Port:</b>	Floating Ball, Full Port
<b>Construction:</b>	A216 LF2Body, A105N LF2 3 MIL ENP Ball & stem Devlon Seat HNBR Seals
<b>Operator:</b>	Lever
<b>Standard:</b>	Meets the intent of NACE MR0175 Meets CSA Z245.15, API 6D, API 607 / 608 and B16.34

### One (1) Only Suction Pressure Relief Valve (PSV-101)

<b>Make:</b>	Farris
<b>Model:</b>	27DA33H-M20
<b>Set Pressure:</b>	150 psig
<b>Inlet Connection:</b>	1.0" MNPT
<b>Outlet Connection:</b>	1.0" FNPT
<b>Trim:</b>	316SST base, disc, disc insert, CS cylinder SST spring
<b>Standard:</b>	NACE, MR-01-75 in the Primary Zone
<b>Basis:</b>	Thermal Relief

## 13 Structural Skid System

CanDyne Pump Services Inc. will manufacture the system design to a minimum of CWB Standards (Canadian Welding Bureau) (RTS FA1).

### One (1) Only Main Structural Skid Package

<b>Dimensions:</b>	17' – 6" x 22' - 11"
<b>Flooring:</b>	1/4" Checker Plate
<b>Main Members:</b>	W12 @ 40 Wide Flange 2 Beams run the full outside length of package, as well as one beam under the pump. Two Beams run across (one at each end)
<b>Pump Support:</b>	W12 @ 40 Wide flange beams C10 @ 15.3 Channel
<b>Lifting Lugs:</b>	Structurally designed to be lifted with four point lift, with little/no deflection
<b>Cross Members:</b>	W12 @ 40 3 cross beams in total.
<b>Floor Support:</b>	C10 @ 15.3 Channel C6 @ 8.2 Channel 2" x 2" x 3/8" Angle Iron

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<b>Containment Lip:</b>	2" x ¼" Flat Bar
<b>Structural Design:</b>	Oversized Beam Design
<b>Sump System:</b>	Sump area near plunger pump fluid ends. Sump drains to skid-edge
<b>Sump Drain:</b>	2" 150 ANSI sump line for drainage
<b>Insulation:</b>	3" Foam Insulation sprayed underneath structural beams of skid.
<b>Certification:</b>	Stamped and signed structural drawing by an engineer registered to practice in the province of Alberta
<b>NDE:</b>	100% MPI of Lifting Lugs

**Added Value:**

- CanDyne has designed our skid with a structural 'box' style skid, with additional I-beam situated underneath the pump/sub-skid assembly, as well as the piping systems. This allows for a much better four point lift and structural design strength.
- CanDyne does not utilize two large runners in conjunction with lighter outriggers as we do not feel this design is conducive to the requirements of a pump system, where the weight is both under the pump and motor, but also the inlet and outlet piping.
- Our structural skid design is such that it distributes the structural strength where it is needed the most – under the pump sub-skid, piping systems, and other misc. components, as well as under the walls and outside area of the building.

**14 Building System**

<b>Skid Size:</b>	17' – 6" x 22' – 11"
<b>Building Size:</b>	17' – 6" x 22' – 11" x 8' – 6"
<b>Exterior Colour:</b>	Galvanized Steel – exterior walls, roof
<b>Roof:</b>	Gable Style – self framing 22 Gauge galvanized steel
<b>Roof Slope:</b>	4/12
<b>External Walls:</b>	22 Gauge galvanized steel
<b>Building Particulars:</b>	R12 Insulation for walls R20 Insulation for roof 24 Gauge white fluted aluminum lining for interior. 4 mil. Poly vapor barrier Building anchors & fasteners Building flashing & cutouts Ice Rakes

