



SHOP DRAWINGS – REV A

FOR

BERENS RIVER –

PACKAGED WATER TREATMENT PLANT

MODEL: DAF-20

EQUIPMENT: DISSOLVED AIR FLOTATION AND FILTRATION EQUIPMENT

CLIENT: ARNASON INDUSTRIES

JOB ORDER No: 11095

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SECTION 01 - DESIGN CRITERIA

DESIGN CRITERIA

Plant Intake Water Quality:

True Colour:	60 - 70 TCU
Ph:	7 to 8.5
Total Dissolved Solids:	35 - 40 mg/L
Turbidity:	5 to 15 NTU
Total Organic Carbon (TOC):	10 to 15 mg/L
Hardness:	25mg/L
Alkalinity:	20 – 25 mg/L

Plant Flow Rate:

DAF Flow:	4.54 m ³ /h (20 USgpm)
Filter Flow:	4.54 m ³ /h (20 USgpm)
No. of Units:	1

DAF Hydraulic Loading:

DAF Clarifier:	4.89 m ³ /h/m ² (2 USgpm/ft ²)
Saturator:	24.91 m ³ /h/m ² (10.19 USgpm/ft ²)
Filter:	6.98 m ³ /h/m ² (2.86 USgpm/ft ²)

DAF Detention Time:

Flocculation:	22.25 min
DAF Clarifier:	5.6 min

Total: 27.85 min

DAF Filter Backwash Flow Rate:

Backwash (Water Only): 25.4 m³/h (112 USgpm) @ 13.7m (45 ft) TDH –By Others

Backwash (During Air Scour)

Water: 12.7 m³/h (56 USgpm)

Air: 21 scfm

DAF Filter Media:

Filter Media depth

450 mm: 1.0 mm anthracite, UC 1.5

450 mm: 0.45-0.55 mm sand, UC 1.45

Chlorine Disinfection:

By Others

Wastewater:

DAF Skimmer Wastewater

DAF Skimmer Wastewater Flow: 5-10 L/h

Flow Type: Continuous when the plant is running

DAF Skimmer Wastewater Total Solids Concentration (TSS): 15 to 20 g/L

DAF Skimmer Coagulant (Alum or PAC) Concentration: 80 to 100 mg/L

Filter Backwash Water

Filter Backwash Flow: 25.4 m³/h (112 USgpm)

Flow Type: Intermittent or Once a day for a duration of 10 minutes

Backwash Wastewater Total Solids Concentration (TSS): 150 to 200 mg/L

Rinse Wastewater Flow: 20Usgpm

Flow Type: Intermittent or Once a day for a duration of 15 to 20 minutes

Rinse wastewater characteristics: Clean and very little solids

Wastewater from Online Analyzers

Flow from each turbidimeter: 0.5 to 0.75 Usgpm

Characteristics of wastewater: Clean and very little solids

**SECTION 02 – PROCESS AND CONTROL
DESCRIPTION**

SECTION 2 - PROCESS AND CONTROL DESCRIPTION

Corix DAF-20 Process Control Description

Plant Start Up/Shut Down

The DAF Plant operation is controlled by the existing reservoir level. On receipt of a low reservoir level signal, the plant PLC starts and opens the influent raw water flow control valves to provide the desired flow and start selected chemical feed pumps (when flow is sensed by inlet flow meter). On high reservoir level, the plants shut down. All control valves close, all chemical dosing is stopped and the raw water flow to the plant is stopped.

Raw Water Flow Control

The DAF plants are designed to run at a constant, pre-set flow rate. The basic raw water control valve on each train is a modulating butterfly valve and is located on the raw water inlet line. The valve would be controlled using a PID loop in the PLC in conjunction with a 4-20mA flow signal from the flowmeter to maintain the raw water flow set point.

It opens on instruction from the PLC following initiation of plant start up on low reservoir level or another control signal.

Chemical Systems and Mixing

The plant chemical dosing systems include the following:

Primary Coagulant: Alum (Liquid) or Clear PAC180

pH Adjustment: Caustic or Sodium Hydroxide

Chlorine disinfection: Sodium Hypochlorite

A static mixer on the inlet line mixes the coagulant with the raw water.

Flocculation

Following mixing, the coagulated water passes sequentially through a two stage, mechanical flocculator. Each stage of the mechanical flocculator is equipped with a variable speed drive to provide for variations in energy input and to allow tapered flocculation to optimize floc formation. Flocculator speeds are manually set on the plant control panel.

Manual drain valves permit tank draining and cleaning. Normally, this will not be required for more than 6 month intervals.

Dissolved Air Flotation Clarifier

The flocculated water enters the inlet contact zone of each dissolved air flotation cell at a low level. Here, microscopic air bubbles of approximately 50 microns in diameter are introduced which attach to the floc particles rendering them buoyant. The contact zone is bounded by an inclined baffle which ensures good contact and eliminates the potential for denser layers of un-aerated water to pass back to the air inlet zone. As the flow passes over the top of the inlet baffle the buoyant floc particles rise to the surface and form a floating sludge layer. Clarified water is collected from the floor of the cell through submerged perforated pipes and then passes over a high-level outlet weir.

The floating sludge layer is periodically removed by a mechanical, variable speed, surface skimmer. When activated, the skimmer pushes the float into the sludge collection trough. The float in the trough drains to waste. The duration and frequency of operation of the scraper are both adjustable through the PLC. On plant shutdown the scraper will continue to operate for an adjustable period (0-30 mins) to ensure all float is removed from the surface of the DAF tank.

A spray bar with solenoid valve is fitted within the DAF float trough to assist in the removal of the float. The spray bar control has a HOA. In auto, the duration and frequency of operation of the spray bar are both adjustable through the PLC.

To generate the microscopic air bubbles approximately 6-10% of the clarified water is pumped using a recycle pump through a packed tower saturator. One saturator is provided to feed all DAF trains. The water is sprayed into the top of the saturator and flows downward over exposed tri-pack packing. Compressed air is also introduced into the top of the saturator and the air space pressure maintained at between 60 and 80 psi. As the water passes downwards it becomes fully saturated with air and then collects in a pool at the foot of the saturator. The level of this pool is monitored using a differential pressure transmitter that controls the inlet flow control valve. The signal from the differential pressure transmitter is sent to the PLC and a PID loop modulates the recycle pump flow using VFDs to maintain the water height in the saturator vessel.

The fully saturated water passes from the foot of the saturator to each DAF cell and into injection manifolds containing fixed orifice nozzles. The nozzles cause a sudden release of pressure and the dissolved air is released from solution in the form of microscopic bubbles. Careful design and orientation of the inlet nozzles eliminate the potential for turbulent recycle flows to damage the incoming floc.

Recycle Pump and Saturator System

Recycle flow rate is measured using a magnetic flowmeter located on the saturator recycle discharge line. Normal control philosophy for the recycle saturation system is as follows:

1. The compressed air is provided from the Corix supplied compressor package.
2. Air pressure within the saturator is set by manual adjustment of the pressure regulator. A local pressure gauge provides indication of the pressure in the saturator. A pressure safety relief valve prevents over-pressurization of the saturator. A pressure switch on the saturator controls the compressor.
3. The saturator level is maintained within a pre-set range by modulation of the recycle pumps using VFDs from a PID control loop with signal input from the saturator differential pressure transmitter.
4. The selection of the duty recycle pump is made at the PLC. Manual valves that isolate the backup recycle pump must be operated by hand.

5. A differential pressure transmitter continuously monitors the level in the saturator. If the level drops to the low-low level (settable in the PLC), the PLC will cause the manifold valves to close, the plant will immediately shutdown and an alarm condition will be announced. Typically this results in a call out to the operator. The shut down avoids the potential for uncontrolled compressed air to be fed into the DAF cells, causing a process upset. The manifold valves will open only when power is available and the saturator water level is above the low-low level.
6. In a similar fashion, if an extreme high level is sensed within the saturator, an alarm is activated, the recycle pump is shutdown, the manifold valves close, and the treatment plant is immediately shutdown.
7. In the event of a power failure the “fail close” manifold valves immediately close and ensure that normal water level and pressure are maintained within the saturator.

