

S-308F-436-5100
SEAWATER REVERSE OSMOSIS SYSTEM
JUNE 2012



**MANUAL FOR
OPERATION AND MAINTENANCE OF
REVERSE OSMOSIS SYSTEM
W/O #: 5100**

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GENERAL INFORMATION and SAFETY

DISCLAIMER:

The information contained in this document is subject to change without notice. Applied Membranes Inc. shall not be liable for technical or editorial omissions made herein; nor for incidental or consequential damages resulting from the furnishing, performance, or use of this material.

READ THIS MANUAL:

Prior to operating or servicing this unit, this manual must be read and understood. If anything is not clear, call for assistance before proceeding. Keep this and other associated manuals for future reference and for new operators or qualified service personnel.

USE PROPER POWER CONNECTIONS:

Use proper wiring and connection methods to satisfy local electrical codes. **SHOCK HAZARD:** Connect this unit to a properly grounded connection in accordance with the National Electrical Code. **DO NOT**, under any circumstances, remove the ground wire or ground prong from any power plug. Do not use extension cords or an adapter without proper consideration.

WARNING:

Unplug the system prior to servicing.

WARNING:

Do not make any alteration or modification in the wiring or plumbing of the system. This can result in damage to the system and cause injury to operators or users.

WARNING:

Flush the system for 30 minutes before use to remove all chemicals present.

CAUTION:

Chlorine can damage the membranes. Chlorine should be removed from the feed stream before entering the system. The feed stream should be tested for chlorine at least once a week. Always follow proper maintenance procedures.

CAUTION:

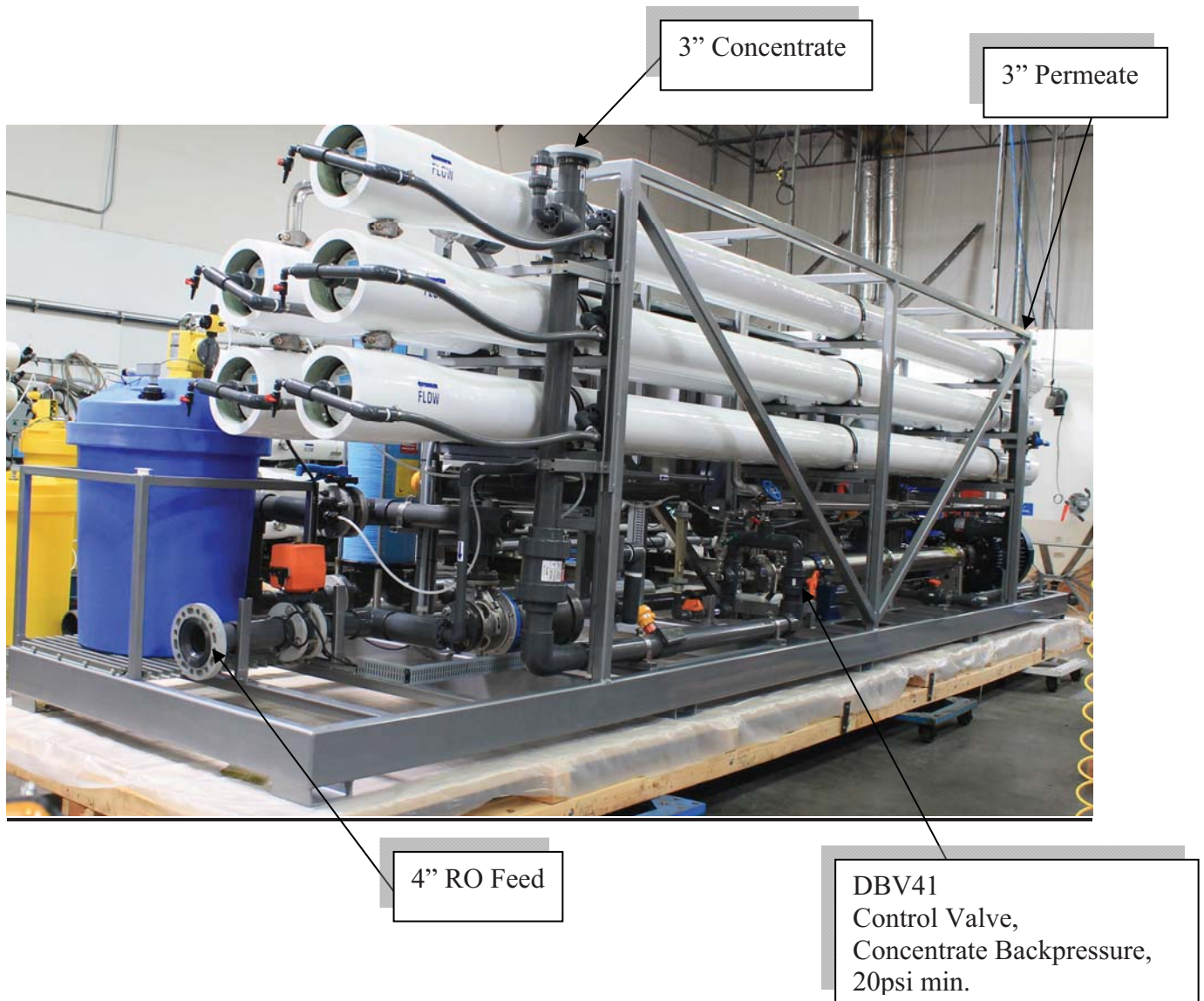
Never let the system freeze. Freezing can damage the membranes and plumbing.

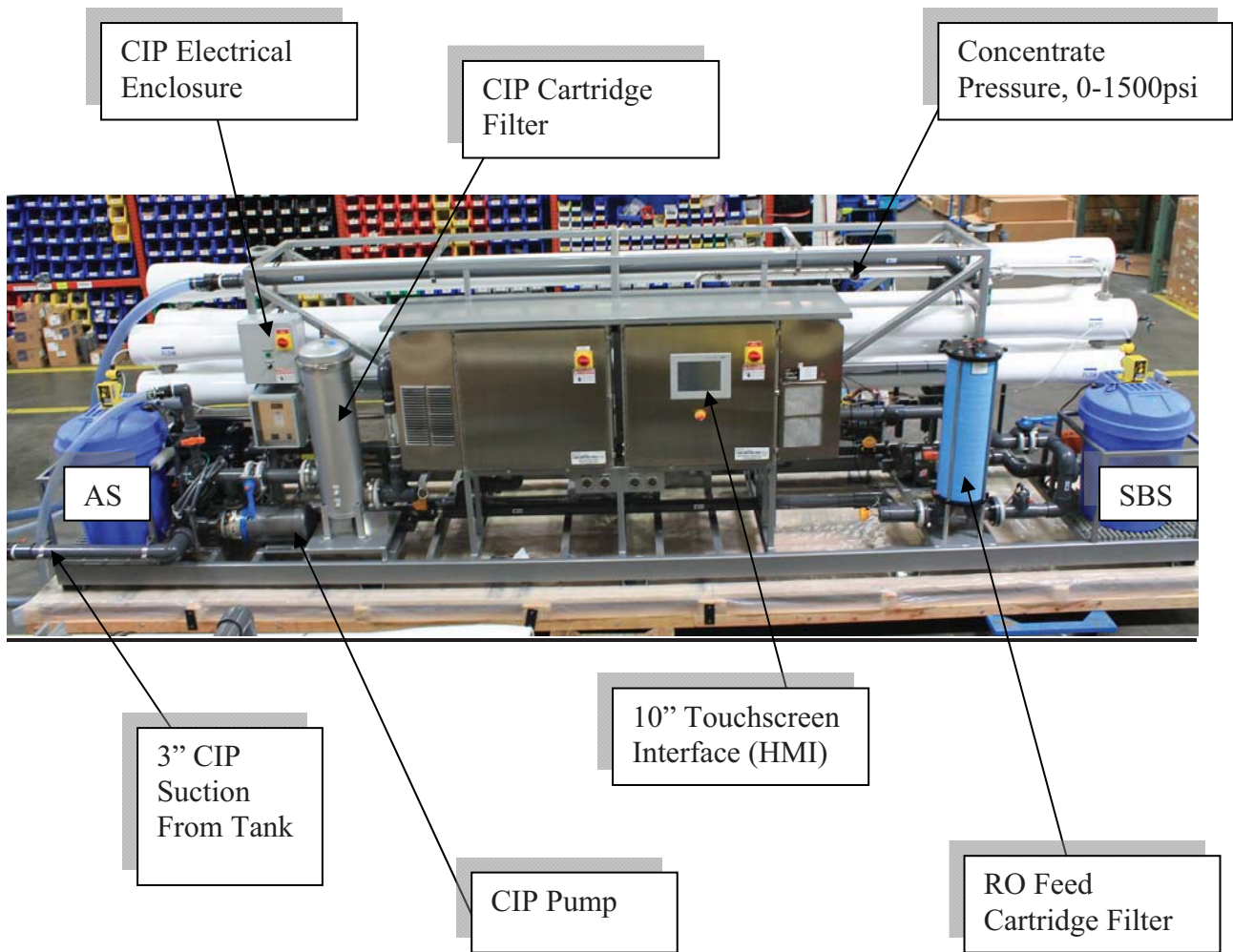
	carbon system.
6	Cleaning is required when normalized permeate flow drops by 15%.
7	RO permeate pH will generally be below neutral and may cause corrosion to piping. Adjustment of pH by injection of Sodium Hydroxide or by a calcite filter is recommended if corrosion is possible.
8	To preserve membranes use 1% sodium metabisulfite (0.1 lbs per gallon) To dechlorinate feed water, use 30-40 % solution SMBS, (3.3 lbs per gallon), Inject at 1.5-3 times the chlorine concentration.

COMPONENT	TYPE	PART REFERENCE	ADDITIONAL INFORMATION		
Pressure Vessels:	1,200 PSI	PRO-8-1200	Array: 5		
RO Pump:	Fedco	4-040-27-0405-100HP	480 VAC	3 PH	60 HZ
CIP Pump:	Goulds	YP4SH2L52AO-10HP			
RO Skid Line Sizes:	FEED: 4"	PERM: 3"	CONC: 3"	CIP: 3"	
Source Water Booster Pump:	FEED: 3"	OUTLET: 3"			

CIP OPERATING CONDITIONS	DESIGN
Cleaning Operating Pressure, PSI	40-60
Stage 1 Cleaning Flow Rate (8 vessel in Parallel), GPM.	200 (max)
pH, Hardness Cleaning	2-3
pH, Organic Cleaning	11-12

Seawater Desalination System Overview





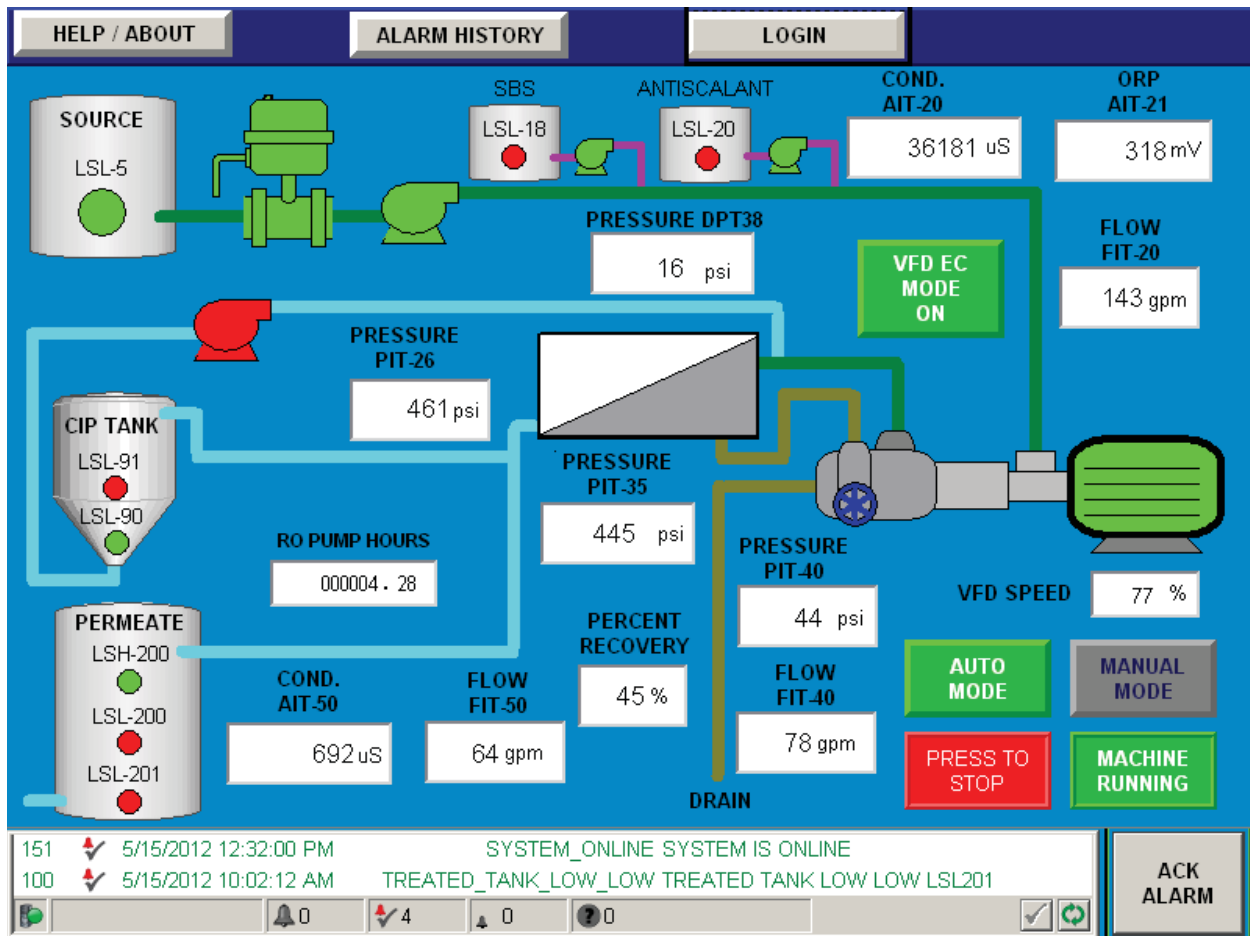
Control System Overview

The Seawater Reverse Osmosis (SWRO) system is provided as a skid mounted unit with built in cleaning equipment. A separate 500 gallon cone bottom tank is provided that must always be connected to the SWRO skid for use in permeate flushing and cleaning procedures.

One CIP system is provided to clean the RO train as necessary. The CIP unit also serves as a permeate flush system to flush the RO unit with permeate. The permeate flush is STARTED as part of an AUTO shutdown and STOPS based upon (1) flush time or (2) CIP tank low level. A heater is included with the CIP system that can be used for improved cleaning, per the RO element manufacturers instructions.

The system is designed to operate in AUTO mode ONLY. Manual mode is provided, but is not a recommended mode of operation and should Not be used.

The main operations screen is shown below:



Once the system has been started up once with all parameters set to the appropriate setpoints, the system will start/stop automatically without adjusting equipment setpoints.

If the "VFD EC" mode is selected, the VFD speed will adjust speed as a function of the source water EC and the VFD speed setpoints entered by the operator.

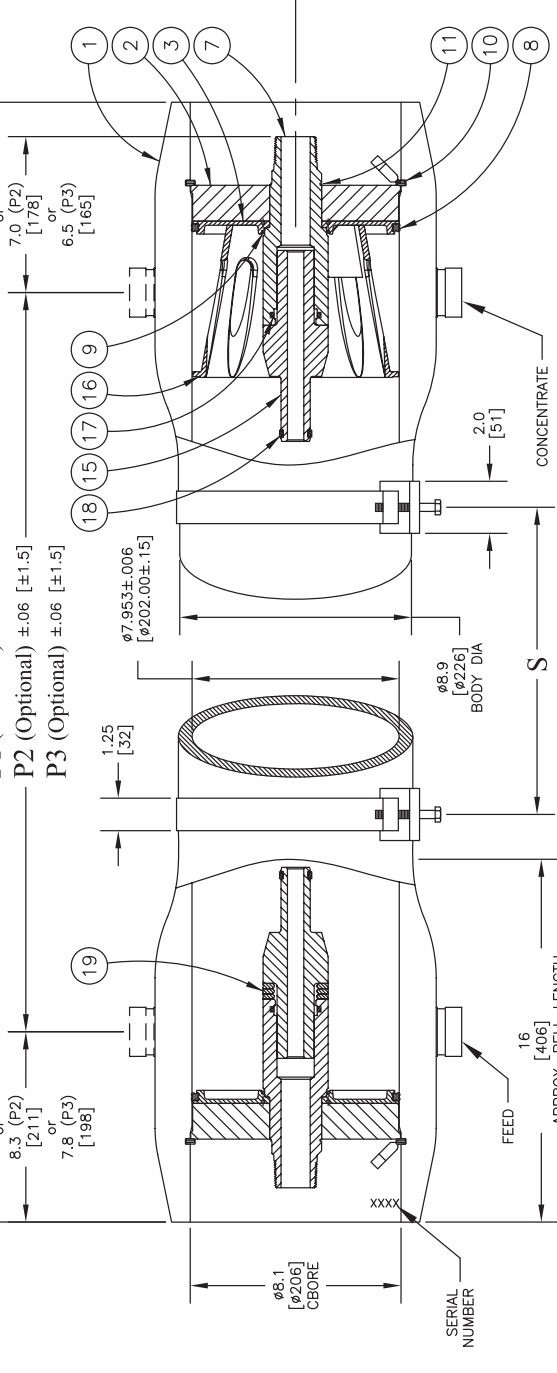
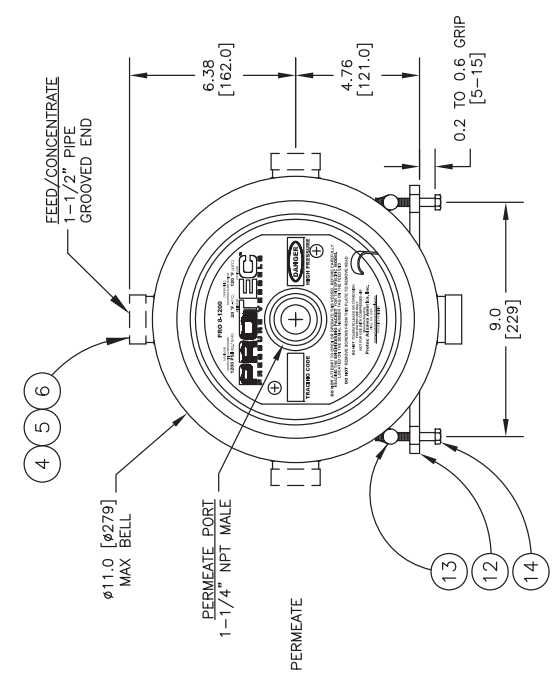
The main setpoints in tuning the RO system operation are (A) the VFD speed (P-20, RO pump) and (B) concentrate backpressure control valve (DBV41). For increased recovery operation, the recycle loop can be used (CV36).

Print all operations screens after the successful startup to provide a future reference document, in case the PLC screens are lost.

The RO system STARTS and STOPS according to sequences/stages. The control logic is outlined below:

Design Pressure = 1200 PSI @ 120 °F
 Min. Design Temperature = 20 °F @ 1200 PSI
 Hydrotest Pressure = 1320 PSI

1200 PSI
 SIDE PORT



NOTE: STANDARD PARTS ARE SHOWN FOR REFERENCE ONLY
 CHECK ORIGINAL ORDER FOR ORDERING SPARE PARTS

ITEM	QTY	PIN	DESCRIPTION	MATERIAL
1	1	4080023	Shell	Filament Wound, Epoxy FRP
2	2	4080034	Bearing Plate	6061-T6 Aluminum, SB-221, Anodized
3	2	4080177-2	Sealing Plate	Thermoplastic
4	2	4080234	Feed/Concentrate Port, 1-1/2", "D"	SST Super Duplex, SA-790
5	4	6121187	Retaining Ring, F/C Port, 1-1/2", "D"	Stainless Steel, 316, SA-479
6	2	6184604-N	O-Ring Seal, F/C Port, 1-1/2", "D"	Ethylene Propylene
7	2	4080308	Permeate Port	Noryl GFN2
8	2	6100442MK	Head Seal	Ethylene Propylene
9	2	6110229-N	Permeate Port Seal	Ethylene Propylene
10	2	4080320	Retaining Ring w/ Flinger Pull	Stainless Steel, 316, SA-479
11	2	6121200	Retaining Ring, Permeate Port	Stainless Steel, 316
12	2*	4080175	Support Saddle	Thermoplastic Rubber
13	2	4080137	Strap Assembly	Stainless Steel, 316
14	4	6150001	Strap Screw	Stainless Steel, 18-8
15	2	A/R	Adapter	Thermoplastic
16	1	4080165-1	Thrust Cone	PVC Thermoplastic
17	2	6110326-N**	Adapter Seal	Ethylene Propylene
18	A/R	A/R	PWT Seal	Ethylene Propylene
19	3	4080071-2	Shim, Adapter	Noryl GFN2

Shell Length Code	L	P1	P2	P3	S	Empty Weight
	inch (mm)	Standard inch (mm)	Optional inch (mm)	Optional inch (mm)	Span in (mm)	lb (kg)
-1	61.6 [1565]	47 [1194]	45 [1143]	46 [1168]	1 @ 28 [711]	140 [64]
-1.5	81.6 [2073]	67 [1702]	65 [1651]	66 [1676]	1 @ 42 [1067]	166 [75]
-2	101.6 [2581]	87 [2210]	85 [2159]	86 [2184]	1 @ 56 [1422]	192 [87]
-3	141.6 [3597]	127 [3226]	125 [3175]	126 [3200]	1 @ 80 [2032]	245 [111]
-4	181.6 [4613]	167 [4242]	165 [4191]	166 [4216]	2 @ 64 [1626]	298 [135]
-5	221.6 [5629]	207 [5258]	205 [5207]	206 [5232]	2 @ 78 [1981]	351 [160]
-6	261.6 [6645]	247 [6274]	245 [6223]	246 [6248]	2 @ 92 [2337]	404 [184]
-7	301.6 [7663]	287 [7290]	285 [7239]	286 [7264]	2 @ 106 [2692]	457 [208]
-7.5	321.6 [8171]	307 [7798]	305 [7747]	306 [7772]	2 @ 114 [2896]	483 [220]
-8	341.6 [8679]	327 [8306]	325 [8255]	326 [8280]	2 @ 120 [3048]	510 [232]

*2 each with shell length -4 and longer
 **6110221-N when Permeate Ports not Noryl

APPROVED
 AP
 MM/DD/YY

CHECKED
 AP
 MM/DD/YY

DRAWN
 AP
 MM/DD/YY

ECO
 10119

REVISED
 4/28/11

DRAWING
 101006

REV
 Q

PROTEC
 GRISAWC
 Visia, California, U.S.A.
 www.protec-grisawc.com

PRO 8-1200-SP

NOTES:
 DIMENSIONS IN INCHES (MM APPROX.)
 FOR REFERENCE ONLY, NOT FOR CONSTRUCTION UNLESS CERTIFIED
 SHIMMING OF THE SADDLES MAY BE REQUIRED
 CENTER VESSEL ON 2 OR 3 SUPPORTS AT SPAN(S)"S".
 INCORRECT MANIFOLDING WILL CAUSE SEVERE LOCAL STRESS AROUND PORT AND MAY RESULT IN LEAKS AND PREMATURE FAILURE. TAKE EVERY PRECAUTION LISTED IN THE ENGINEERING PACKET OR USERS MANUAL.
 INTERNAL PERMEATE PRESSURE MUST NOT EXCEED 125 PSI.
 ASME SECTION X, 2010
 RP CODE STAMP OPTIONAL
 SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE



EFCS HOUSING SERIES



THE EDEN DIFFERENCE

Eden Equipment Company, manufacturer of patented and highly engineered filtration systems, is committed to meeting the global demand for cost effective filtration solutions.

With a focus on durability and reliability, our products minimize downtime through an easy to maintain design. Replacement costs are reduced by outlasting most competitors, especially in corrosive applications.

Our housings are 3 to 5 times stronger than comparable steel vessels at 50% of the weight and are compatible with most filter cartridges. The life of our housings, even in highly corrosive environments, has exceeded 20 years.

EFCS HOUSING DESCRIPTION

The Eden Excel patented line of vessels and filtration systems provide exceptional chemical resistance and outstanding tensile strength.

- EFCS housings are constructed from a proprietary fiberglass reinforced plastic barrel manufactured with a flexible and fatigue-resistant vinyl ester resin
- Seamless construction adds strength and longevity
- Engineered to minimize downtime; easy to clean and replace parts
- Internal components are constructed of PVC, CPVC, Polypropylene and PVDF available for specialized applications
- Externals are constructed of anodized aluminum & 303 stainless steel with other materials optional
- Buna o-rings are standard

FEATURES

- Designed to ASME Code, Section X standards
- All wetted materials meet the FDA CFR Title 21 requirements
- Pressure rating – standard use pressure 150PSI at 150°F
- Hydrostatically pressure tested to 300PSI w/ a design pressure of 900PSI
- Corrosion resistant-compatible with fluids in PH range of 2-13
- Standard 3" NPT inlet/outlet
- Standard 1/4" NPT vent



FLOW RATES

The following flow rates are suggested for standard use, though significantly higher rates may be obtained with corresponding pressure drop.

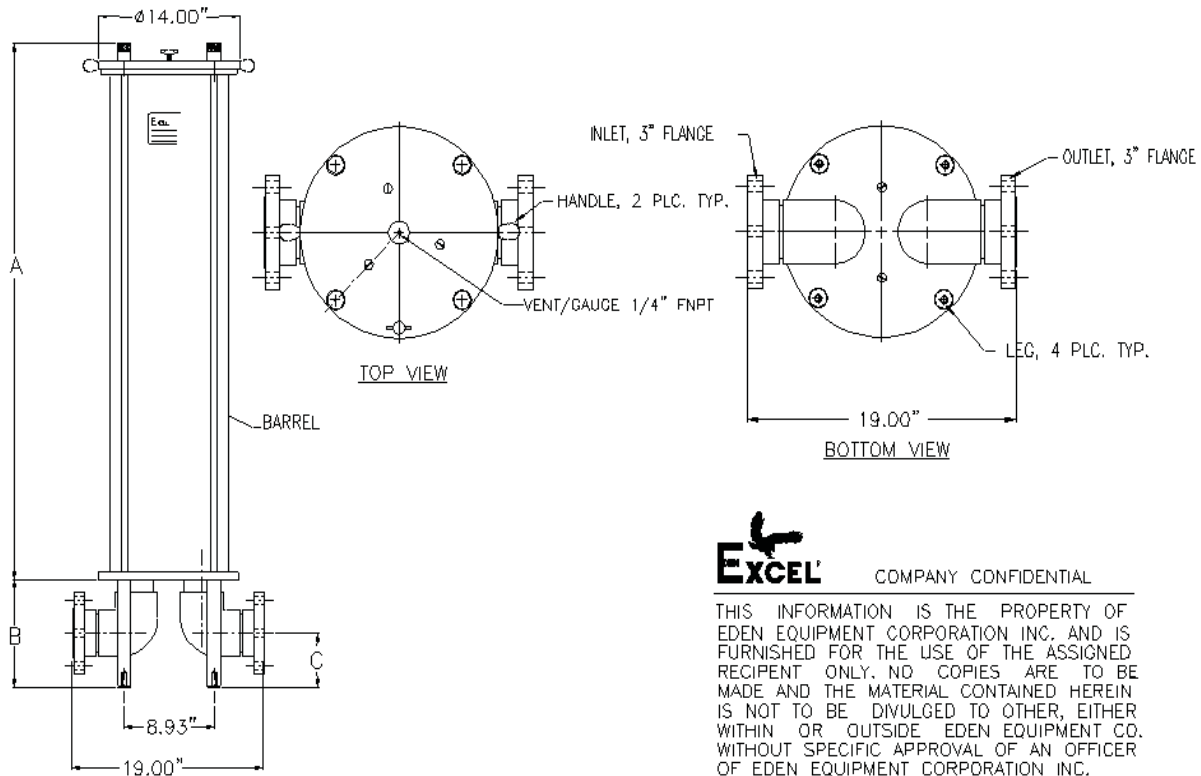
<u>EFCS Product</u>	<u>Max Flow Rate</u>	<u>Cartridge Size</u>	<u># of Cartridges</u>
20EFCS2-3C150	to 100 GPM	20"	10
30EFCS3-3C150	to 150 GPM	30"	10
40EFCS4-3C150	to 200 GPM	40"	10
50EFCS5-3C150	to 250 GPM	50"	10

OPTIONS

- All vessels are highly customizable for specialized applications
- 2" or 3" flange sets in PVC, CPVC, or Polypropylene
- EPDM, Viton, Silicone, Kalrez O-Rings
- Polypropylene liner
- 316 Stainless Steel externals
- BPO bleach service



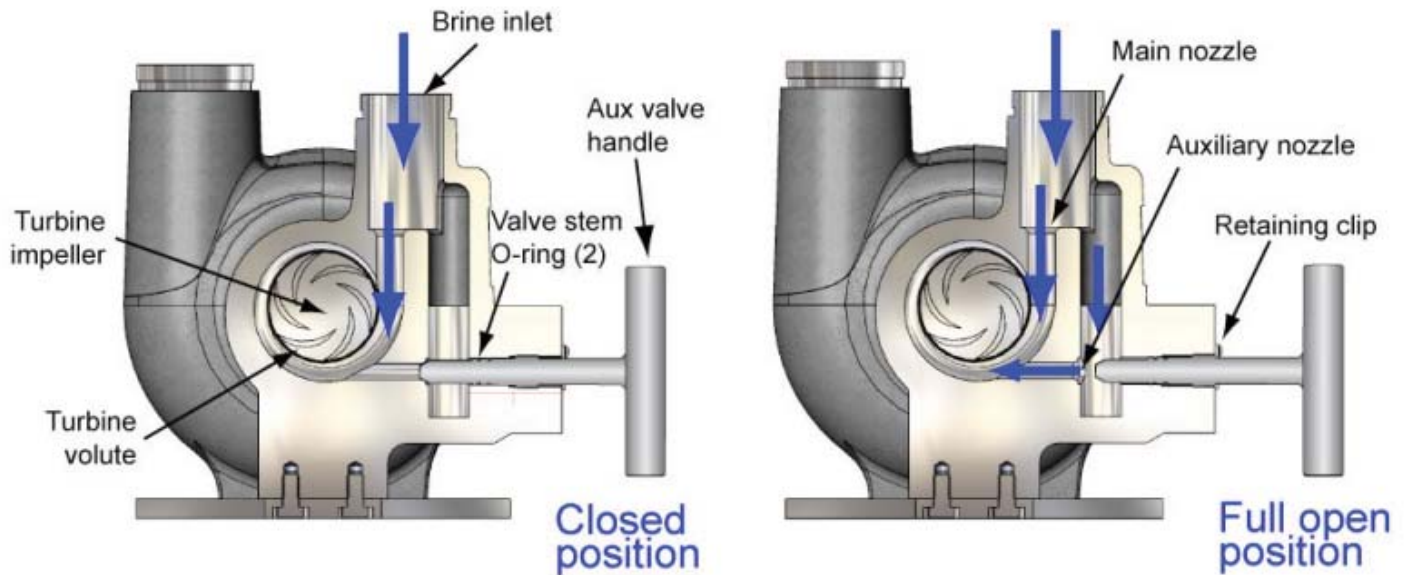
EFCS HOUSING SERIES



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Model #	A	B	C	I/O Type	Cartridge Length
20EFCS2-3C150	29"	10"	N/A	3" NPT	20"
20EFCS2-3FC150	29"	10"	5"	3" PVC flange	20"
30EFCS3-3C150	39"	10"	N/A	3" NPT	30"
30EFCS3-3FC150	39"	10"	5"	3" PVC flange	30"
40EFCS4-3C150	49"	10"	N/A	3" NPT	40"
40EFCS4-3FC150	49"	10"	5"	3" PVC flange	40"
50EFCS5-3C150	59"	10"	N/A	3" NPT	50"
50EFCS5-3FC150	59"	10"	5"	3" PVC flange	50"
Please contact us for your custom size and application requirements					



Features

- All brine passes through the turbine volute and impeller - no wasted energy
- Double o-rings ensure reliable valve stem sealing - standard o-ring sizes
- Retaining clip prevents accidental removal of valve stem from the unit
- Valve stem in duplex SS 2205
- Valve handle in 316 SS
- Multi-turn design allows precise brine flow adjustment
- May be adjusted by suitable valve actuator - contact FEDCO for details

Operation


- Open Aux Valve - increase brine flow / reduce brine pressure
- Close Aux Valve - reduce brine flow / increase brine pressure

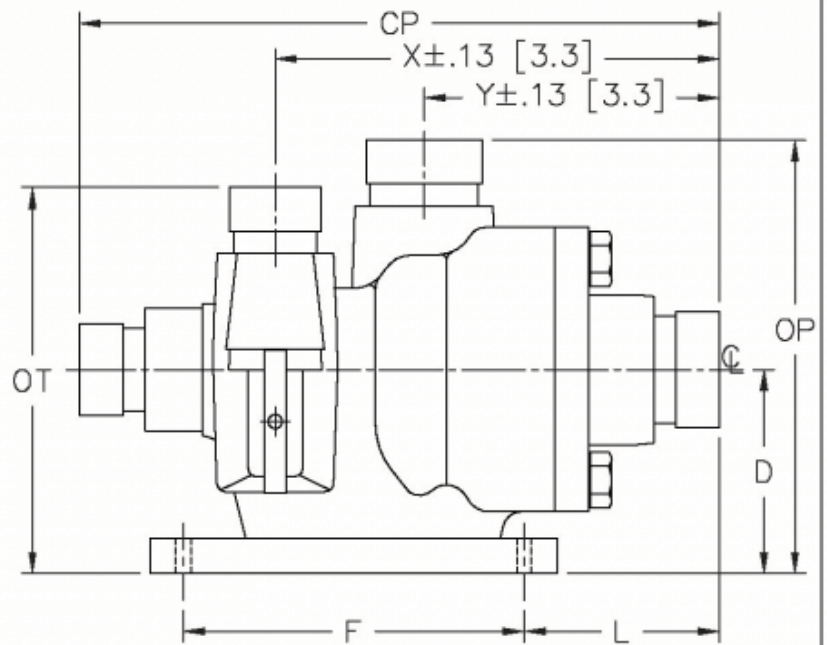
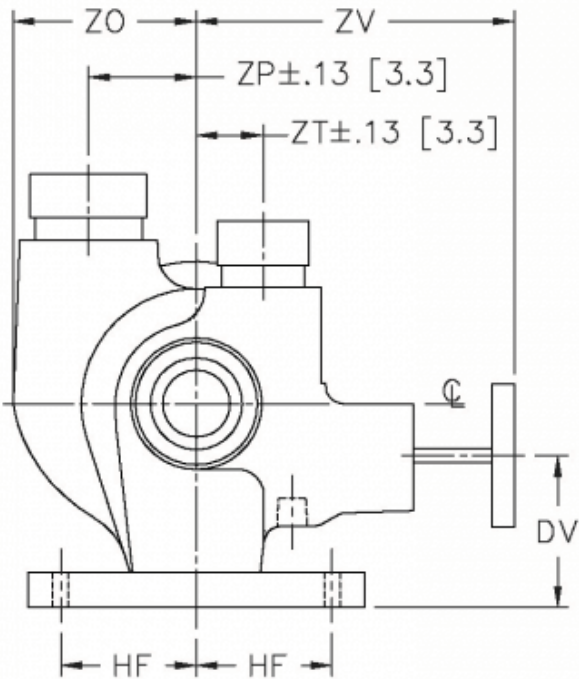
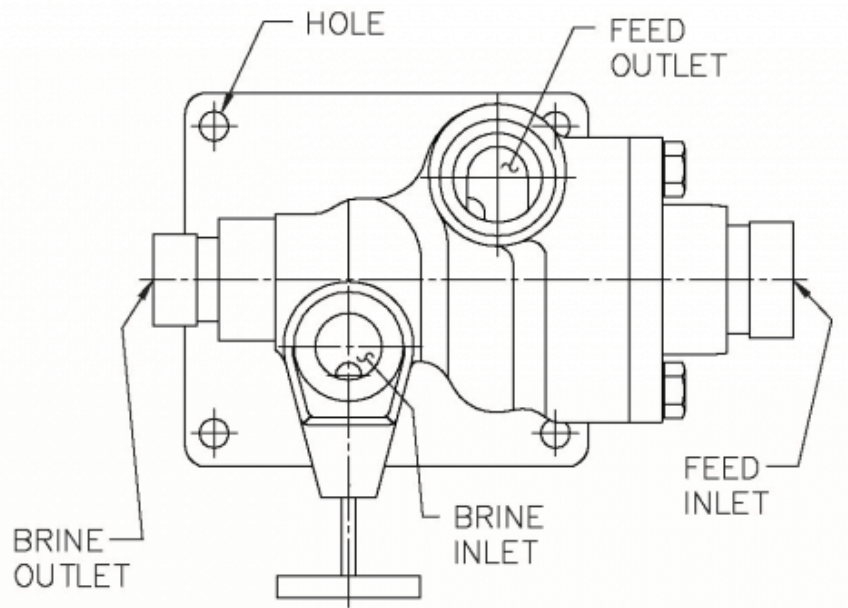
Installation Considerations

- Brine discharge pressure is required to be at least 7 psig (0.5 barg)
- Brine flow shall not be bypassed during startup or shutdown - let entire brine flow pass through HPB
- Do not allow the membranes to drain after shutdown. This can damage the membranes and result in large amounts of air passing through the HPB turbine section during startup.
- If system recovery is more than 50%, contact FEDCO for review

UNLESS OTHERWISE SPECIFIED DIMENSIONS
ARE IN INCHES AND [MM]

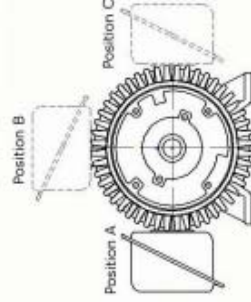
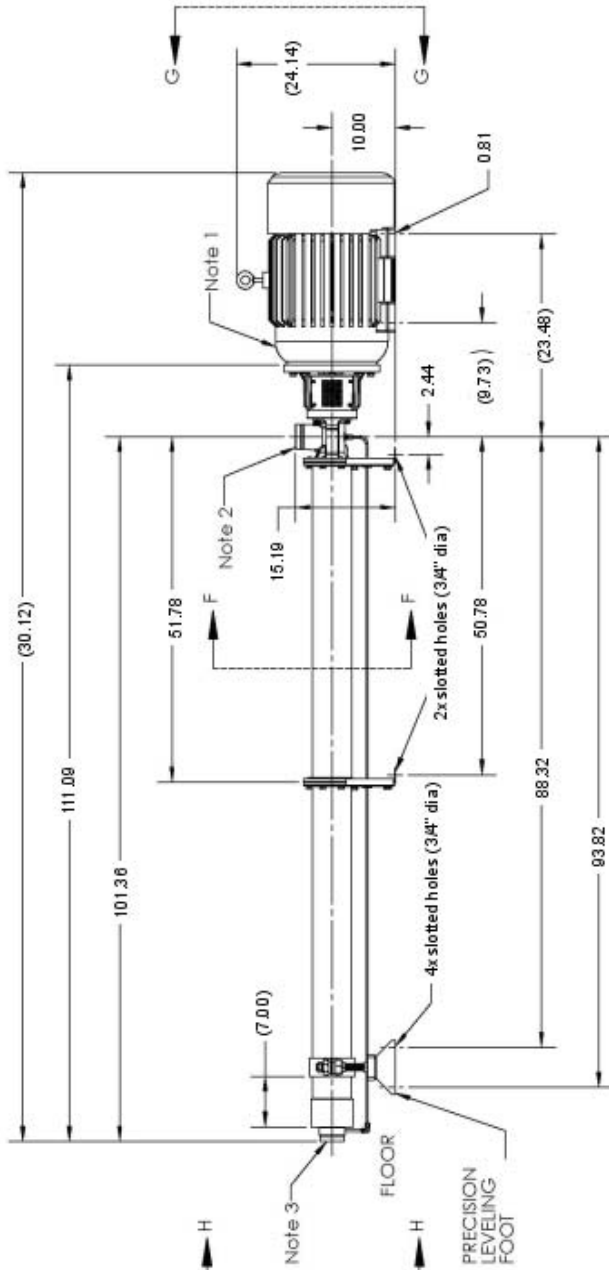
TOLERANCES - UNLESS OTHERWISE SPECIFIED:
LINEAR: ± 0.010 ANGULARITY: $\pm 1/2^\circ$
 $\pm 1/64$

SHEET OF	DR.: PI	APPR.:
TITLE	SCALE	Last Modified:
HYDRAULIC PRESSURE BOOSTER MODEL HPBe-40 WITH BASE	NONE	05/12/08
	DO NOT SCALE	
	No.	1-040-3
	Fluid Equipment Development	
	800 Ternes Dr., Monroe, MI 48162 (USA) Phone: 734-241-3935 Fax: 734-241-5173	

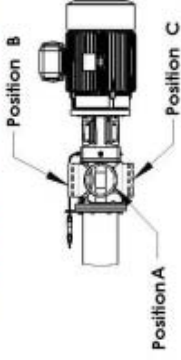


	CP	X	Y	OP	D	OT	L	F	ZP	ZT	ZV	ZO	DV	HF
Inches	10.3	7.3	4.4	8.2	4.1	7.1	1.9	7.5	2.1	1.3	5.9	3.3	3.1	3.3
mm	261	186	111	210	104	181	48	191	54	34	150	83	78	84
	HOLE (4)		FEED INLET		FEED OUTLET		BRINE INLET		BRINE OUTLET		WEIGHT lbs [Kg]			
	17/32		1-1/2		1-1/2		1-1/4		1-1/4		35 [16]			

- Note 1 405T SC Motor Frame
- Note 2 Feed Inlet 3" Hydraulic Style 77
- Note 3 Feed Outlet 3" Hydraulic Style 77
- Note 4 Inlet Position A
- Note 5 Electrical Box Position A
- Note 6 Dimensions are in inches

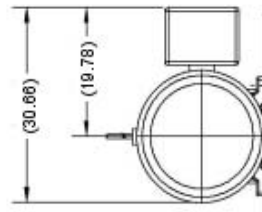


Electrical Box Position
(Viewed From Motor Front)

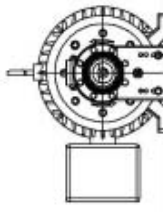


Inlet Position
(Viewed From Top of Pump)

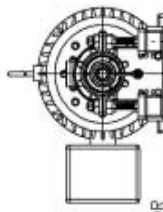
		600 Terrace Drive Monroe, MI 48162 USA Tel: (734) 241-3835 Fax: (734) 241-5173 www.fedco-usa.com	
UNLESS OTHERWISE SPECIFIED: DIMENSIONS: FRACTIONAL & DECIMAL ANGLES (ARROWS) TWO PLACE DECIMAL THREE PLACE DECIMAL DIM.		MODEL: MSS-4027 TITLE: MSS-4027-405TSC OUTLINE	
UNLESS OTHERWISE SPECIFIED: DIMENSIONS: FRACTIONAL & DECIMAL ANGLES (ARROWS) TWO PLACE DECIMAL THREE PLACE DECIMAL DIM.	UNLESS OTHERWISE SPECIFIED: DIMENSIONS: FRACTIONAL & DECIMAL ANGLES (ARROWS) TWO PLACE DECIMAL THREE PLACE DECIMAL DIM.	SIZE DWG. NO. B 4040-27-0405-80-0-0-0-q SCALE: WEIGHT 1483.8 SHEET 1 OF 1	REV SHEET 1 OF 1