<b>Doors:</b>	<b>One Door – Double:</b> 6' x 7' insulated double man/equipment door Prepainted steel door Locking panic hardware, check chain, single glazed fixed wired glass window, rubber sweeps, weather-stripping, canopy and aluminum threshold <b>One Door – Single:</b> 3' x 7' insulated double man/equipment door Prepainted steel door Locking panic hardware, check chain, single glazed fixed wired glass window, rubber sweeps, weather-stripping, canopy and aluminum threshold
<b>Windows:</b>	<b>Two Windows:</b> 40" x 40" Double glazed aluminum sash glass type sliding windows c/w 1/2 screens & locks.
<b>Louvers and Fans:</b>	<b>Two Louvers:</b> 12" x 18", Wall louvers c/w bugscreen and sliding closer <b>One Exhaust Fans:</b> Dayton 12", Interior wall mounted, explosion proof exhaust fan. c/w back draft damper, storm hood, and screen sized for 12 A.C.P.H.

## Two (2) Only Building Heaters (H-101/102)

<b>Make:</b>	Catadyne
<b>Model:</b>	WX Series
<b>Size:</b>	24" x 36"
<b>Type:</b>	Natural Gas
<b>Starter:</b>	120 VAC
<b>Temperature Setting:</b>	70°F Units come c/w SSOV, Maxitrol and ball valve Protection Grill Temperature Control Valve (thermostat) 24" Vent hood assembly
<b>Classification:</b>	Class 1, Div. 2
<b>Regulator:</b>	912 Fisher Regulator
<b>Mounting:</b>	HSS Mounting Posts

## 15 Sump & Drain System

### One (1) Only Drain System

<b>Type:</b>	Hard Piped
<b>Size:</b>	1"
<b>Design Pressure:</b>	Atmospheric
<b>Connection:</b>	T.O.L. To Piping

<b>Valves:</b>	1" 2000# CS Ball Valves – THD(Suction) 1" 2000# CS Ball Valves – THD (Discharge)
<b>Drain Locations:</b>	One off the Basket strainer One off the filter vessels One off the suction line One off the discharge line

## 16 Surface Preparation and Painting

<b>Structural Skid:</b>	Sandblasted top and sides of skid and guards to SSPC-SP6 (Commercial blast grade) Top Coat: DTM F34 Warm Grey Underside sandblasting and painting of skid will be additional.
<b>Piping:</b>	Sandblasted external spool pipe to SSPC-SP-6 (Commercial blast grade). Top Coat: DTM F34 Warm Grey

## 17 Documentation, Engineering and Testing

### Three (3) Only Operating Manuals

- Two copies CDROM format, one copy paper (field copy)
- Pump parts manual
- Pump operation and service manual
- Pump drawings
- Pump specifications
- Centrifugal charge pump operation and service manual
- Electric Motor parts & operations manual
- Relief valve parts/operations manual
- Instrumentation installation/operations manual
- Suction & discharge stabilizer installation/parts/operations manual
- Miscellaneous parts/operations manual systems
- Design drawings consisting of
  - Process & Instrumentation Drawings (P&ID), Line List P.Eng. Stamped
  - PSV List
  - General arrangement drawing
  - Elevation drawing
  - Building layout
  - Detail drawings (sump/heater support, etc.)
  - In Adobe (PDF) format only.
- One paper operation manual to ship within package or system, unless stated otherwise.

- CanDyne's Quality Assurance manual is available for clients to review as required at any time and/or to request an 'uncontrolled copy' for an additional \$200.00, and is subject to a non-disclosure agreement.
- All Supplier Documentation Requirement Listings, (SDRL) will be considered on an individual project basis and may incur additional charges if deemed outside of the normal scope of supply.
  - Any additional forms, documentation and or drawings for submittal and requiring development to suite a mandatory format and is deemed to be outside of CanDyne's standard'(s) will be an additional cost to be determined on a case by case basis.