Filtration

From the clarifier section, water flows to the top of the filter section and is filtered through a dual media filter. The filter operates on a constant level, constant rate principle.

The filter is equipped with:

- 38mm electrically actuated, modulating effluent (filtered) water flow control valve
- 38mm electrically actuated, modulating, rinse flow control valve
- 75mm Cla-val 43-01 Rate if Flow Control - backwash inlet valve
- 38mm electrically actuated, on/off air scour inlet control valve

The media comprises:

450 mm	1.0 mm anthracite
450 mm	0.45-0.55 mm sand, UC 1.45

The filtered water is collected through an array of 0.2 mm, slotted polypropylene nozzles and flows into a plenum at the base of the filter. The recycle pumps modulate using VFDs to maintain a constant level in each filter.

A pressure transmitter provides indication that total head loss has exceeded the maximum acceptable level and that backwashing is required. This indication can also be initiated through high filtered water turbidity, by elapsed run time, or by manual initiation.

Filter Backwashing

After a considerable period of time, depending upon the amount of turbidity contained in the incoming water, the filter media becomes saturated with the removed solids causing an increase in filter headloss and/or a rise in effluent turbidity. Backwashing of the media is then necessary. The backwash sequence includes an initial air scour followed by a water only backwash. The backwash water supply is provided by others. A Cla-Val flow control valve modulates the backwash flow and provides for controlled start-up of the backwash flow. Dirty backwash water is collected through surface launders and is directed to waste.

After completion of the backwash, the filter is run to waste until the effluent quality meets the required standard. At that point the filter is returned to normal service. The full backwashing sequence can be both initiated and controlled either manually or automatically. Automatic operation is through a PLC controller with sequence times easily adjustable by the plant operator.

The following provides further details of this process.

Backwash Initiation

Backwashing is initiated automatically through either;

- high media head loss, or
- high filtered water turbidity, or
- elapsed run time, whichever preset limit value is first reached.

The backwash sequence can also be initiated manually. A loss of head transmitter at each filter provides indication that total head loss has exceeded the maximum acceptable level and that backwashing is required.

The PLC monitors filter elapsed run time. This allows for an automatic "scheduled" backwash to be programmed into the PLC controller and is normally used in installations where demand from the clearwell is very low and the operator wishes to backwash on a regular basis.

On initiation of backwash, the influent valves close, the raw water flow stops and the chemical feed pumps are shut down automatically.

Air Scour Flow

Air for the air scour is supplied by the Corix supplied blower package. The air scour requires $5.05 \text{ m}^3/\text{min}/\text{m}^2$ (3 scfm/ft²).

Backwash Flow

Backwash water is supplied from the clearwell using a dedicated backwash pump (by others). The Cla-Val flow control valve modulates the backwash flow and provides for controlled start-up of the backwash flow. A lower rate is used for the combined air scour/backwash component of the cycle and a higher rate for the water only backwash component. These rates are established during start up but are normally in the range of 6-12 USgpm/ft² and 12-16 USgpm/ft². On/off electric butterfly valves open upon the start of backwashing. The backwash flow is distributed evenly through the slotted PVC filter nozzles in the base of the filter. Dirty backwash water is collected through surface launders and is directed to the waste sumps.

Filter to Rinse

Following completion of the backwash cycle the filter is run to waste through a waste line fitted with an electrically operated butterfly valve. The purpose of the rinse is to settle and flush the media prior to normal operation of the filter. The filter gradually matures and effluent turbidity falls to acceptable levels. After a preset time interval, the rinse to waste valve closes, the effluent (filter) valve opens and the filter returns to normal service. Flow rate during the rinse cycle is the same as during normal filter operation.

Filter Backwash Sequence

Full details of the backwash sequence are:

- Backwash initiation (by loss of head, high turbidity, elapsed time or manual)
- Close raw water valve, and stop chemical dosing
- Filter drains down to low level using rinse to waste valve
- Filter effluent valve de-energized and valve held closed
- Close solenoid for turbidity meter sampling
- Start air scour blower
- Open air scour inlet valve and air scour for adjustable period, typically 3-4 minutes
- Open the backwash valve at low flow setting
- Open backwash inlet flow control valve
- Combined air scour/water wash for adjustable duration
- As water level in filter rises, air scour flow slowly reduces
- Close air scour inlet valve
- Stop air scour blower
- Change backwash pump to high flow setting
- Water only backwash for adjustable duration
- Filter water level rises to wash water outlet weir and dirty washwater flows to waste
- After pre-set adjustable time (typically 6 minutes) close backwash inlet valve
- Stop backwash pump
- Allow media to resettle
- Open raw water inlet valve
- When flow sensed by raw water flow meter, restart chemical feeds
- Open filter to rinse valve and filter to waste
- After pre-set interval close filter to rinse valve
- Open filter effluent valve, turbidity sampling solenoid and return to normal service

Plant Level Protection

An ultrasonic level transmitter is installed in each filter section to detect an abnormal low filter

level. If this occurs, the effluent valve is closed and PLC sends out low-level alarm. This prevents premature backwash by an artificial loss of head signal and prevents air binding of the filter media.

Filter Plenum Over-Pressure Protection

A pressure transmitter is installed in the filter section to detect any abnormal high pressure during backwashing. If pressure exceeds 62 kPa (9 psig), the backwash valve is closed and backwash pump will be shut off. The PLC will send out a plenum over pressure alarm, preventing unnecessary damage to the plenum.

Online Monitoring

Turbidity

Hach 1720E turbidimeters are to be installed at the outlet of the filter trains to continuously monitor water quality. Turbidity is indicated locally to the unit and relayed to the plant control panel and PLC for indication. Pre-set turbidity limits allow for level alarms. Waste flows (0.5 to 0.75L/min) from the sensors are sent to local drains.

Filter Level

An online level transmitter continuously monitors the level in the filter. The filter level signal is sent to the PLC and is used for plant start-up and shut-down.

Packaged Plant Control Panel

Plant shall be supplied with a NEMA 4 enclosure c/w Allen Bradley Compact Logix PLC.

Control panel shall allow automatic operation of all packaged plant systems, including but not limited to: control valves; flocculators, backwash operation; etc. All equipment shall have individual HOA selector switches and indicator lights.

SECTION 03 – EQUIPMENT SPECIFICATION

Project: Berens River WTP
Plant: DAF-20
Ref: 11095

22-Feb-13

Part Quantity

Description

Tank

- 1 Corix DAF-20 Prefabricated water treatment trains
Treatment capacity 20 USgpm per train, including
2 stage mechanical flocculation
DAF clarifier
Dual media filter
Tank Internal Dimensions 4 ft wide X 7 ft long X 9 ft high
Constructed with 1/4" marine grade aluminum, 5086 H116 or H32
Shipping weight 2000 Kg per tank
Media weight 1,000 Kg

Walkway

- 1 Aluminum construction along one side of tank c/w stairs

Influent Raw Water Flow Control

- 1 1-1/2" MAS G2E Ball valve c/w EPI2 electric modulating actuator

Chemical Injection and mixing

- 1 1-1/2" Westfall static Mixer c/w 2 injection ports

Flocculation

- 1 Two stage mechanical flocculator c/w
Aluminum paddles
Variable speed 1/4 HP, 208V/3/60Hz and reduction gearbox
Adjustable G values: 100 to 10 S-1
Detention time: 22.25 mins total
One 25mm (1") MAS drain valves per flocculation cell.

Dissolved Air Flotation Clarifier

- 1 Dissolved Air Flotation clarifiers with mechanical defloating
Max. net surface loading: 4.89 m/hr (2.0 USgpm/ft²)
Max air loading 12 mg/L
Inclined inlet baffle to ensure good bubble contact
One PVC Sched 80 recycle injection manifolds with fixed orifice 304SS nozzles
Two, 50 mm dia, perforated PVC effluent collector laterals
Full width outlet weir with adjustable top plate
Mechanical float skimmer