SECTION G-G
SCALE 1 : 16

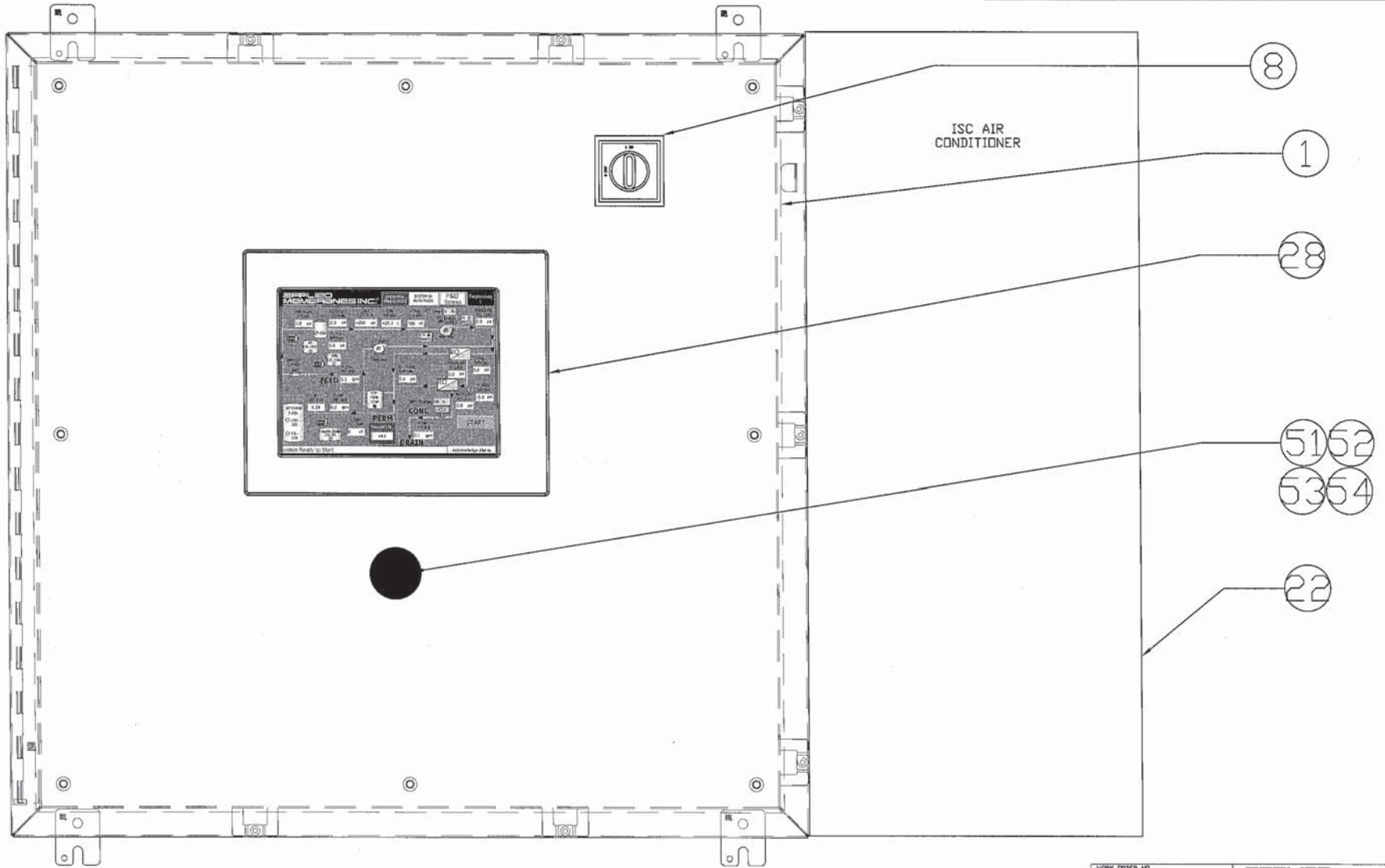


SECTION F-F
SCALE 1 : 16



SECTION H-H
SCALE 1 : 16

REV	DESCRIPTION	DATE
3	AS BUILT	5/18/2012

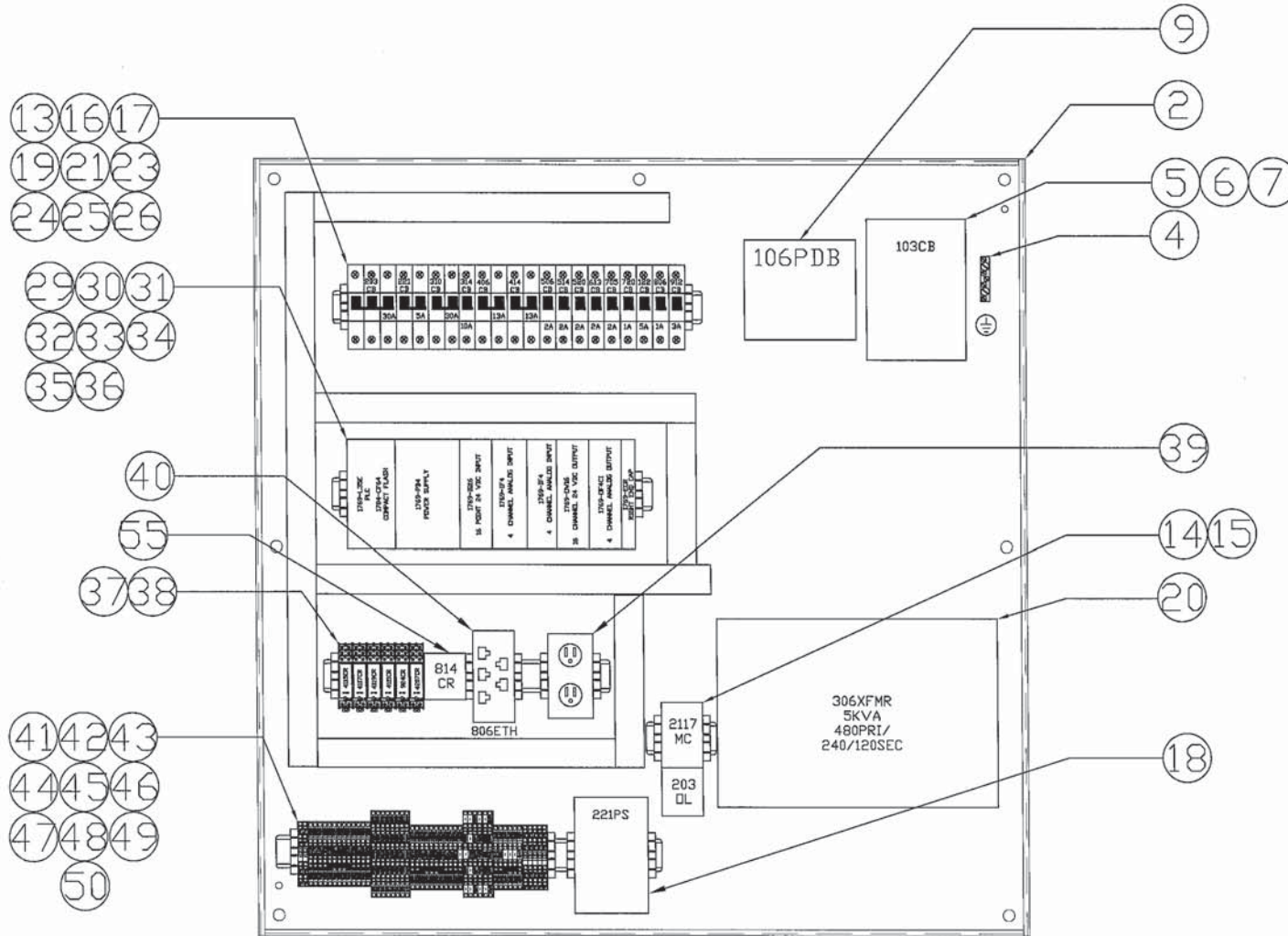


RIGHT PLC PANEL FRONT VIEW

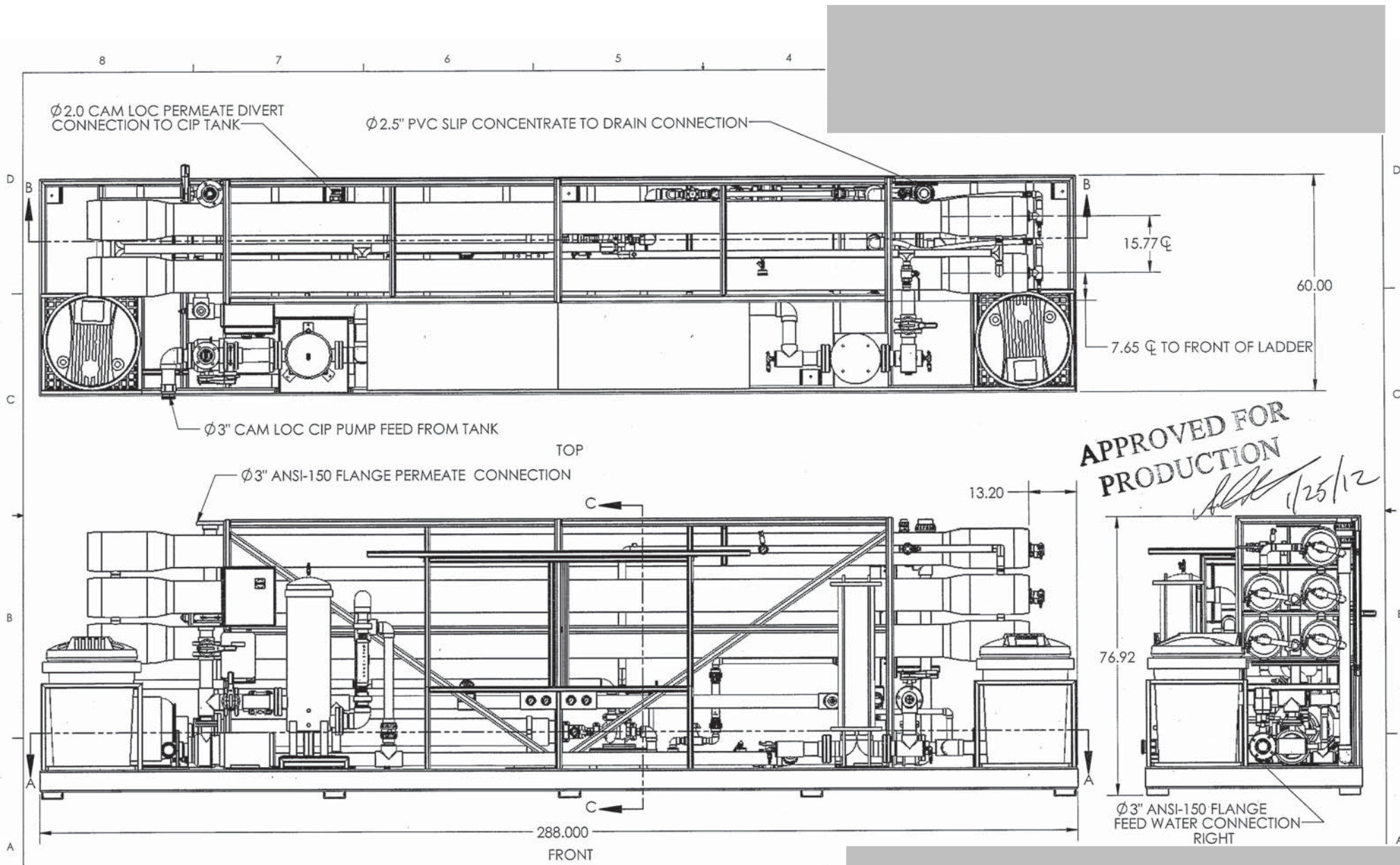
WORK ORDER NO	5100	APPLIED MEMBRANES INC. <small>2005 GONZALES ROAD, SANTA CA 95001 PHONE: 707-777-3711 FAX: 707-777-4497</small>
DESIGN ENG	MBB	
APPROVED BY:	-	
DATE	5/18/2012	
CUSTOMER	-	TITLE
		5100 ELE-SL308F-436-SCH-B
		DWG NO
		5100 ELE-SL308F-436-SCH-B
		SCALE NONE
		SHEET PLC ENCLOSURE

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REV	DESCRIPTION	DATE
3	AS BUILT	5/18/2012