#### **One (1) Only QA/QC Data Book**

- Please note that it is an ABSA requirement that you, as company representative, have to sign off on AB-83 forms and witness requisite testing and reporting as required.
- Mill Test Reports (MTR's) for all piping, flanges and fittings
- Pressure relief calibration tests
- Instrument data sheets (as provided by instrument supplier)
- Pressure test reports
- X-ray reports
- AB-83 ABSA form

#### **P&ID Certification, Engineering Work, and ABSA Requirements, System Interactions:**

- CanDyne current design drawing will be completed with Autodesk's AutoCAD 2D software, or Autodesk Inventor 3D software programs – depending upon scope CanDyne will determine which program is to be utilized, or upon client request.
- Per the ABSA Safety Codes Act AB-508 and the Pressure Equipment Safety Regulation AB-516 Rev.2, if the medium is non-compressible fluid, then CanDyne Pump Services Inc. (CanDyne) is not required to register the piping system with ABSA if the volume of piping within the skidded or packaged unit is over  $0.5 \text{ m}^3$ . However, if the fluid is deemed to be expansible per the definition given in the Pressure Equipment Safety Regulation AB-516 Rev.2 then CanDyne will register the skidded or packaged unit with ABSA and will provide the required P.Eng. stamped drawing(s).
- CanDyne will NOT register with ABSA all piping systems  $<0.5 \text{ m}^3$  in volume unless the client specifically requests. Upon client request, it will then be incorporated into the Order Confirmation documentation. Additional charges will be applied for this service.
- CanDyne can incorporate within the scope of quotation the cost to register piping in AB, SK or BC as required. Professional Engineered stamped drawings are an additional cost to the client unless requested initially, and mainly cover cost of Errors and Omissions insurance with labour of engineering included within scope of supply.
- Various analyses can be done for a number of purposes – stress, thermal, structural, etc. – CanDyne will make best efforts to design the system to the best of its ability under these conditions. However, without the analysis being completed we cannot guarantee the system has been designed to these requirements. Therefore, if the various analyses

- requested by the client dictate a change in systems and/or design, the cost of any changes will be at additional cost to the client.
- Note that 'system interaction' – the on-skid pump and piping in conjunction with the off-skid piping – could possibly cause, very infrequently, unforeseen vibration or pulsation forces that will require further analysis from specialists (CanDyne has personnel on retainer for this).
    - You can either request a design analysis of CanDyne's equipment, as well as proceed with an analysis of your off-skid piping, at the outset (on a cost plus basis).
    - Or you can presume this will not occur with your system, and then possibly have to do so upon completion of said system and a problem occurs.
    - This is something that neither CanDyne nor client personnel can predict until the system is started.
    - CanDyne wants this know upon time of quotation, as CanDyne states that this responsibility is up to the client entirely and the cost should be borne by the client either up front initially or after construction.
  - CanDyne will spend a maximum of 4 hours per quotation reviewing the client supplied, technical specifications (specifications); and will make every attempt to comply with the specifications within the allotted time frame.
    - Within the quotation, CanDyne will attempt to fulfill any specific, specification item that is clearly identified in the clients Request for Quote or Scope of Work.
    - CanDyne is not responsible for missing client specification items.
    - If a specification item is not included within the quotation provided by CanDyne, the client or client representatives can advise CanDyne of such and we will revised our quotation accordingly.
  - The below excerpt pertains to the owners responsibilities with regards to ASME B31.3-2010:

*300 (b) Responsibilities*

*(1) Owner. The owner of a piping installation shall have overall responsibility for compliance with this Code, and for establishing the requirements for design, construction, examination, inspection, and testing which will govern the entire fluid handling or process installation of which the piping is a part. The owner is also responsible for designating piping in certain fluid services and for determining if a specific Quality System is to be employed. [See paras. 300(d)(4), (d)(5), (e), and Appendix Q.]*

**Additional Engineering, Documentation or Testing:**

- CanDyne has estimated 20 hours of engineering and design time incorporated within this particular system. This is deemed a 'normal' amount of work for this type of system for the average client.
  - You will be notified by your Project Manager immediately upon reaching the allowance stated above.
  - If you have requested additional work to be completed over/above this for engineering, vendor documentation or testing, a change order will be issued. When approved, you will be invoiced for the additional time per the rates below: