

APPENDIX M
Reverse Osmosis for Community Water System

SIEMENS

January 21, 2009

Riordan Materials Corporation
8712 Inwood Road
Baltimore, MD 21244

Attn: Mr. Thomas Rainier

Reference: URS Confidential Client
Reverse Osmosis/Nanofiltration Application
Equipment: Vantage M84-024RO
Vantage M83-006RO
Pretreatment for Iron and Manganese
Quote #: 09PS4202GFM

Dear Mr. Rainier:

This letter includes budgetary pricing and information for the proposed application using reverse osmosis (RO) submitted by URS Engineers for a confidential client. Our recommendations are based on water quality data that we received from you via email.

We have attached computer models of the NF/RO system performance. Overall, this system would be very effective at removing dissolved contaminants with a recovery of approximately 92% for the primary and secondary RO.



Vantage M84 System

The following is the budgetary pricing and information offered regarding the above referenced project:

Equipment	Capacity (permeate, gpm)	Budget Price
One (1) Vantage M84-024RO - Primary	100	\$137,600.00
One (1) Vantage M83-006RO - Secondary	24	\$ 90,100.00

Estimated Delivery: 12-14 weeks after receipt of approval drawings

Siemens Water Technologies Corp.

100 Highpoint Drive, Suite 101
Chalfont, PA 18914

Tel: 215-712-7040
Fax: 215-996-1156

Equipment Furnished:

Vantage M units are pre-piped and skid mounted on a painted steel skid with the following with each system:

- Membrane elements as manufactured by DOW FILMTEC™, either NF90-400 (primary) or LE400 (secondary). **MEMBRANE ELEMENTS ARE FIELD INSTALLED.**
- FRP membrane housings adequate for above membranes.
- Control panel with Siemens PLC controller and Siemens touch screen Human Machine Interface (HMI).
- Schedule 10 316L Stainless Steel high pressure piping.
- Schedule 80 PVC low pressure piping.
- Stainless steel pre-filter housing with first 2 sets of cartridge filters (about 1 month worth).
- Booster pump.
- Manual and automatic control valves.
- Instrumentation including flow meters/transmitters, pH and ORP meters, conductivity and pressure gauges.
- Product water divert line for wasting of below-quality water during startup.
- Reject flush line for flushing of system with raw water for shutdown.
- Raw water blend line including diaphragm valve and rotameter (on primary unit only).
- Air compressor with receiver and starter panel for automatic valve operation.
- Polyethylene CIP makeup tank with CIP hose kit (included with first skid only, additional skids will share the same tank and hose kit).
- Freight to the jobsite.
- Technical direction during plant installation, membrane loading, start-up and training. See table above for std. time.
- Antiscalant Feed System includes 16 gallon day tank, Grundfos DME series digital pump, rigid suction tubing with low level switch, priming aid, injection valve, alarm cable, communication cable and wall bracket for pump.

Refer to Equipment Lists for exact scope of supply.

Equipment Not Furnished:

Installation and field assembly, interconnecting piping, interconnecting wiring, backwash pumps, motor starters not specifically called out, and finished water storage.

Pretreatment for Iron and Manganese

The client also requested information on pretreatment options for iron and manganese. Per our correspondence, iron and manganese have been detected at 5.0 mg/L and 0.35 mg/L, respectively. Our recommendation for this application is our vertical pressure filter with oxidative media. We have provided pricing and information on a three-tank system. This provides redundancy and reduces the amount of backwash flow required on an instantaneous basis. Due to the relatively high levels of iron and manganese, we recommend running the filters at 2 gpm per square foot loading rate.

Budgetary pricing and information are as follows:

Equipment	Capacity (gpm)	Budget Price
Three (3) 84"-dia. vertical pressure filter vessels with Manganese ANTHRA/SAND Media	135	\$187,900.00

Estimated Delivery: 12-14 weeks after receipt of approval drawings

Equipment Furnished:

Scope: (3) tanks, each includes 100 psi working pressure filter tank with supporting legs. Top side inlet connection with overdrain and bottom head effluent connection. Shop installed steel plate underdrain with gravel retaining strainers. Screwed air release connection. One 14" x 18" manhole in top head. One coat of interior and exterior primer, and one coat of interior finish paint. Sch. 40 steel filter face piping with exterior primer coat. Automatic backwash control panel, NEMA 12 rated. Pneumatically operated butterfly valves for inlet, backwash waste and effluent. Automatic air release valve and piping. Airwash grid and air blower. 10" of support gravel and 24" of 1.0-1.2 mm LO-d:C Manganese ANTHRA/SAND media. GFC #4879 loss of head gauge and #1639 backwash rate of flow indicator.

Equipment Not Furnished:

Installation, concrete slab work including waste sump, interconnecting piping, chemical feeds, and overall plant operation and controls.

Notes:

- Prices include technical direction, commission and freight.
- Filter tank size is outside diameter. Straight side shell height is 5'-0".
- Unit capacity ranges based on 2 to 3 gpm/sq.ft. of filter area.

We look forward to working with you on this exciting project. Should you have any questions or require further information, please contact me at (215)712-7040.

Best Regards,

Richard Ross, P.E.
Technical Sales Manager, East

Attachments: Equipment lists, sales drawings, brochure, ROSA projections, and specification.

cc: Dave Lucey, Siemens Water Technologies

SIEMENS

Vantage™ M83 Reverse Osmosis System Operating Cost Estimate

Note: This operating cost estimate is provided as a courtesy for Siemen Water Technologies customers and is an estimate only. No warranties are expressed or implied.

Project Name: Confidential URS, VA Secondary System

Location: Confidential, Virginia

Date: January 21, 2009

System Configuration

Number of Vantage™ Skids:	1
Vantage Model Number:	M83-006
Membrane Type:	Reverse Osmosis
Array Configuration:	1:1 3M
Number of Pressure Vessels:	2 per skid
Total Number of Elements:	6 per skid
Number of Cartridge Filters:	4 - 30" per skid

System Flow Rates

Feed Flow per Skid:	33 GPM
Permeate Flow per Skid:	25 GPM
Total Feed Flow:	33 GPM
Total Permeate Flow:	25 GPM
RO System Recovery:	75%
Acid Dose Rate:	0 mg/l H ₂ SO ₄
Antiscalant Feed Rate:	8 mg/l

Operating Times

System Operating Time:	24 hrs/day
Percent Online:	100%
Water Temperature:	70 °F
CIP Interval:	90 days

Cost Assumptions

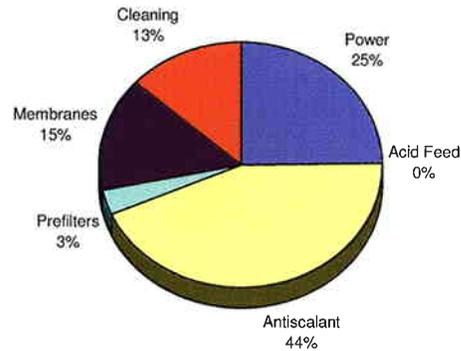
Power Cost:	\$0.06/kwhr
Acid Cost:	\$3.27/gallon
Antiscalant Cost:	\$3.22/gallon
Membrane Element Cost:	\$650/element
Low pH Clean Solution:	\$39.00/gallon
High pH Clean Solution:	\$45.00/gallon

Operating Cost Summary

PERMEATE PRODUCED	13,140,000 gallons/year
Power	\$2453/year (\$0.187/kgal)
Acid Feed	\$0/year (\$0/kgal)
Antiscalant	\$4329/year (\$0.329/kgal)
Prefilters	\$333/year (\$0.025/kgal)
Membranes	\$1495/year (\$0.114/kgal)
Cleaning	\$1332/year (\$0.101/kgal)
EST ANNUAL OP COST \$9942/year (\$0.757/kgal)	

Estimated Operating Costs do not include labor, water and sewer charges, CIP pumping costs, or disposal costs.

Operating Cost Breakdown



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Vantage™ M84 Reverse Osmosis System Operating Cost Estimate

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Project Name: Confidential URS, VA
Location: Confidential, Virginia
Date: January 21, 2009

System Configuration

Number of Vantage™ Skids:	1
Vantage Model Number:	M84-024
Membrane Type:	Reverse Osmosis
Array Configuration:	3:2:1 4M
Number of Pressure Vessels:	6 per skid
Total Number of Elements:	24 per skid
Number of Cartridge Filters:	7 - 40" per skid

System Flow Rates

Feed Flow per Skid:	133 GPM
Permeate Flow per Skid:	100 GPM
Total Feed Flow:	133 GPM
Total Permeate Flow:	100 GPM
RO System Recovery:	75%
Acid Dose Rate:	0 mg/l H2SO4
Antiscalant Feed Rate:	2 mg/l

Operating Times

System Operating Time:	24 hrs/day
Percent Online:	100%
Water Temperature:	50 °F
CIP Interval:	90 days

Cost Assumptions

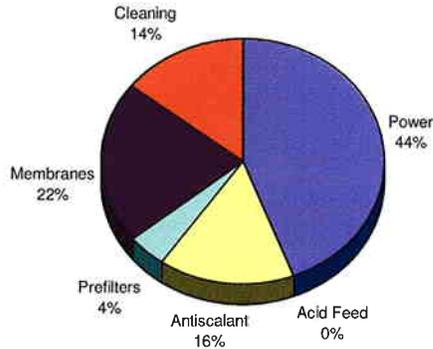
Power Cost:	\$0.06/kwhr
Acid Cost:	\$3.27/gallon
Antiscalant Cost:	\$3.22/gallon
Membrane Element Cost:	\$650/element
Low pH Clean Solution:	\$39.00/gallon
High pH Clean Solution:	\$45.00/gallon

Operating Cost Summary

PERMEATE PRODUCED	52,560,000 gallons/year
Power	\$12264/year (\$0.233/kgal)
Acid Feed	\$0/year (\$0/kgal)
Antiscalant	\$4329/year (\$0.082/kgal)
Prefilters	\$1199/year (\$0.023/kgal)
Membranes	\$5980/year (\$0.114/kgal)
Cleaning	\$3996/year (\$0.076/kgal)
EST ANNUAL OP COST \$27768/year (\$0.528/kgal)	

Estimated Operating Costs do not include labor, water and sewer charges, CIP pumping costs, or disposal costs.

Operating Cost Breakdown



Reverse Osmosis System Analysis for FILMTEC™ Membranes

ROSA v6.1.5 ConfigDB U238786_55

Project: Confidential URSV2

Case: 3

AFZ, Siemens Water Technologies

1/12/2009

Project Information: Municipal groundwater source with high levels of Boron. URS would like projections done for a confidential client.**System Details**

Feed Flow to Stage 1	34.00 gpm	Pass 1 Permeate Flow	23.80 gpm	Osmotic Pressure:	
Raw Water Flow to System	34.00 gpm	Pass 1 Recovery	70.00 %	Feed	27.09 psig
Feed Pressure	272.00 psig	Feed Temperature	62.6 F	Concentrate	86.60 psig
Fouling Factor	0.85	Feed TDS	3089.11 mg/l	Average	56.84 psig
Chem. Dose	None	Number of Elements	6	Average NDP	208.95 psig
Total Active Area	2400.00 ft ²	Average Pass 1 Flux	14.28 gfd	Power	5.03 kW
Water Classification: Well Water SDI < 3				Specific Energy	3.52 kWh/kgal

Stage	Element	#PV	#Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)	Perm Flow (gpm)	Avg Flux (gfd)	Perm Press (psig)	Boost Press (psig)	Perm TDS (mg/l)
1	BW30-400/34i	1	3	34.00	267.00	0.00	19.16	262.43	14.84	17.80	0.00	0.00	17.64
2	BW30-400/34i	1	3	19.16	257.43	0.00	10.20	255.61	8.96	10.76	50.00	0.00	51.07

Pass Streams (mg/l as Ion)								
Name	Feed	Adjusted Feed	Concentrate		Permeate			
			Stage 1	Stage 2	Stage 1	Stage 2	Total	
NH4	3.30	3.30	5.83	10.88	0.03	0.08	0.05	
K	58.40	58.40	103.32	193.14	0.37	1.10	0.64	
Na	668.50	668.50	1182.73	2211.01	4.23	12.43	7.32	
Mg	83.20	83.20	147.36	276.04	0.32	0.91	0.54	
Ca	169.40	169.40	300.06	562.12	0.62	1.80	1.07	
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Ba	0.10	0.10	0.18	0.33	0.00	0.00	0.00	
CO3	5.29	5.29	16.19	49.07	0.00	0.00	0.00	
HCO3	868.10	868.10	1521.48	2804.83	6.32	17.79	10.63	
NO3	0.20	0.20	0.34	0.58	0.02	0.06	0.04	
Cl	1079.90	1080.71	1913.27	3580.68	5.24	15.55	9.12	
F	0.80	0.80	1.41	2.64	0.01	0.02	0.01	
SO4	53.70	53.70	95.17	178.48	0.13	0.36	0.21	
SiO2	97.40	97.40	172.53	323.28	0.35	0.96	0.58	
Boron	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
CO2	20.11	20.11	24.38	35.84	20.95	26.85	23.18	
TDS	3088.29	3089.11	5459.89	10193.09	17.64	51.07	30.22	
pH	7.70	7.70	7.81	7.85	5.74	6.06	5.91	

Permeate Flux reported by ROSA is calculated based on ACTIVE membrane area. DISCLAIMER: NO WARRANTY, EXPRESSED OR IMPLIED, AND NO WARRANTY OF MERCHANTABILITY OR FITNESS, IS GIVEN. Neither FilmTec Corporation nor The Dow Chemical Company assume liability for results obtained or damages incurred from the application of this information. FilmTec Corporation and The Dow Chemical Company assume no liability, if, as a result of customer's use of the ROSA membrane design software, the customer should be sued for alleged infringement of any patent not owned or controlled by the FilmTec Corporation nor The Dow Chemical Company.

Reverse Osmosis System Analysis for FILMTEC™ Membranes

ROSA v6.1.5 ConfigDB U238786_55

Project: Confidential URSV2

Case: 3

AFZ, Siemens Water Technologies

1/12/2009

Design Warnings

WARNING: Maximum element recovery has been exceeded. Please change your system design to reduce the element recoveries. (Product: BW30-400/34i, Limit: 19.00%)

CAUTION: The concentrate flow rate is less than the recommended minimum flow. Please change your system design to increase concentrate flow rates. (Product: BW30-400/34i, Limit: 13.00gpm)

Solubility Warnings

Langelier Saturation Index > 0

Stiff & Davis Stability Index > 0

BaSO₄ (% Saturation) > 100%

CaF₂ (% Saturation) > 100%

SiO₂ (% Saturation) > 100%

Antiscalants may be required. Consult your antiscalant manufacturer for dosing and maximum allowable system recovery.

Stage Details

Stage	Element	Recovery	Perm Flow (gpm)	Perm TDS (mg/l)	Feed Flow (gpm)	Feed TDS (mg/l)	Feed Press (psig)
Stage 1	1	0.15	5.17	13.46	34.00	3089.11	267.00
	2	0.17	4.96	17.17	28.83	3640.06	265.04
	3	0.20	4.70	22.76	23.86	4392.09	263.54
Stage 2	1	0.18	3.37	36.61	19.16	5459.89	257.43
	2	0.19	3.02	49.85	15.80	6611.76	256.63
	3	0.20	2.58	71.36	12.78	8154.64	256.03

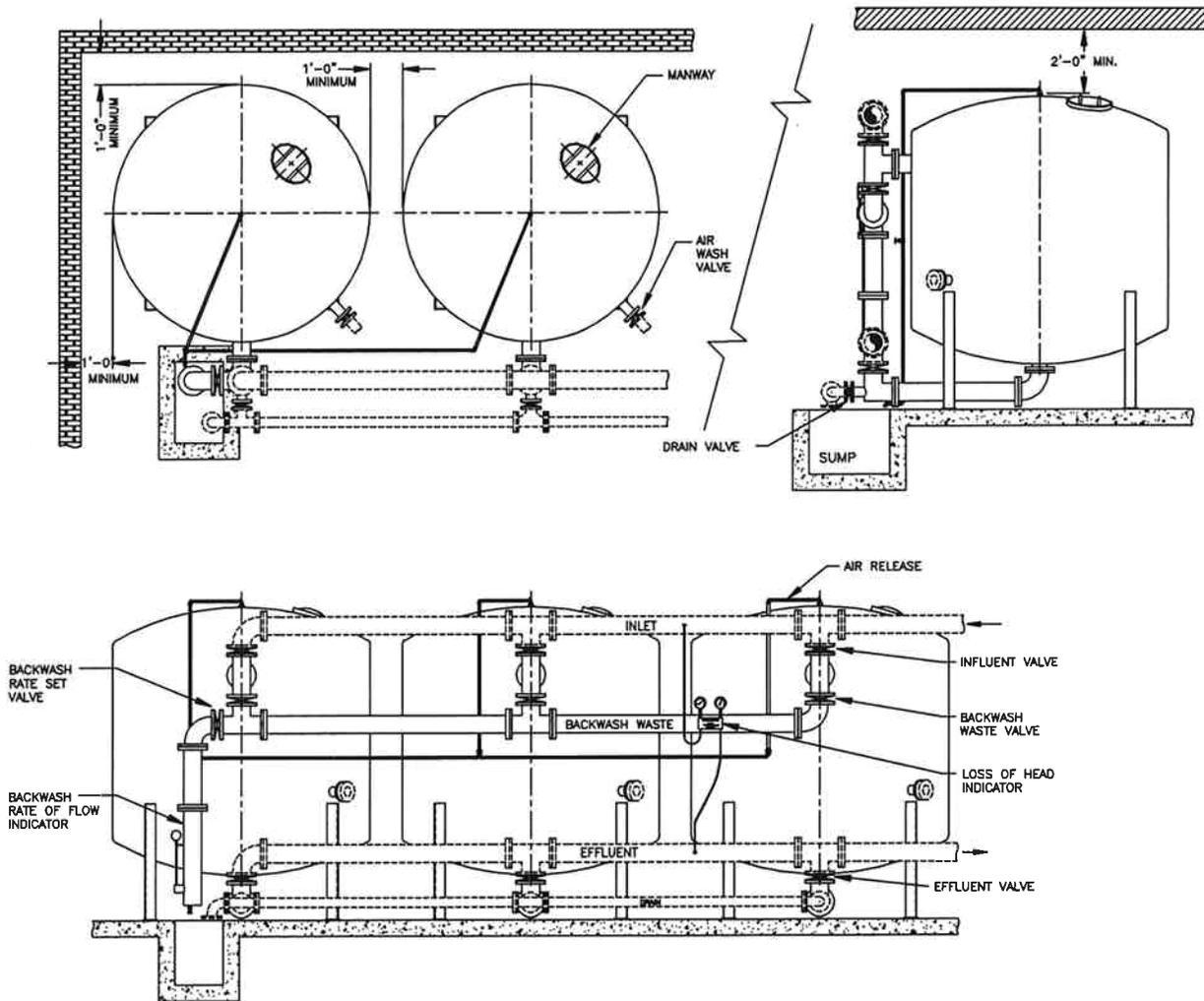
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Scaling Calculations

	Raw Water	Adjusted Feed	Concentrate
pH	7.70	7.70	7.85
Langelier Saturation Index	1.04	1.04	2.19
Stiff & Davis Stability Index	1.07	1.07	1.76
Ionic Strength (Molal)	0.05	0.05	0.18
TDS (mg/l)	3088.29	3089.11	10193.09
HCO ₃	868.10	868.10	2804.83
CO ₂	20.11	20.11	35.82
CO ₃	5.29	5.29	49.07
CaSO ₄ (% Saturation)	1.19	1.19	5.57
BaSO ₄ (% Saturation)	80.00	80.00	260.06
SrSO ₄ (% Saturation)	0.00	0.00	0.00
CaF ₂ (% Saturation)	14.41	14.41	520.66
SiO ₂ (% Saturation)	89.36	89.36	297.86
Mg(OH) ₂ (% Saturation)	0.01	0.01	0.05

To balance: 0.81 mg/l Cl added to feed.

GENERAL FILTER
THREE UNIT MANGANESE GREENSAND VERTICAL FILTER BATTERY
 STANDARD FLANGED PIPING



NOTE: ON JOBS WHERE PRESSURE AERATION OCCURS BEFORE FILTRATION, THERE NEEDS TO BE A PROVISION MADE FOR AIR RELEASE IN THE HIGHEST POINT OF THE INLET PIPING.

NOTE: FILTER PIPING SHOWN DASHED IS PROVIDED BY OTHERS UNLESS SPECIFICALLY QUOTED.

NOTE: CONFIGURATION SHOWN IS STANDARD REF. DATA SHEET D-22.00A,B

FILTER DIAMETER	INFLUENT VALVE	EFFLUENT VALVE	BACKWASH WASTE VALVE	DRAIN VALVE	AIR WASH VALVE	BACKWASH RATE SET VALVE
84"	6"	6"	6"	3"	2.5"	6"

SIEMENS Water Technologies
 Ames, IA
 515-268-8400

A-28512-2
 REV. 1-3-07

Project Information: Municipal groundwater source with high levels of Boron. URS would like projections done for a confidential client.

System Details

Feed Flow to Stage 1	133.33 gpm	Pass 1 Permeate Flow	100.01 gpm	Osmotic Pressure:	
Raw Water Flow to System	133.33 gpm	Pass 1 Recovery	75.01 %	Feed	10.72 psig
Feed Pressure	105.22 psig	Feed Temperature	62.6 F	Concentrate	38.82 psig
Fouling Factor	0.85	Feed TDS	1188.35 mg/l	Average	24.77 psig
Chem. Dose	None	Number of Elements	24	Average NDP	58.91 psig
Total Active Area	9600.00 ft²	Average Pass 1 Flux	15.00 gfd	Power	7.63 kW
Water Classification: Well Water SDI < 3				Specific Energy	1.27 kWh/kgal

Stage	Element	#PV	#Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)	Perm Flow (gpm)	Avg Flux (gfd)	Perm Press (psig)	Boost Press (psig)	Perm TDS (mg/l)
1	NF90-400	3	4	133.33	100.22	0.00	66.98	85.06	66.35	19.90	0.00	0.00	48.13
2	NF90-400	2	4	66.98	80.06	0.00	39.64	69.14	27.35	12.31	0.00	0.00	127.70
3	NF90-400	1	4	39.64	64.14	0.00	33.32	46.96	6.32	5.69	0.00	0.00	329.14

Pass Streams (mg/l as Ion)									
Name	Feed	Adjusted Feed	Concentrate			Permeate			
			Stage 1	Stage 2	Stage 3	Stage 1	Stage 2	Stage 3	Total
NH4	1.30	1.30	2.49	4.04	4.70	0.10	0.24	0.58	0.17
K	22.74	22.74	44.05	72.14	84.17	1.23	3.32	8.71	2.27
Na	259.88	259.89	503.70	826.03	965.00	13.73	36.47	93.68	25.00
Mg	31.40	31.40	61.84	103.27	122.00	0.67	1.78	4.56	1.22
Ca	63.89	63.89	125.85	210.23	248.38	1.33	3.54	9.21	2.43
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ba	0.03	0.03	0.05	0.09	0.10	0.00	0.00	0.00	0.00
CO3	0.69	0.69	2.94	8.37	11.60	0.00	0.00	0.01	0.00
HCO3	331.00	331.00	648.43	1075.34	1266.37	7.40	19.59	51.22	13.48
NO3	0.11	0.11	0.14	0.16	0.17	0.08	0.11	0.14	0.09
Cl	420.00	420.00	813.84	1334.34	1558.67	22.37	59.34	152.20	40.68
F	0.30	0.30	0.58	0.93	1.09	0.02	0.06	0.14	0.04
SO4	20.00	20.00	39.66	66.73	79.19	0.15	0.41	1.07	0.28
SiO2	37.00	37.00	72.61	120.73	142.20	1.05	2.85	7.62	1.96
Boron	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CO2	17.70	17.70	18.65	20.81	21.98	17.82	19.12	20.92	18.38
TDS	1188.34	1188.35	2316.16	3822.42	4483.65	48.13	127.70	329.14	87.63
pH	7.40	7.40	7.63	7.76	7.79	5.86	6.23	6.58	6.09

Permeate Flux reported by ROSA is calculated based on ACTIVE membrane area. DISCLAIMER: NO WARRANTY, EXPRESSED OR IMPLIED, AND NO WARRANTY OF MERCHANTABILITY OR FITNESS, IS GIVEN. Neither FilmTec Corporation nor The Dow Chemical Company assume liability for results obtained or damages incurred from the application of this information. FilmTec Corporation and The Dow Chemical Company assume no liability, if, as a result of customer's use of the ROSA membrane design software, the customer should be sued for alleged infringement of any patent not owned or controlled by the FilmTec Corporation nor The Dow Chemical Company.

Reverse Osmosis System Analysis for FILMTEC™ Membranes

ROSA v6.1.5 ConfigDB U238786_55

Project: Confidential URSV2

Case: 2

AFZ, Siemens Water Technologies

1/12/2009

Design Warnings

-None-

Solubility Warnings

Langelier Saturation Index > 0

Stiff & Davis Stability Index > 0

SiO2 (% Saturation) > 100%

Antiscalants may be required. Consult your antiscalant manufacturer for dosing and maximum allowable system recovery.

Stage Details

Stage	Element	Recovery	Perm Flow (gpm)	Perm TDS (mg/l)	Feed Flow (gpm)	Feed TDS (mg/l)	Feed Press (psig)
Stage 1	1	0.14	6.25	33.15	44.44	1188.35	100.22
	2	0.15	5.75	41.70	38.20	1377.09	95.02
	3	0.16	5.29	53.27	32.45	1613.62	90.85
	4	0.18	4.83	69.55	27.16	1917.13	87.58
Stage 2	1	0.12	4.10	89.86	33.49	2316.16	80.06
	2	0.12	3.64	113.14	29.39	2626.23	76.53
	3	0.12	3.19	143.84	25.76	2980.39	73.59
	4	0.12	2.75	184.71	22.57	3380.01	71.16
Stage 3	1	0.05	2.12	241.64	39.64	3822.42	64.14
	2	0.05	1.73	302.07	37.52	4024.37	59.41
	3	0.04	1.38	379.29	35.79	4203.52	55.02
	4	0.03	1.09	478.47	34.41	4356.98	50.89

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Scaling Calculations

	Raw Water	Adjusted Feed	Concentrate
pH	7.40	7.40	7.79
Langelier Saturation Index	-0.07	-0.07	1.46
Stiff & Davis Stability Index	0.31	0.31	1.34
Ionic Strength (Molal)	0.02	0.02	0.08
TDS (mg/l)	1188.34	1188.35	4483.65
HCO3	331.00	331.00	1266.37
CO2	17.70	17.70	21.98
CO3	0.69	0.69	11.60
CaSO4 (% Saturation)	0.26	0.26	2.03
BaSO4 (% Saturation)	17.14	17.14	80.78
SrSO4 (% Saturation)	0.00	0.00	0.00
CaF2 (% Saturation)	0.76	0.76	38.93
SiO2 (% Saturation)	33.94	33.94	130.46
Mg(OH)2 (% Saturation)	0.00	0.00	0.02

To balance: 0.01 mg/l Na added to feed.

Water Technologies

Vantage™ M84 Reverse Osmosis Units

The Clear Advantage
In Membrane Systems

SIEMENS

Vantage™ M84 units are packaged single-pass 8-inch reverse osmosis units designed for a variety of applications requiring high quality equipment with a fast delivery and competitive price. These pre-engineered, pre-assembled and factory tested units minimize installation and start-up time. With simple utility connections and easy to set up controls, the unit is ready for quick on-line service.

The Vantage™ M84 unit comes with a user friendly touch screen Human Machine Interface (HMI), Variable Frequency Drive (VFD) for flow control, built in Clean In Place (CIP) function, and pH/ORP monitoring.

The unit features an "On-Board" integrated cleaning system (CIP) initiated through the HMI. The CIP system includes plumbing to the on-skid RO cartridge filter housing and VFD controlled pump along with the factory supplied valves, hoses, and a polyethylene CIP tank (off-skid).

VANTAGE™ M84 UNIT BENEFITS:

- Compact footprint saves valuable floor space
- Quick equipment delivery keeps project moving fast
- Clean in place connections maximize system serviceability
- Comprehensive factory testing performed at our ISO9001 certified facility
- FilmTec's iLEC® interlocking endcaps, an innovative element coupling technology that significantly enhances the performance of RO systems

STANDARD M84 UNIT FEATURES:

- Choice of brackish water or low energy TFC membranes (400 ft²) to ensure optimum water quality
- High pressure 316 stainless steel vertical multi-stage feed pump
- ASME Code FRP, RO pressure vessels with ASME pressure relief protection
- PVC low pressure feed, product and reject piping, 316L stainless steel high pressure piping
- Urethane coated carbon steel frame rated for Seismic Zone 4 anchorage
- Dry contacts are provided for chemical feed, pre-treatment equipment, storage tank levels, and pressure switches
- All alarm and shut down conditions are indicated on the control interface



Specifications

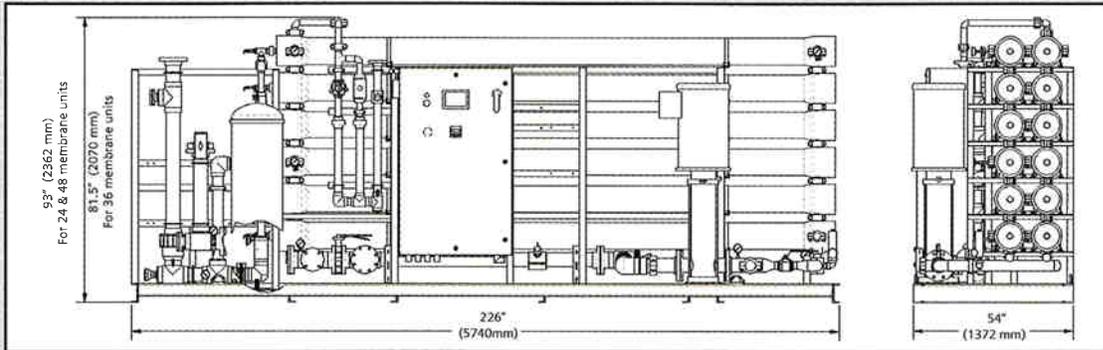
Model No**	Flow Rate Specifications GPM Nominal (m ³ /hr)			Vessel Staging	Membrane/Vessel	Membrane Quantity	Customer Connection Specifications			Utility Requirements***			Approx. Shipping Weight lb (kg)
	Product*	Feed	Reject				Feed	Product	Reject	High Voltage Service	High Voltage FLA	Pump HP	
M84R024	100(22.7)	134(30.4)	34(7.7)	3:2:1	4	24	3"	3"	2"	480 VAC 3 ph	36	25	5400 (2449)
M84R036	150(34.1)	200(45.4)	50(11.4)	4:3:2	4	36	4"	4"	2"	480 VAC 3 ph	67	50	5750 (2608)
M84R048	200(45.4)	267(60.6)	67(15.2)	6:4:2	4	48	4"	4"	2"	480 VAC 3 ph	67	50	6100 (2767)

*Product flow rates are based on a flux rate of 15 GFD and equipment design parameters listed below. Product flow rates may not be appropriate for other feed waters.

**The 8 designates 8" housing, the 4 designates 4 elements in length, and the -RXXX designates the number of membranes.

***Additional voltage options are available. Refer to equipment specifications.

Dimensions



Model Features

Component	Description
Controls	Siemens PLC
HMI	6" Color Touch Screen
Inputs/Outputs	Discrete 24 point (14 input/ 10 output)
I/O Expansion Capability	Yes
Communication Port	PLC-RS485/HMI-Ethernet
Remote Monitoring/Communications*	Optional Modules
Flow Monitoring	Paddlewheel to PLC (feed/reject)
Conductivity	Signet Multiparameter
Auto-Flush (Standby)	Yes
Visual/Audible Alarm	Yes
Single Power Drop (460/575 VAC)	Yes
304LSS Pre-Filter Housing	Yes
Product Divert Kit	Yes
Variable Frequency Drive (VFD) Pump	Yes
On-Board CIP (Tank off-skid)	Yes
ORP/pH with alarms	Yes
Product Blend Kit	Yes
Low Energy Membranes (Cold Water)	Optional

*Additional communication modules and remote monitoring capabilities available upon request.

Design Parameters:

Feed Water Source	Well or Pretreated
Maximum Turbidity	1 NTU
Maximum Free Chlorine and/or chloramine	<0.1 PPM
Feed Water Fouling Index	Silt Density Index (SDI) <3
Design Feed Water Temperature	65°F (18.3°C)
Inlet Pressure Requirements	30-60 PSIG
Product Pressure Available	10 PSIG
System Recovery (Nominal)	75%
Performance Basis	A specific computer projection must be run for each individual application.

*Lower temperature may require larger booster pump or use of low energy membranes.

If any of the feed water parameters are not within the limits given, contact Siemens Water Technologies Technical Support.

The information provided in this brochure contains merely general descriptions or characteristics of performance which in actual case of use do not always apply as described or which may change as a result of further development of the products. An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of contract.

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EQUIPMENT LIST
VANTAGE™ M84 REVERSE OSMOSIS SYSTEM

Confidential URS, VA

Equipment Supplied by Siemens Water Technologies

One (1) Vantage M84 Reverse Osmosis Membrane Skid: Model M84-024, rated for 100 GPM permeate. The skid would be in the 3:2:1 configuration using 8" diameter x 4 membrane long 4M FRP pressure vessels. The operating weight of the skid is approximately 7,200 lbs. The skid measures 18 feet 10 inches long by 4 feet 6 inches wide by 7 feet 9 inches high, outside dimensions. The skid is painted steel construction and has the following prepiped and installed on the skid:

FRP Membrane Vessels: Six (6) Protec model PRO-8-300 FRP membrane vessels arranged in a 3:2:1 configuration for housing the membrane elements. The vessels are rated for 300 psi, are ASME code stamped and are NSF 61 approved for contact with potable water. Connections to the vessels are stainless steel grooved side entry type for feed and concentrate connections.

Piping: High pressure skid piping will be constructed from welded, schedule 10 Type 316L stainless steel. Low pressure piping will be constructed from schedule 80 PVC.

Prefilter Housing: One (1) prefilter housing constructed of 304L stainless steel. The size of the prefilter shall be 7Rx4H.

Booster Pump: One (1) with stainless steel housing and 25 hp, 460V, 3ph, 60 Hz TEFC motor. The pump is a Grundfos CRN Series.

Automatic Control Valves:

Inlet Valve: One (1) per skid, butterfly type with pneumatic actuator.

Auto Flush Valve: One (1) per skid, ball type, 316 SS, with pneumatic actuator.

Product Isolation Valve: One (1) per skid, butterfly type, with fail-to-close pneumatic actuator.

Product to Drain Valve: One (1) per skid, butterfly type, with fail-to-open pneumatic actuator.

Manual Valves:

Pump Throttling Valve: One (1) per skid, ball type, 316 SS, with locking manual actuator.

Reject Throttling Valve: One (1) per skid, globe valve, 316 SS, with manual actuator.

Blend Line Valve: One (1) per skid, diaphragm type, PVC construction with manual handwheel actuator.

Miscellaneous Valves:

Sample Valves: One (1) set ¼" PVC sample valves for feed water, product connections on each pressure vessel and a combined product sample.

Sample Valve: One (1) ¼" 316 stainless steel plug valve for high pressure feed sampling.

Pressure Relief: One (1) per skid, relief valve with ASME certified carbon steel body with stainless steel trim and Viton soft seat.

Controls:

Skid Control Panel: One (1) skid mounted NEMA 12 enclosure per skid, with Siemens operator interface terminal, relays, lights, and switches controlled by a Siemens programmable controller. The panel will have discrete interlocks for integration with additional skids, chemical prefeed and external run and stop signals. An HMI will be provided consisting of a Siemens model TP177B with 6" diagonal color touch screen. In addition, the PLC will have an Ethernet connection module that will allow remote communication with the skid.

Variable Frequency Drive (VFD): One (1) solid state variable frequency motor drive for the booster pump continuously adjustable over a range of 10 to 1. The VFD shall be mounted in the instrument control panel.

Pressure Gauges: Pressure gauges are 316 stainless steel bourdon tube and socket type with glycerin filled dial. Pressure gauges shall be provided for:

- cartridge prefilter inlet
- prefilter outlet
- booster pump discharge
- membrane housing inlet
- first stage permeate pressure prior to orifice plate
- concentrate outlet from each of stage 1, 2 and 3
- combined permeate

Pressure Switches: Two (2) per skid, one low pressure and one high pressure. The low pressure switch is adjustable between 4 and 50 psig. The high pressure switch is adjustable between 30 and 600 psig. Units have a BUNA N primary wetted diaphragm and a 1/4" 316 stainless steel wrought casing.

Conductivity Sensor: One (1) per skid, panel mounted in a NEMA 12 housing, monitor will be Signet 8900 Series Multi-parameter.

Conductivity Probe: Two (2) per skid, with 316 stainless steel electrodes, and PFM O-rings, rated to 100 psig. Probes will be Signet 2850 Series.

Flow Sensors: Two (2) per skid, for feed and reject flow monitoring and control. The sensors are paddlewheel style, polypropylene construction, and mount in a T fitting in the process piping. The flow sensor is Signet 2536 series.

Flow Indicating Rotameter: One (1) per skid, for blend line flow determination. The rotameter will be acrylic construction and have 316 stainless steel end connections.

pH and ORP Monitor: One (1) per skid, panel mounted in a NEMA 12 housing. Monitor will be Signet 8900 Series Multi-parameter.

pH Probe: One (1) per skid, pH probe is Signet model 2774

ORP Probe: One (1) per skid, ORP probe is Signet model 2775.

The Following Items are Shipped Loose for Field Assembly:

Twenty Four (24) – Membrane Elements: Model LE-400 Reverse Osmosis membrane elements as manufactured by DOW FILMTEC™.

Fourteen (14) – Cartridge Prefilters: 40" long for field installation in the prefilter housing. This quantity is sufficient for two complete sets of cartridge filters.

One (1) – Chemical Clean-in-Place (CIP) Tank: The CIP will be constructed of polyethylene and will be 36" diameter with a nominal capacity of 200 gallons. The tank will be supplied with four (4) PVC bulkhead fittings with PVC connections to allow flow into and out of the tank from the Vantage skid during cleaning. An additional bulkhead fitting and PVC ball valve will be supplied for tank draining.

One (1) – CIP Hose and Recirculation Valve Kit: for connection of above tank to the Vantage skid during CIP operation. The hoses shall be reinforced flexible hose with appropriate end connections for attachment to the skid.

One (1) – Set Antiscalant Feed Equipment: consisting of the following:

Chemical Feed Pump: One (1) per skid high-precision diaphragm type, on/off control by control panel with rate set from integral interface on pump. Pump will be Grundfos DME series with maximum capacity of 0.66 gph. Pump will be 120V, 1ph, 60 Hz service. Pump will be supplied with alarm wire and communication wire. Dose rate will be manually set from the pump, the pump will be turned on and off from skid control panel.

Chemical Day Storage Tank: One (1) 53 gallon Polyethylene Tank.

Suction Line: One (1) rigid suction tube with low level switch assembly.

Miscellaneous Hardware: Additional hardware consisting of pump wall mounting bracket, priming kit, inlet valve and pulsation dampener will be provided.

One (1) Air Compressor Pack: For Operation of the filter function valves consisting of two Quincy air compressors set for lead/lag, 4.4 CFM FAD @ 80 psig with ½ hp, 230 VAC, 3 ph, 60 Hz, 1750 rpm,

open drip proof drive motors, mounted on a common 30 gallon ASME code receiver (optional for additional cost: TEFC with NEMA 4 enclosure).

Accessories include:

- V-belt drive
- enclosed belt guard
- inlet filter/silencer air filter with spare cartridge
- automatic adjustable pressure switches
- ASME safety relief valve on air receiver
- in-tank type check valve
- compressor vibration mounts
- manual tank drain
- 120V (mounted) electronic type automatic tank drain (contractor to provide wall outlet at proper location)
- 120V (mounted) refrigerated air dryer (contractor to provide wall outlet at proper location)
- compressed air filter with spare filter cartridge
- single-supply alternator/starter panel with control circuit transformer and test-off-auto selector switches in a NEMA 1 enclosure with IEC magnetic starters.
- vibration isolation pads
- manufacturer's standard paint system

(Note to Proposals Specialist: Additional items requiring an air supply, such as modulating valves, may require a larger compressor.)

Owners Manuals: six (6), with installation, operating, and maintenance instructions, drawings and manufacturers' bulletins. Information contained on CD's.

Technical Direction: Six (6) days, for installation supervision, plant start-up, and operator training in a total of three (3) trips to the jobsite.

NOTE: Availability of equipment components specified may dictate substitutions of equal quality at the discretion of Siemens Water Technologies. Interconnecting wiring and piping is not included in the equipment supplied. Chemicals for startup are not included.

Installation is by others.

Equipment Specifications

Vantage™ M84 Series Reverse Osmosis Water Treatment System

Confidential URS, VA

Section 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section of the specification covers the furnishing and installation of a Vantage M84 Series Reverse Osmosis treatment skid and appurtenances as shown on the drawings and as specified herein.
- B. The following items are a part of this section and shall be furnished by one manufacturer to ensure a properly designed and integrated water treatment system.
 - 1. Factory built structural carbon steel skid with urethane coating.
 - 2. Membrane elements in fiberglass pressure vessels, high pressure pump, prefilter housing, stainless steel high pressure piping, PVC low pressure piping, automatic process valves, and the system control panel all mounted on the above skid.
 - 3. Cleaning solution tank and clean-in-place (CIP) hose kit.
 - 4. Instrumentation and control system designed to automatically control flow to the membranes based on a product flow setpoint input by the operator, automatically control CIP flow, prevent unacceptable water from being directed to downstream unit operations and to prevent damage to the membranes from over pressure or low reject flow rates.
 - 5. Raw water blend line built into the skid with rate set valve and flow meter.

1.02 QUALITY ASSURANCE:

- A. The treatment system shall be furnished by a single manufacturer who shall comply with the following:

The manufacturer supplying equipment for this specification shall furnish proof of a minimum of 100 installations and 10 years of manufacturing treatment systems similar to the specified system.

In addition to normal start-up service, the systems detailed above shall be fully operational including the demonstration of a fully automated control sequence for the flush of the system and prevention of over-pressure of the membranes.

Membrane elements, housings and piping of the packaged treatment system shall be certified to NSF® Standard 61.

1.03 SUBSTITUTIONS:

- A. Manufacturers other than that which is specified and/or not meeting EVERY provision of the specification shall be required to submit a complete and detailed PRE-QUALIFICATION PACKAGE to the engineer at least fifteen (15) days prior to the bid. Any PRE-QUALIFICATION PACKAGE must contain as a minimum:
1. Detailed Layout Drawings.
 2. Detailed component specifications and catalog cut sheets.
 3. Process P&ID Drawing.
 4. Detailed list of variations required from original design, referencing appropriate sections of the specifications and locations on the drawings.
 5. History of the process offered, including pilot data and experience.
 6. Installation list including actual scale-up data from pilot testing to full scale plant operation, also including plant contact names and telephone numbers.
 7. All other data as required in Quality Assurance section above.
 8. A detailed System Performance Guarantee with appropriate remedies for non-performance.
- B. Manufacturers qualifying will be recognized by addendum a minimum of five (5) days prior to the bid. Contractors shall include all costs associated with any redesign required with their bid.
- C. Manufacturers not meeting this specification in EVERY WAY or are not PRE-QUALIFIED and approved by the engineer as outlined above will not be considered for use on this project.

Section 2 - PRODUCTS

2.01 GENERAL

- A. All component parts and equipment utilized in the pre-engineered water treatment system shall be furnished as a complete integrated system by one manufacturer. This specification describes a Vantage Series M84 Water Treatment System as manufactured by Siemens Water Technologies.

Furnish and install one (1) identical skid capable of producing 100 GPM* permeate. Total plant design flow rate is 100 GPM. The pre-engineered treatment system shall be Vantage Model M84-024.

*** This is based on a nominal design flux of 15 gfd, which is typical for well water or pretreated surface water with an SDI of less than 5.**

2.02 REVERSE OSMOSIS SKID

- A. The configuration of the system shall be multi-stage, single pass, with a design system recovery of 75%. The skid shall be staged in a 3:2:1 configuration and shall utilize 4M vessels.

- B. Influent temperature shall be greater than 50°F, have an SDI less than 5 and have undetectable free chlorine and/or chloramines.

C. Skid Fabrication

The Vantage Series Reverse Osmosis System shall be mounted on a rectangular steel skid. Major components shall be of the size and configuration shown on the drawings and fabricated of ASTM A36 structural carbon steel and ASTM A500 structural carbon steel tubing. Surface shall be prepared using an SSPC SP-6 commercial blast and coated with 6-9 mils DFT urethane. The skid frame shall extend to the full footprint of the skid.

All external connections shall be provided as flanged connections as shown in the drawings.

1. High pressure piping on the skid (greater than 90 psi) shall be welded Schedule 10, 316L stainless steel.
2. Low pressure piping shall be Schedule 80 PVC conforming to ASTM-D-1784, socket welded and flanged (threaded for instrumentation).
3. Gaskets shall be 1/8" thick EPDM, ring or full face.

D. Membrane and Pressure Vessels

1. Membranes shall be thin film composite, 8" spiral wound and shall come in a standard 40" length. The membranes shall be DOW FILMTEC™ LE-400.
2. Each membrane element shall have an active surface area of 400 ft².
3. The system shall be designed for a flux of 15 gallons/ft²/day (GFD).
4. Membrane elements shall be housed in a fiberglass reinforced plastic (FRP) pressure vessel rated to 300 psig. Each housing shall be 8" diameter, and have grooved 1 1/2" side entry connections. Housings shall be ASME code stamped. Membrane housings shall be Protec™ Pro-8-300 Series. Pressure relief must also be provided, as per ASME and the code stamped housing.

E. Booster Pump

1. A multistage centrifugal pump shall be mounted on each skid for pressurizing the water to the RO system. Each pump will be designed to provide 133 gpm of water at a pressure of 250 psig.
2. Pump housing shall be constructed of 316 stainless steel. Pump impellers shall be 316 stainless steel.
3. Pump motor shall be 25 hp, TEFC, 460 volt, 3 phase, 60 hz. Motor shall have Class F insulation, be UL recognized, and have a service factor of 1.15.

4. Pump shall be Grundfos CRN series.

F. Plant Process Valves

The treatment plant manufacturer shall provide all process control valves in sizes shown on the drawings.

1. There shall be automatic control valves with pneumatic actuators for the skid including:

One inlet valve, wafer butterfly style, with EPDM seats.

One auto flush valve, which shall be a ball valve with 316 stainless steel body, ball and stem.

One product isolation valve, wafer butterfly style, with EPDM seats. Actuator shall be fail-to-close.

One product to drain valve, wafer butterfly style, with EPDM seats. Actuator shall be fail-to-open.

2. There shall be adequate manual valves on the skid as follows:

One pump throttling valve, which shall be a ball valve with 316 stainless steel body, ball and stem and locking manual actuator.

One reject throttling valve, which shall be a 316 stainless steel globe valve with manual actuator.

One lot ¼" PVC sample valves for feed water, product connections on each pressure vessel and a combined product sample.

One ¼" 316 stainless steel plug valve for high pressure feed sampling.

One ¼" PVC valve for low pressure feed sampling

3. There shall be a pressure relief valve with ASME certified carbon steel body with stainless steel trim and Viton soft seat on the skid on both the feed to the membrane housings and on the product piping.

Gauges shall be isolated from the process stream by ¼" stainless steel threaded plug valves.

G. System Prefilters

1. The skid shall be provided with one multi-element prefilter for removal of suspended solids in the influent water.
2. The filter elements shall be non-shedding polypropylene with a nominal opening of 5 microns.

3. The filter housing shall be 304L stainless steel and shall have a 150 psig non-code pressure rating. The housing shall be sized for no more than 5 gpm per 10" filter equivalent.

H. Blend Line

1. Each membrane skid shall be equipped with a raw water blend line that allows a portion of raw water to be blended with the membrane permeate to reach a desired finished water quality goal.
2. The blend line shall consist of a diaphragm valve, check valve and rotameter to allow the operator to manually adjust the desired raw water bypass rate.

2.03 CLEAN-IN-PLACE SYSTEM

- A. The cleaning system pump, filter and controls will be fully integrated into the Reverse Osmosis skid. The only additional CIP components that shall be required will consist of a chemical makeup tank and a hose kit.
1. The CIP Chemical Makeup Tank shall have a capacity of 200 gallons and shall be 36" diameter. The tank will be installed by the contractor near the membrane skid as shown on the project plans. It shall be polyethylene construction and use PVC bulkhead fittings for the connection points.
 2. A hose kit shall be provided by the manufacturer with sufficient hoses and connection hardware to make the CIP system operational when required. The hose kit shall also be supplied with a bypass valve for mixing of CIP solution.

2.04 AIR COMPRESSOR

- A. Manufacturer shall furnish one compressor pack consisting of two (2) single stage automatic air compressors with one ASME code, 30 gallon horizontal receiver, motor, load-less starting, pressure gauge, safety valve, crankcase drain, intake air filter, pressure switch, manual and automatic receiver blowdown, continuously running refrigeration type air dryer, dryer moisture trap with manual and automatic blowdown, shut off valve and compressed air filter with spare cartridge. Compressor pack to be completely shop assembled with dryer. Refrigeration dryer shall be 120 volt single phase, contractor to provide wall outlet at proper location for dryer. Compressors shall have a piston displacement of 4.4 cfm FAD and driven by ½ hp, 230 volt, 3 phase, 60 Hz drive motors. Compressors shall be alternating with lead compressor switch setting 70 - 90 psig, lag compressor switch setting 60 - 80 psig. Capacity of a single compressor shall be sufficient for normal operation of pneumatic valves. An IEC specific purpose motor starter assembly is to be provided as part of the compressor pack and is to be installed by the contractor.

2.05 ANTISCALANT FEED SYSTEM

- A. Manufacturer shall furnish chemical dosing equipment for the introduction of antiscalant to the system feedwater. It shall consist of a metering pump, calibration column, tubing and injection quill.
 - 1. The pump will be field mounted by others on the chemical storage container for the antiscalant. The pump will be Grundfos DME series, capable of a maximum of 0.66 gph, with a turndown capability of 1000:1. The pump rate shall be manually set by the operator, but pump run status will be controlled by the skid control system.

Section 3 - PLANT CONTROL

3.01 PLANT CONTROL - GENERAL

A PLC based control panel shall be supplied to monitor and control the Vantage Series System. The PLC based system shall be capable of operating in an automatic mode completely autonomously. The control panel shall provide automatic starting and stopping of the Treatment System, based on clearwell level or device failure.

- A. The control system shall be supplied complete including all necessary equipment to provide a complete and functioning system. The components shall include PLC, human machine interface (HMI), control relays, push-buttons & selector switches, indicating lights, power supplies, fuses and terminal strips. The PLC shall have an Ethernet™ port, enabling interface to a SCADA System or, Master Control Panel or to other membrane skids.

3.02 TREATMENT SYSTEM CONTROL PANEL

- A. The treatment system controls shall consist of Local Control Panel (LCP) on the skid. The control panel shall be supplied in a NEMA 4/12 steel enclosure suitable for indoor use. The front panel of the cabinet shall contain all push buttons, and Human Machine Interface as detailed within this specification. The internal portion of the cabinet shall contain all rail-mounted PLC equipment, power supply, processor, and interface cards. Relays and terminals shall also be contained within the cabinet. The PLC subsystem shall be Siemens S7/200 model CPU224XP. Terminal strips for all field wiring shall be furnished within the panel.
- B. Fuses and simplex outlet shall be provided within the panel.
- C. All digital outputs shall be provided with relay contacts.

3.03 VARIABLE FREQUENCY DRIVE (VFD)

- A. The drive for the booster pump shall consist of an adjustable frequency AC motor controller.
- B. The VFD shall provide continuously adjustable settings over a range of not less than 10 to 1. The controller shall be solid state.

- C. The VFD shall be mounted in the instrument control panel.

3.04 DEVICES FOR OPERATOR INTERFACE

External face mounted devices for operator interface shall be as follows:

- A. Human Machine Interface

The HMI shall be touch screen type with 6 in. diagonal full color display. The HMI shall be fully programmed with shall allow the operator to view and modify system variables within the PLC. It shall allow the operator to set process flow rate, run status and CIP operation through the use of virtual switches/pushbuttons. The HMI shall have an Ethernet port to allow interfacing with other membrane skids, pretreatment devices or other control devices. The HMI shall be Siemens model TP177B DP/PN with Ethernet.

- B. Pushbuttons

1. Pushbuttons shall be Siemens. Panel Mounted Pushbuttons shall be provided to perform the following functionality:
 - a. Emergency Stop

3.05 PROCESS CONTROL SYSTEM FUNCTIONS

- A. The LCP shall automatically control the treatment process.
- B. The HMI shall provide operator adjustable set points for the following parameters:
 1. RO selector Man/Auto
 2. RO selector Start/Stop
 3. Permeate Flow Rate Setpoint
 4. Auto flush selector On/Off
 5. Alarm silence
 6. Alarm reset
 7. CIP Start/Stop
 8. CIP Flow rate set
- C. The PLC shall, via the HMI, provide the following status indicators at a minimum:
 1. Feed flow, reject flow, product flow, % recovery
 2. Total run time
 3. RO operating mode
 4. Pump status
 5. Inlet, reject, product to tank, product to drain valve status
 6. Pretreatment lockout
 7. Storage tank full (Standby – no call for water)

- D. The following alarm conditions shall be monitored by LCP. All alarms shall be visible via the HMI Display.
1. Low quality product
 2. Low feed pressure
 3. Low reject flow
 4. High product flow
 5. Low feed flow
 6. High pump discharge pressure
 7. High feed water temperature
 8. ORP alarm
 9. Emergency Stop
 10. VFD fault
 11. CIP low flow
- E. The following additional features shall be provided in the LCP.
1. Alarm horn and alarm pilot light
 2. Chemical injection pump terminals
 3. Auxiliary contacts for pump running & fault

3.06 INSTRUMENTS

A. Pressure Sensors and Gauges

1. Pressure gauges shall be 316 stainless steel bourdon tube and socket with a 63mm glycerin filled dial. Pressure gauges shall be Ashcroft series 1009.
2. Pressure switches shall be provided for low feed pressure and high discharge pressure. The pressure switches shall have a 15 amp switching power at 120 volts. The low pressure switch shall have an adjustable range between 4 and 50 psig. The high pressure switch shall have an adjustable range between 30 and 600 psig. Units shall have a BUNA N primary wetted diaphragm and a 1/8" 316 stainless steel wrought casing.

B. Conductivity Sensors

1. Conductivity shall be continuously monitored by the control system. The monitor shall be NEMA 4 and be panel mounted. Conductivity monitors shall be Signet 8900 Series Multi-parameter.
2. Conductivity probes shall have 316 stainless steel electrodes, 316 stainless steel body, and FPM O-rings. Units shall thread into a 3/4" NPT connection and be rated to 100 psig. Probes shall be Signet 2850 Series.

C. Flow Sensors/Indicators

1. Each skid will be equipped with two flow sensors for feed and reject flow monitoring and control. The sensors shall be paddlewheel style and shall be polypropylene and mount in a T fitting in the process piping. The flow sensor will be Signet 2536 series.

2. Each skid shall have an acrylic rotameter for flow determination in the product blend line. The rotameter shall have 316 stainless steel end connections. The rotameter shall be manufactured by King Products.

D. PH/ORP Sensors

1. PH and ORP of the raw water shall be continuously monitored by the control system. A sample shall be taken from a high pressure point, fed to the sensors, and returned to a low pressure point so that no waste stream is generated from the sampling. The monitor shall be NEMA 4 and be panel mounted. The monitor shall be Signet 8900 Series Multi-parameter.
2. PH probe shall be Signet model 2774 and ORP probe shall be Signet model 2775.

Section 4 - Execution

4.01 DELIVERY OF EQUIPMENT

- A. The membrane skids shall be shipped to site as a complete unit with the exception of the blend line and membrane elements, which will be installed on-site by the contractor.
- B. The CIP tank and hose kit shall be shipped loose for placement and field installation by others.

4.02 INSTALLATION AND TRAINING

The Vantage Series Reverse Osmosis System shall be installed as shown on the Contract Drawings and specified herein.

The Manufacturer shall inspect the installation of all equipment in this section prior to start-up in order to verify that the equipment has been properly installed and operates properly as a system and individually.

After the equipment has been properly installed, the Manufacturer shall calibrate the equipment with the Owner's operator present.

The Manufacturer shall furnish the service of a competent technical service representative after Contractor's start-up to instruct the Owner's personnel in the operation and maintenance of the equipment.

The Manufacturer's representative shall be present for six (6) days in three (3) trips total to provide services described above.

Water Technologies

Vantage™ M83 Reverse Osmosis Units

The Clear Advantage
In Membrane Systems

Vantage™ M83 units are packaged single-pass 8-inch reverse osmosis units are designed for a variety of applications requiring high quality equipment with a fast delivery and competitive price. These pre-engineered, pre-assembled and factory tested units minimize installation and start-up time. With simple utility connections and easy to set up controls, the unit is ready for quick on-line service.

The Vantage™ M83 unit comes with a user friendly touch screen Human Machine Interface (HMI), Variable Frequency Drive (VFD) for flow control, built in Clean In Place (CIP) function, and pH/ORP monitoring.

The system features an "On-Board" integrated cleaning system (CIP) initiated through the HMI. The CIP system includes plumbing to the on-skid RO cartridge filter housing and VFD controlled pump along with the factory supplied valves, hoses, and a polyethylene CIP tank (off-skid).

VANTAGE™ M83 UNIT BENEFITS:

- Compact footprint saves valuable floor space
- Quick equipment delivery keeps project moving fast
- Clean in place connections maximize system serviceability
- Comprehensive factory testing performed at our ISO9001 certified facility
- Optional Filmtec's iLEC® interlocking endcaps, an innovative element coupling technology that significantly enhances the performance of RO systems

STANDARD M83 UNIT FEATURES:

- Choice of *brackish water*, *low energy TFC*, or *nanofiltration membranes* (400 ft²) to ensure optimum water quality
- High pressure 316 stainless steel vertical multi-stage feed pump
- ASME Code FRP, RO pressure vessels with pressure relief protection
- PVC low pressure feed, product and reject piping, 316L stainless steel high pressure piping
- Urethane coated carbon steel frame rated for Seismic Zone 4 anchorage
- Dry contacts are provided for chemical feed, pre-treatment equipment, storage tank levels, and pressure switches
- All alarm and shut down conditions are indicated on the control interface

SIEMENS



Specifications

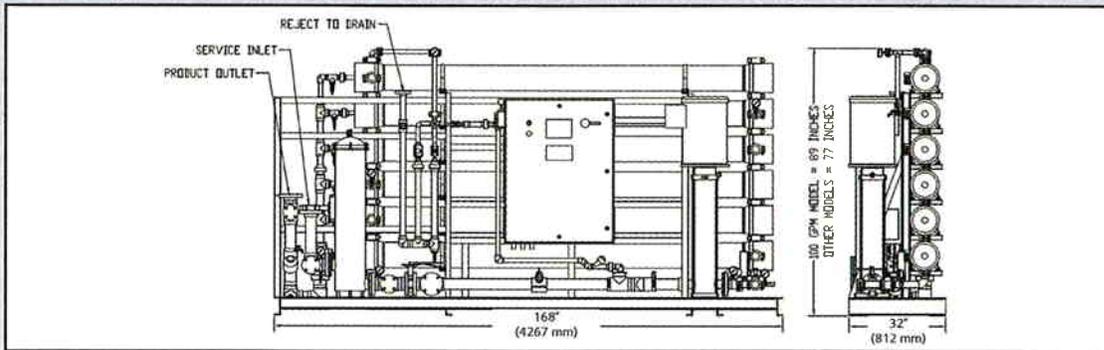
Model No.**	Flow Rate Specifications GPM Nominal (m ³ /hr)				Vessel Staging	Membrane/Vessel	Membrane Quantity	Customer Connection Specifications			Utility Requirements***			Approx. Shipping Weight lb (kg)
	Product*	Feed	Reject	Recycle				Feed	Product	Reject	High Voltage Service	High Voltage FLA	Pump HP	
M83R006	25(5.7)	33(7.5)	8(1.8)	10(2.3)	1:1	3	6	2"	1.5"	1.5"	480 VAC 3ph	16	10	2900 (1315)
M83R009	37(8.4)	49(11.1)	12(2.7)	5(1.1)	1:1:1	3	9	2"	1.5"	1.5"	480 VAC 3ph	29	20	3175 (1440)
M83R012	50(11.4)	67(15.2)	17(3.9)	5(1.1)	2:1:1	3	12	2"	2"	1.5"	480 VAC 3ph	36	20	3450 (1565)
M83R015	62(14.1)	83(18.9)	21(4.8)	3(0.7)	2:2:1	3	15	3"	2"	1.5"	480 VAC 3ph	36	25	3725 (1690)
M83R018	75(17.0)	100(27.7)	25(5.7)	3(0.7)	3:2:1	3	18	3"	3"	1.5"	480 VAC 3ph	42	30	4000 (1814)

*Product flow rates are based on equipment design parameters listed below. Product flow rates may not be appropriate for other feed waters.

**The 8 designates 8" housing, the 3 designates 3 elements in length, and the R0XX designates the nominal design product flow rate at 65°F (18.3°C).

***Additional voltage options are available. Refer to equipment specifications.

Dimensions



Model Features

Component	Description
Controls	Siemens PLC & HMI
Inputs/Outputs	Discrete 24 point (14 input/ 10 output)
I/O Expansion Capability	Yes
Communication Port	RS485
Remote Monitoring/Communications*	Optional Modules
Flow Monitoring	Paddlewheel (feed/reject) Rotometer (recycle)
Conductivity	Signet Multiparameter
Auto-Flush (Standby)	Yes
Visual/Audible Alarm	Yes
Single Power Drop (480 VAC)	Yes
304LSS Pre-Filter Housing	Yes
Variable Frequency Drive (VFD) Pump	Yes
On-Board CIP (Tank off-skid)	Yes
ORP/pH with alarms	Yes
Low Energy Membranes (Cold Water)	Optional
Product Divert Kit	Optional

*Additional communication modules and remote monitoring capabilities available upon request.

Design Parameters:

Feed Water Source	Well or pretreated
Maximum Turbidity	1 NTU
Maximum Free Chlorine and/or chloramine	<0.1 PPM
Feed Water Fouling Index	Silt Density Index (SDI) <3
Design Feed Water Temperature	65°F (18.3°C)
Inlet Pressure Requirements	30-60 PSIG
Product Pressure Available	10 PSIG
System Recovery (Nominal)	75%
Performance Basis	A specific computer projection must be run for each individual application.

*Lower temperature may require larger booster pump or use of low energy membranes.

If any of the feed water parameters are not within the limits given, contact Siemens Water Technologies Technical Support.

The information provided in this brochure contains merely general descriptions or characteristics of performance which in actual case of use do not always apply as described or which may change as a result of further development of the products. An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of contract.

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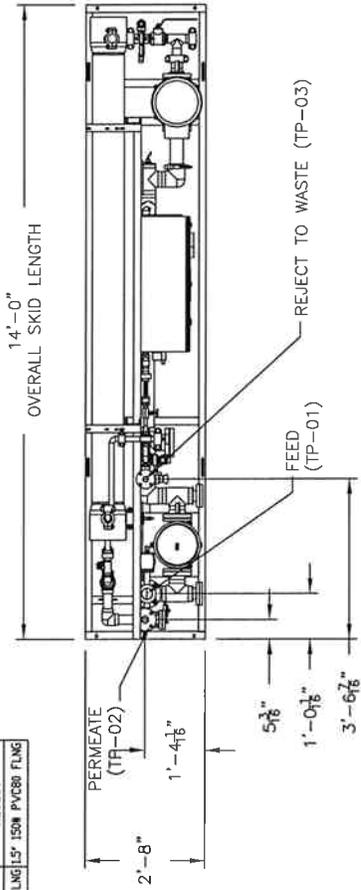
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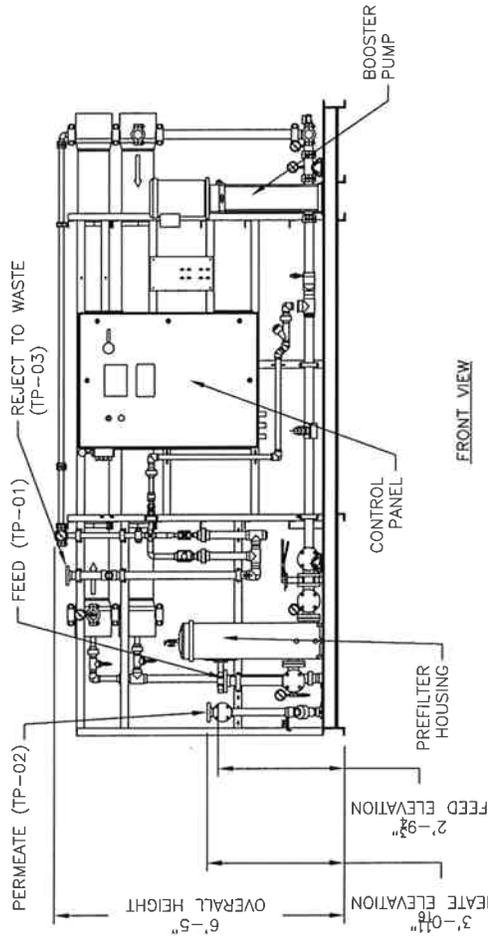
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CONNECTION TABLE

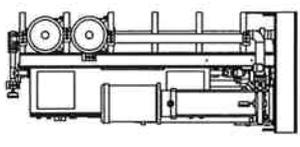
MEMBRANES	TP-01 FEED	TP-02 PRODUCT	TP-03 REJECT
6	2' 150M PVC80 FLANG	15' 150M PVC80 FLANG	15' 150M PVC80 FLANG



TOP VIEW



FRONT VIEW



RIGHT SIDE VIEW

1" = 1" AT PLOT SCALE

INTL REF:

STD: BORDER-1101-11X17B

REV	DESCRIPTION	DATE	BY	CHKD	APPD	ECN

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DESIGNER	DATE	TITLE
005	4-16-07	VANTAGE M83 MEMBRANE SYSTEM
DRAWN	DATE	NANOFILTRATION/REVERSE OSMOSIS
		MODEL: M83-006 1:1 3M ARRAY
ENGINEER	DATE	CLIENT
MANAGER	DATE	
FILE		
SCALE 3/8" = 1'-0"		
PROJECT CODE		
M83-006-01		
SHEET		
1		
OF		
1		
REV		

SIEMENS Water Technologies
 Ames, IA
 515-268-8400

EQUIPMENT LIST
VANTAGE™ M83 REVERSE OSMOSIS SYSTEM

Confidential URS, VA Secondary System

Equipment Supplied by Siemens Water Technologies

One (1) Vantage M83 Reverse Osmosis Membrane Skid: Model M83-006, rated for 25 GPM permeate. The skid would be in the 1:1 configuration using 8" diameter x 3 membrane long 3M FRP pressure vessels. The operating weight of the skid is approximately 4,400 lbs. The skid measures 14 feet 0 inches long by 2 feet 8 inches wide by 6 feet 5 inches high, outside dimensions. The skid is painted steel construction and has the following prepiped and installed on the skid:

FRP Membrane Vessels: Two (2) Protec model PRO-8-300 FRP membrane vessels arranged in a 1:1 configuration for housing the membrane elements. The vessels are rated for 300 psi, are ASME code stamped and are NSF 61 approved for contact with potable water. Connections to the vessels are stainless steel grooved side entry type for feed and concentrate connections.

Piping: High pressure skid piping will be constructed from welded, schedule 10 Type 316L stainless steel. Low pressure piping will be constructed from schedule 80 PVC.

Prefilter Housing: One (1) prefilter housing constructed of 304L stainless steel. The size of the prefilter shall be 4Rx3H.

Booster Pump: One (1) with stainless steel housing and 10 hp, 460V, 3ph, 60 Hz TEFC motor. The pump is a Grundfos CRN Series.

Automatic Control Valves:

Inlet Valve: One (1) per skid, butterfly type with pneumatic actuator.

Auto Flush Valve: One (1) per skid, ball type, 316 SS, with pneumatic actuator.

Product Isolation Valve: One (1) per skid, butterfly type, with fail-to-close pneumatic actuator.

Product to Drain Valve: One (1) per skid, butterfly type, with fail-to-open pneumatic actuator.

Manual Valves:

Pump Throttling Valve: One (1) per skid, ball type, 316 SS, with locking manual actuator.

Reject Throttling Valve: One (1) per skid, globe valve, 316 SS, with manual actuator.

Reject Recycle Valve: One (1) per skid, globe type, 316 SS, with manual actuator.

Miscellaneous Valves:

Sample Valves: One (1) set ¼" PVC sample valves for feed water, product connections on each pressure vessel and a combined product sample.

Sample Valve: One (1) ¼" 316 stainless steel plug valve for high pressure feed sampling.

Pressure Relief: One (1) per skid, relief valve with ASME certified carbon steel body with stainless steel trim and Viton soft seat.

Controls:

Skid Control Panel: One (1) skid mounted NEMA 12 enclosure per skid, with Siemens operator interface terminal, relays, lights, and switches controlled by a Siemens programmable controller. The panel will have discrete interlocks for integration with additional skids, chemical prefeed and external run and stop signals. An HMI will be provided consisting of a Siemens model TP177A with 6" diagonal touch screen.

Variable Frequency Drive (VFD): One (1) solid state variable frequency motor drive for the booster pump continuously adjustable over a range of 10 to 1. The VFD shall be mounted in the instrument control panel.

Pressure Gauges: Pressure gauges are 316 stainless steel bourdon tube and socket type with glycerin filled dial. Pressure gauges shall be provided for:

- cartridge prefilter inlet
- prefilter outlet
- booster pump discharge
- membrane housing inlet
- first stage permeate pressure prior to orifice plate
- concentrate outlet from each of stage 1, 2 and 3
- combined permeate

Pressure Switches: Two (2) per skid, one low pressure and one high pressure. The low pressure switch is adjustable between 4 and 50 psig. The high pressure switch is adjustable between 30 and 600 psig. Units have a BUNA N primary wetted diaphragm and a 1/4" 316 stainless steel wrought casing.

Conductivity Sensor: One (1) per skid, panel mounted in a NEMA 12 housing, monitor will be Signet 8900 Series Multi-parameter.

Conductivity Probe: Two (2) per skid, with 316 stainless steel electrodes, and PFM O-rings, rated to 100 psig. Probes will be Signet 2850 Series.

Flow Sensors: Two (2) per skid, for feed and reject flow monitoring and control. The sensors are paddlewheel style, polypropylene construction, and mount in a T fitting in the process piping. The flow sensor is Signet 2536 series.

pH and ORP Monitor: One (1) per skid, panel mounted in a NEMA 12 housing. Monitor will be Signet 8900 Series Multi-parameter.

pH Probe: One (1) per skid, pH probe is Signet model 2774

ORP Probe: One (1) per skid, ORP probe is Signet model 2775.

The Following Items are Shipped Loose for Field Assembly:

Seventy Two (72) – Membrane Elements: Model BW30-400/34i Reverse Osmosis membrane elements as manufactured by DOW FILMTEC™.

Eight (8) – Cartridge Prefilters: 30" long for field installation in the prefilter housing. This quantity is sufficient for two complete sets of cartridge filters.

One (1) – Chemical Clean-in-Place (CIP) Tank: The CIP will be constructed of polyethylene and will be 36" diameter with a nominal capacity of 200 gallons. The tank will be supplied with four (4) PVC bulkhead fittings with PVC connections to allow flow into and out of the tank from the Vantage skid during cleaning. An additional bulkhead fitting and PVC ball valve will be supplied for tank draining.

One (1) – CIP Hose and Recirculation Valve Kit: for connection of above tank to the Vantage skid during CIP operation. The hoses shall be reinforced flexible hose with appropriate end connections for attachment to the skid.

One (1) – Set Antiscalant Feed Equipment: consisting of the following:

Chemical Feed Pump: One (1) per skid high-precision diaphragm type, on/off control by control panel with rate set from integral interface on pump. Pump will be Grundfos DME series with maximum capacity of 0.66 gph. Pump will be 120V, 1ph, 60 Hz service. Pump will be supplied with alarm wire and communication wire. Dose rate will be manually set from the pump, the pump will be turned on and off from skid control panel.

Chemical Day Storage Tank: One (1) 53 gallon Polyethylene Tank.

Suction Line: One (1) rigid suction tube with low level switch assembly.

Miscellaneous Hardware: Additional hardware consisting of pump wall mounting bracket, priming kit, inlet valve and pulsation dampener will be provided.

One (1) Air Compressor Pack: For Operation of the filter function valves consisting of two Quincy air compressors set for lead/lag, 4.4 CFM FAD @ 80 psig with ½ hp, 230 VAC, 3 ph, 60 Hz, 1750 rpm, open drip proof drive motors, mounted on a common 30 gallon ASME code receiver (optional for additional cost: TEFC with NEMA 4 enclosure).

Accessories include:

- V-belt drive
- enclosed belt guard
- inlet filter/silencer air filter with spare cartridge

- automatic adjustable pressure switches
- ASME safety relief valve on air receiver
- in-tank type check valve
- compressor vibration mounts
- manual tank drain
- 120V (mounted) electronic type automatic tank drain (contractor to provide wall outlet at proper location)
- 120V (mounted) refrigerated air dryer (contractor to provide wall outlet at proper location)
- compressed air filter with spare filter cartridge
- single-supply alternator/starter panel with control circuit transformer and test-off-auto selector switches in a NEMA 1 enclosure with IEC magnetic starters.
- vibration isolation pads
- manufacturer's standard paint system

(Note to Proposals Specialist: Additional items requiring an air supply, such as modulating valves, may require a larger compressor.)