Equipment Specification Sheet

Project: Berens River WTP
Plant: DAF-20
Ref: 11095

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Part Quantity

Description

	Frame:	Marine grade aluminum alloy 5086-H116/H32		
	Blades:	2 full width aluminum blades per scraper compete with Polypropylene bristles with depth adjustment		
	Drive shafts:	304 Stainless steel		
	Chain:	Polymeric Chain Type NH45 as manufactured by Rex. These chain materials are in compliance with FDA regulations for use in direct food industry. It is a low friction thermoplastic, resistant to most chemicals. Wide wearing strips on top and bottom of links offer extended sliding wear life.		
	Sprockets	Polymeric as manufactured by Rex.		
	& Idler Wheel:	Type N45 sprocket, 1.63" pitch, 12 teeth. 6.3" dia. idlers.		
	Motor drive:	AC Drive c/w gear reducer, 0.25HP, 208V/3PH/60Hz c/w Eaton variable speed controller		
	Float beach weir and sludge trough in marine grade aluminum			
1	Float spray washdown assembly			
		19mm	Cla-Val #136 Solenoid Control Valve c/w flow limiting assembly	
1	Set	Recycle Inlet Valve c/w		
		25mm	MAS G2E Ball valve w/ lever handle	
1	Set	Recycle Outlet Valve c/w		
		25mm	MAS G2E Ball valve w/ lever handle	
2	Drains	25mm	MAS B-3 brass ball valve c/w lever handle	

Saturation/Recycle System

One skid mounted saturator/recycle system and including following components

2	Recycle pumps (1 duty, 1 standby) per saturator skid	Grundfos Model CR1S vertical multistage pump 2 USgpm @ 200 ft TDH c/w VFDs 1/2 HP, 3500 RPM, 208/3PH/60Hz		
2	Sets	19mm	Pump check valves	
2	Sets	25mm	MAS B-3, Pump Inlet Isolation valves	
2	Sets	19mm	MAS B-3, Pump Outlet Isolation valves	
1	Saturator	Packed tower configuration for increased efficiency 150mm dia epoxy coated steel vessel		
	Following components will be pre-fitted to saturator			
	Lifting lugs and inspection manway			
	ARO air pressure regulator			
	Sight glass with isolation valves			

Equipment Specification Sheet

Project: Berens River WTP
Plant: DAF-20
Ref: 11095

22-Feb-13

Part Quantity

Description

ASME safety pressure relief valve
MAS #700 air inlet check valve
ENFM pressure gauge
E&H differential pressure transmitter w/ LCD display
25mm dia. polypropylene media (900 mm deep)
Bottom drain and MAS B-3 valve
ASCO P-Series pressure switch
ASCO solenoid valve
Recycle flow control valve
25 mm MAS G2E Ball valve c/w EPI2 electric on/off actuator
Fail close, saturator outlet valve

Air Compressor (for DAF Saturation Process)

- 1 Duplex Air Compressor, Oilless
- 8 Usgal receiver

Filtration

- 1 Dual media filters
Max surface loading 2.86 USgpm/ft2 (6.98 m/h)
Water backwash with air scour
Backwash at 16 gpm/ft2, air scour at 3 scfm/ft2
Filter Media to AWWA Standard
450 mm 1.0 mm anthracite, UC 1.5
450 mm 0.45-0.55 mm sand, UC 1.45
Underdrain: Orthos nozzles at 150 mm (6") centres
Loss of Head WIKA Pressure Transmitters c/w Pressure Gauge

Valves (each filter)

- 1 *Effluent* 38 mm MAS G2E valve c/w EPI2 electric modulating actuator
- 1 *Rinse* 38 mm MAS G2E valve c/w EPI2 electric modulating actuator
- 1 *Backwash inlet* 75 mm Cla-Val 43-01 Rate of Flow Control valve
- 1 *Outlet Isolation* 75 mm Keystone #61L butterfly valve c/w lever
- 1 *Air Scour* 38mm MAS G2E valve c/w EPI2 electric on/off actuator
- 1 *Drain* 38mm MAS B-3 Ball Valve

Backwash Pump - By Others (112 usgpm at 50 ft TDH)

Effluent Pump

Equipment Specification Sheet

Project: Berens River WTP
Plant: DAF-20
Ref: 11095

22-Feb-13

Part Quantity

Description

- 1 Goulds End Suction Stainless Steel Pumps, Model # 1ST1C4F4
20 usgpm at 50 ft TDH, 240V/1 Phase
c/w pressure relief and check valve