PLC BACK PANEL VIEW

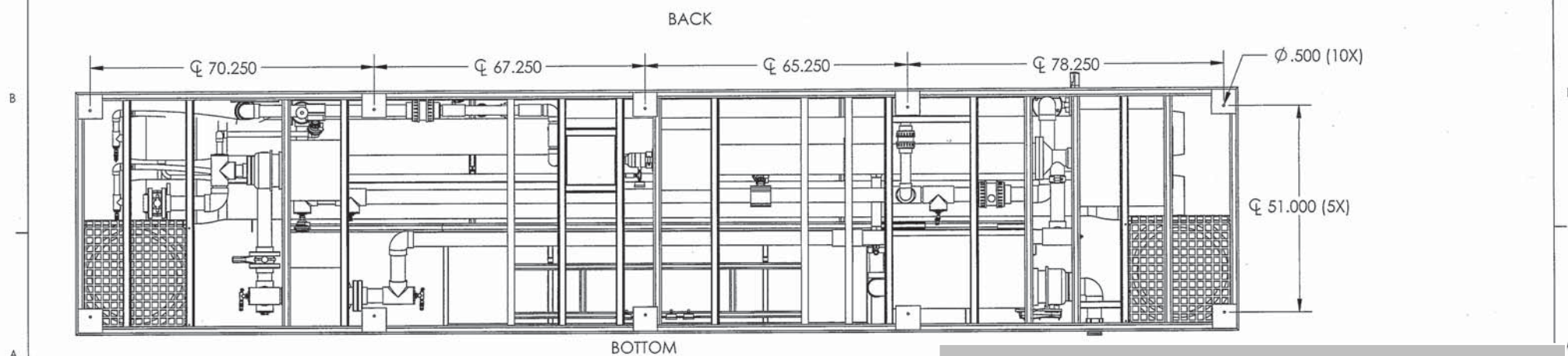
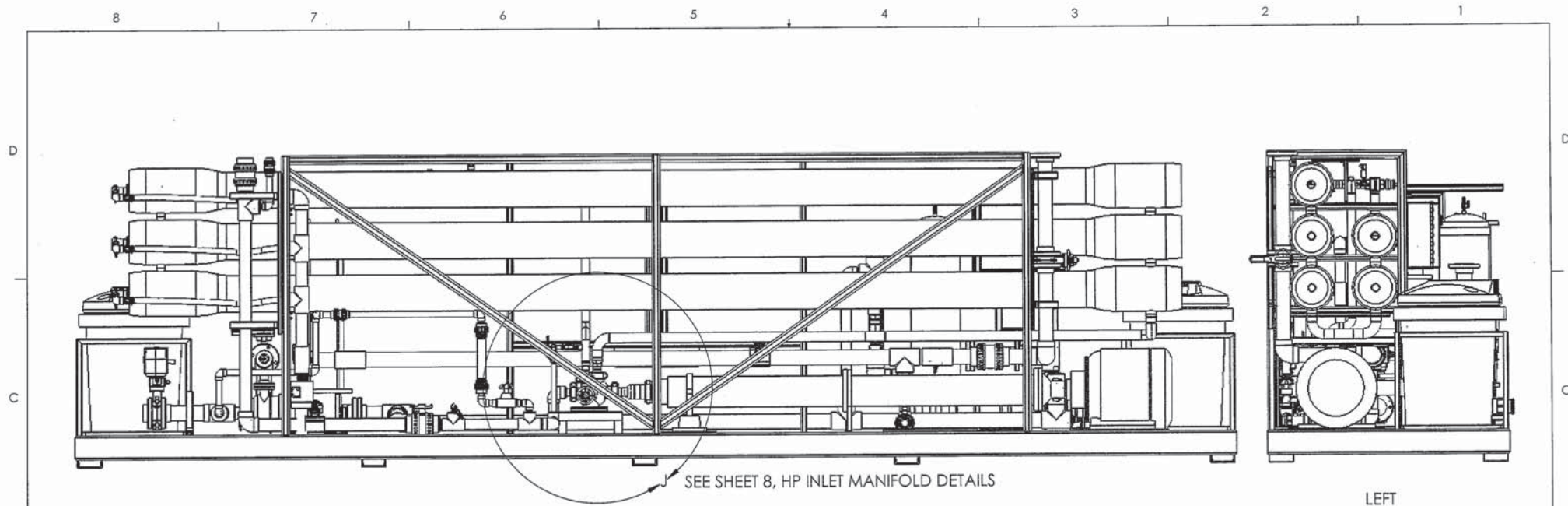


NOTE: SECTION S A,B & C SEE SHEET 7, HP PUMP DETAIL

APPROVED FOR PRODUCTION
[Signature] 1/25/12

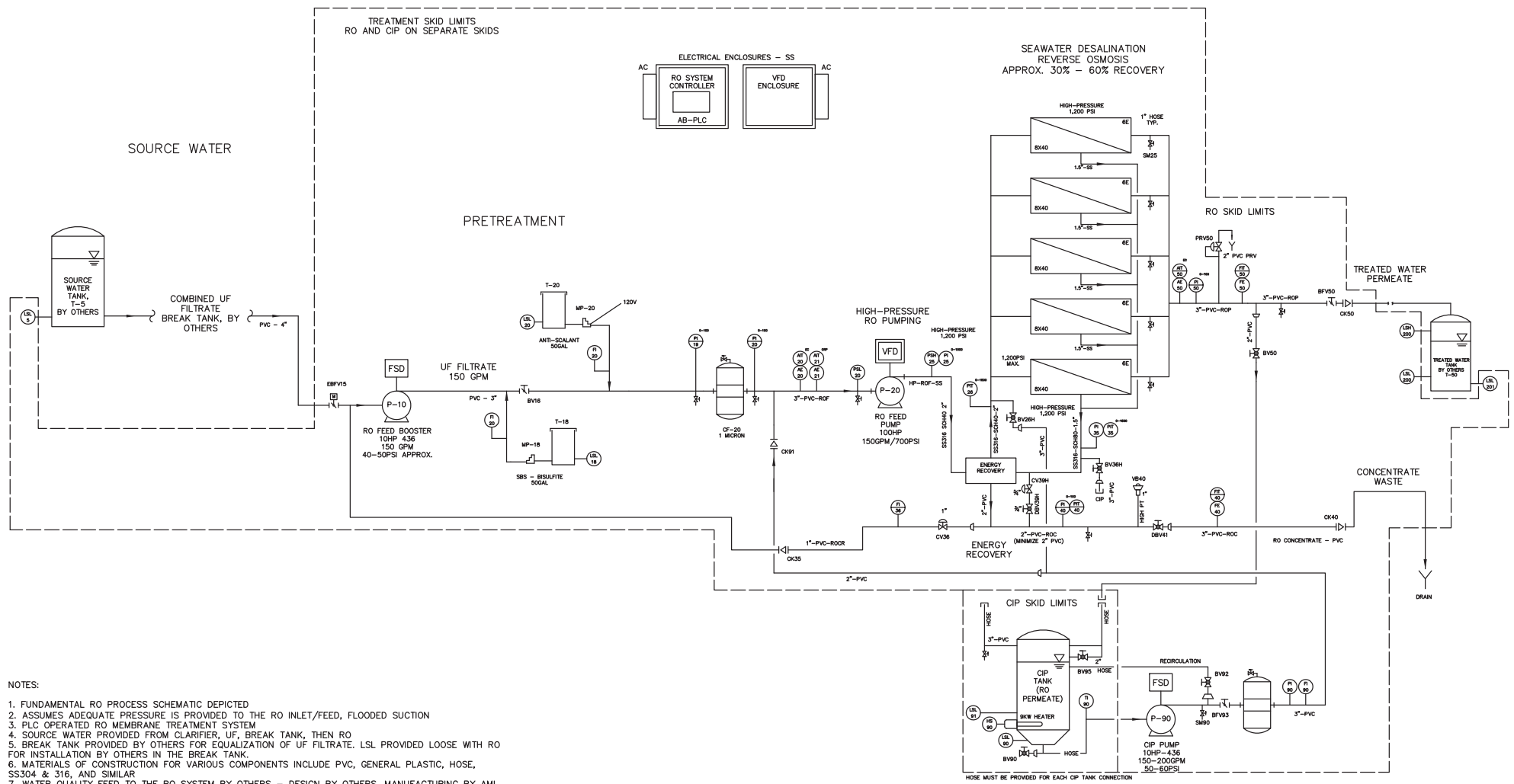
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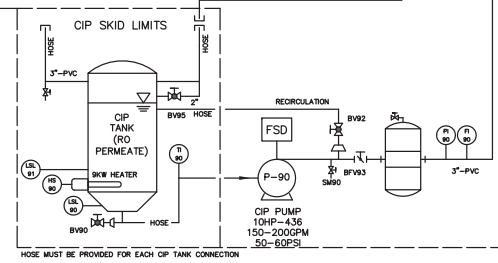


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REV	DESCRIPTION	DATE
0	SUBMITTED PROPOSAL	2011



- NOTES:
- FUNDAMENTAL RO PROCESS SCHEMATIC DEPICTED
 - ASSUMES ADEQUATE PRESSURE IS PROVIDED TO THE RO INLET/FEED, FLOODED SUCTION
 - PLC OPERATED RO MEMBRANE TREATMENT SYSTEM
 - SOURCE WATER PROVIDED FROM CLARIFIER, UF, BREAK TANK, THEN RO
 - BREAK TANK PROVIDED BY OTHERS FOR EQUALIZATION OF UF FILTRATE. LSL PROVIDED LOOSE WITH RO FOR INSTALLATION BY OTHERS IN THE BREAK TANK.
 - MATERIALS OF CONSTRUCTION FOR VARIOUS COMPONENTS INCLUDE PVC, GENERAL PLASTIC, HOSE, SS304 & 316, AND SIMILAR
 - WATER QUALITY FEED TO THE RO SYSTEM BY OTHERS - DESIGN BY OTHERS, MANUFACTURING BY AMI
 - CIP SYSTEM PROVIDED WITH AUTOMATED FLUSH



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