Air Scour Blower

- 1 *Blower* Republic regenerative Blower
c/w 240V, 1 Ph, 60 Hz, TEFC motor &
- 1 *Check Valve* 38mm Double Door Check Valve
- 1 *Isolation* 38mm Mas B-3 Ball valve

Control Panel

- 1 Corix control panel
Fully automatic plant operation with manual override
Allen Bradley type Compact Logix programmable logic controller
Allen Bradley HMI colour screen
Nema 12 Enclosure, CSA approved
UPS and Modem

Instrumentation

Filtered water turbidity

- 2 Hach 1720E low range turbidimeter c/w Common SC200
- 1 lot *Accessories* Solenoid Controls, Calibration Kit

Flowmeter

- 1 25mm Endress and Hauser Magnetic Flowmeter *Raw Water*
- 1 Seametrics PE102 Low Flow Magmeter *Recycle Flow*

Chemical Systems

Storage, mixing and dosing systems as follows

PACL

- 1 Stenner Peristaltic Pump
- 40 ft Flexible chemical tubing

Caustic Soda (or Spare)

- 1 Stenner Peristaltic Pump
- 40 ft Flexible chemical tubing

Hypochlorite

- 1 Stenner Peristaltic Pump
- 40 ft Flexible chemical tubing

Equipment Specification Sheet

Project: Berens River WTP
Plant: DAF-20
Ref: 11095

22-Feb-13

Part Quantity Description

Drawings and manuals

- 3 Corix Mechanical Layout
- 3 Corix Electrical Drawings
- 3 Operating and maintenance manuals

Start up & training

1 trip, 12 days on site for start up and training

Shipping FOB, Winnipeg. Forwarding to site by others.

Warranty

12 month period commencing from date of commissioning of the plant or 18 months from delivery, whichever is earlier.

THIS PROPOSAL DOES NOT INCLUDE:

- Receiving, off-loading and suitable storage of material
- Concrete foundation for plant
- Field erection, labour and supervision
- Piping connections, influent and effluent piping, rinse and backwash piping, yard piping, air scour piping, drain piping, or other piping outside the plant structure
- Raw water, treated water, backwash supply pumping
- Field electrical wiring and conduit
- Field paint or painting labour
- Installation of air compressor and instrumentation air connections to required instruments
- Installation of chemical feed systems and air scour blower
- Onsite cleaning and washing of tank
- Field electrical wiring and conduit is by others
- Corix will not be providing any material or services not quoted in our sections.

SECTION 04 – EQUIPMENT DATASHEETS

SECTION 4 - EQUIPMENT DATA SHEETS

1. Westfall Static Mixer
2. MAS2 G2E Stainless Steel Ball Valve
3. MAS B3 Brass Ball Valve
4. Keystone Butterfly Valves
5. Keystone Electric Actuators
6. Dodge Flocculator Gear Box
7. Republic Regenerative Blower
8. Cla-Val 43-01 Backwash Rate of Flow Control Valve
9. Cla-Val #136-01 Solenoid Control Valve
10. Wika Pressure Transmitter and gauge
11. Hach 1720E Turbidimeter c/w SC200 Controller
12. Endress and Hauser Magnetic Flowmeter
13. Seametrics Low Flow Magmeter
14. Grundfos – Recycle Pumps
15. Cla-Val #55F Pressure Relief Valve
16. Enermex Saturator Tank
17. Campbell Hausfeld Air Compressor
18. E and H Differential Pressure Transmitter – For Saturator Tank
19. Asco Pressure Switch – For Saturator Tank
20. Kunkle Safety Relief Valve
21. DAF Polymeric Chain and Sprockets
22. Milltronics “The Probe” Level Transmitter
23. Stenner Chemical Feed Pump
24. Spears PVC Ball Valve
25. Erecta Float Switches – For Chemical Tank Level Monitoring
26. Asco Solenoid Valves
27. Jaeger Tri-pack media for Saturator Tank
28. Orthos Nozzles for Filter