Owners Manuals: six (6), with installation, operating, and maintenance instructions, drawings and manufacturers' bulletins. Information contained on CD's.

Technical Direction: Six (6) days, for installation supervision, plant start-up, and operator training in a total of three (3) trips to the jobsite.

NOTE: Availability of equipment components specified may dictate substitutions of equal quality at the discretion of Siemens Water Technologies. Interconnecting wiring and piping is not included in the equipment supplied. Chemicals for startup are not included.

Installation is by others.

Equipment Specifications

Vantage™ M83 Series Reverse Osmosis Water Treatment System

Confidential URS, VA Secondary System

Section 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section of the specification covers the furnishing and installation of a Vantage M83 Series Reverse Osmosis treatment skid and appurtenances as shown on the drawings and as specified herein.
- B. The following items are a part of this section and shall be furnished by one manufacturer to ensure a properly designed and integrated water treatment system.
 - 1. Factory built structural carbon steel skid with urethane coating.
 - 2. Membrane elements in fiberglass pressure vessels, high pressure pump, prefilter housing, stainless steel high pressure piping, PVC low pressure piping, automatic process valves, and the system control panel all mounted on the above skid.
 - 3. Cleaning solution tank and clean-in-place (CIP) hose kit.
 - 4. Instrumentation and control system designed to automatically control flow to the membranes based on a product flow setpoint input by the operator, automatically control CIP flow, prevent unacceptable water from being directed to downstream unit operations and to prevent damage to the membranes from over pressure or low reject flow rates.

1.02 QUALITY ASSURANCE:

- A. The treatment system shall be furnished by a single manufacturer who shall comply with the following:

The manufacturer supplying equipment for this specification shall furnish proof of a minimum of 100 installations and 10 years of manufacturing treatment systems similar to the specified system.

In addition to normal start-up service, the systems detailed above shall be fully operational including the demonstration of a fully automated control sequence for the flush of the system and prevention of over-pressure of the membranes.

Membrane elements, housings and piping of the packaged treatment system shall be certified to NSF® Standard 61.

1.03 SUBSTITUTIONS:

- A. Manufacturers other than that which is specified and/or not meeting EVERY provision of the specification shall be required to submit a complete and detailed PRE-QUALIFICATION PACKAGE to the engineer at least fifteen (15) days prior to the bid. Any PRE-QUALIFICATION PACKAGE must contain as a minimum:
1. Detailed Layout Drawings.
 2. Detailed component specifications and catalog cut sheets.
 3. Process P&ID Drawing.
 4. Detailed list of variations required from original design, referencing appropriate sections of the specifications and locations on the drawings.
 5. History of the process offered, including pilot data and experience.
 6. Installation list including actual scale-up data from pilot testing to full scale plant operation, also including plant contact names and telephone numbers.
 7. All other data as required in Quality Assurance section above.
 8. A detailed System Performance Guarantee with appropriate remedies for non-performance.
- B. Manufacturers qualifying will be recognized by addendum a minimum of five (5) days prior to the bid. Contractors shall include all costs associated with any redesign required with their bid.
- C. Manufacturers not meeting this specification in EVERY WAY or are not PRE-QUALIFIED and approved by the engineer as outlined above will not be considered for use on this project.

Section 2 - PRODUCTS

2.01 GENERAL

- A. All component parts and equipment utilized in the pre-engineered water treatment system shall be furnished as a complete integrated system by one manufacturer. This specification describes a Vantage Series M83 Water Treatment System as manufactured by Siemens Water Technologies.

Furnish and install one (1) identical skid capable of producing 25 GPM* permeate. Total plant design flow rate is 25 GPM. The pre-engineered treatment system shall be Vantage Model M83-006.

*** This is based on a nominal design flux of 15 gfd, which is typical for well water or pretreated surface water with an SDI of less than 5.**

2.02 REVERSE OSMOSIS SKID

- A. The configuration of the system shall be multi-stage, single pass, with a design system recovery of 75%. The skid shall be staged in a 1:1 configuration and shall utilize 3M vessels.

- B. Influent temperature shall be greater than 70°F, have an SDI less than 5 and have undetectable free chlorine and/or chloramines.

C. Skid Fabrication

The Vantage Series Reverse Osmosis System shall be mounted on a rectangular steel skid. Major components shall be of the size and configuration shown on the drawings and fabricated of ASTM A36 structural carbon steel and ASTM A500 structural carbon steel tubing. Surface shall be prepared using an SSPC SP-6 commercial blast and coated with 6-9 mils DFT urethane. The skid frame shall extend to the full footprint of the skid.

All external connections shall be provided as flanged connections as shown in the drawings.

1. High pressure piping on the skid (greater than 90 psi) shall be welded Schedule 10, 316L stainless steel.
2. Low pressure piping shall be Schedule 80 PVC conforming to ASTM-D-1784, socket welded and flanged (threaded for instrumentation).
3. Gaskets shall be 1/8" thick EPDM, ring or full face.

D. Membrane and Pressure Vessels

1. Membranes shall be thin film composite, 8" spiral wound and shall come in a standard 40" length. The membranes shall be DOW FILMTEC™ BW30-400/34i.
2. Each membrane element shall have an active surface area of 400 ft².
3. The system shall be designed for a flux of 15 gallons/ft²/day (GFD).
4. Membrane elements shall be housed in a fiberglass reinforced plastic (FRP) pressure vessel rated to 300 psig. Each housing shall be 8" diameter, and have grooved 1 1/2" side entry connections. Housings shall be ASME code stamped. Membrane housings shall be Protec™ Pro-8-300 Series. Pressure relief must also be provided, as per ASME and the code stamped housing.

E. Booster Pump

1. A multistage centrifugal pump shall be mounted on each skid for pressurizing the water to the RO system. Each pump will be designed to provide 33 gpm of water at a pressure of 200 psig.
2. Pump housing shall be constructed of 316 stainless steel. Pump impellers shall be 316 stainless steel.
3. Pump motor shall be 10 hp, TEFC, 460 volt, 3 phase, 60 hz. Motor shall have Class F insulation, be UL recognized, and have a service factor of 1.15.

4. Pump shall be Grundfos CRN series.

F. Plant Process Valves

The treatment plant manufacturer shall provide all process control valves in sizes shown on the drawings.

1. There shall be automatic control valves with pneumatic actuators for the skid including:

One inlet valve, wafer butterfly style, with EPDM seats.

One auto flush valve, which shall be a ball valve with 316 stainless steel body, ball and stem.

One product isolation valve, wafer butterfly style, with EPDM seats. Actuator shall be fail-to-close.

One product to drain valve, wafer butterfly style, with EPDM seats. Actuator shall be fail-to-open.

2. There shall be adequate manual valves on the skid as follows:

One pump throttling valve, which shall be a ball valve with 316 stainless steel body, ball and stem and locking manual actuator.

One reject throttling valve, which shall be a 316 stainless steel globe valve with manual actuator.

One lot ¼" PVC sample valves for feed water, product connections on each pressure vessel and a combined product sample.

One ¼" 316 stainless steel plug valve for high pressure feed sampling.

One ¼" PVC valve for low pressure feed sampling

3. There shall be a pressure relief valve with ASME certified carbon steel body with stainless steel trim and Viton soft seat on the skid on both the feed to the membrane housings and on the product piping.

Gauges shall be isolated from the process stream by ¼" stainless steel threaded plug valves.

G. System Prefilters

1. The skid shall be provided with one multi-element prefilter for removal of suspended solids in the influent water.

2. The filter elements shall be non-shedding polypropylene with a nominal opening of 5 microns.

3. The filter housing shall be 304L stainless steel and shall have a 150 psig non-code pressure rating. The housing shall be sized for no more than 5 gpm per 10" filter equivalent.

2.03 CLEAN-IN-PLACE SYSTEM

- A. The cleaning system pump, filter and controls will be fully integrated into the Reverse Osmosis skid. The only additional CIP components that shall be required will consist of a chemical makeup tank and a hose kit.
 1. The CIP Chemical Makeup Tank shall have a capacity of 200 gallons and shall be 36" diameter. The tank will be installed by the contractor near the membrane skid as shown on the project plans. It shall be polyethylene construction and use PVC bulkhead fittings for the connection points.
 2. A hose kit shall be provided by the manufacturer with sufficient hoses and connection hardware to make the CIP system operational when required. The hose kit shall also be supplied with a bypass valve for mixing of CIP solution.

2.04 AIR COMPRESSOR

- A. Manufacturer shall furnish one compressor pack consisting of two (2) single stage automatic air compressors with one ASME code, 30 gallon horizontal receiver, motor, load-less starting, pressure gauge, safety valve, crankcase drain, intake air filter, pressure switch, manual and automatic receiver blowdown, continuously running refrigeration type air dryer, dryer moisture trap with manual and automatic blowdown, shut off valve and compressed air filter with spare cartridge. Compressor pack to be completely shop assembled with dryer. Refrigeration dryer shall be 120 volt single phase, contractor to provide wall outlet at proper location for dryer. Compressors shall have a piston displacement of 4.4 cfm FAD and driven by ½ hp, 230 volt, 3 phase, 60 Hz drive motors. Compressors shall be alternating with lead compressor switch setting 70 - 90 psig, lag compressor switch setting 60 - 80 psig. Capacity of a single compressor shall be sufficient for normal operation of pneumatic valves. An IEC specific purpose motor starter assembly is to be provided as part of the compressor pack and is to be installed by the contractor.

2.05 ANTISCALANT FEED SYSTEM

- A. Manufacturer shall furnish chemical dosing equipment for the introduction of antiscalant to the system feedwater. It shall consist of a metering pump, calibration column, tubing and injection quill.
 1. The pump will be field mounted by others on the chemical storage container for the antiscalant. The pump will be Grundfos DME series, capable of a maximum of 0.66 gph, with a turndown capability of 1000:1. The pump rate shall be manually set by the operator, but pump run status will be controlled by the skid control system.

Section 3 - PLANT CONTROL

3.01 PLANT CONTROL - GENERAL

A PLC based control panel shall be supplied to monitor and control the Vantage Series System. The PLC based system shall be capable of operating in an automatic mode completely autonomously. The control panel shall provide automatic starting and stopping of the Treatment System, based on clearwell level or device failure.

- A. The control system shall be supplied complete including all necessary equipment to provide a complete and functioning system. The components shall include PLC, human machine interface (HMI), control relays, push-buttons & selector switches, indicating lights, power supplies, fuses and terminal strips. The PLC shall have an Ethernet™ port, enabling interface to a SCADA System or, Master Control Panel or to other membrane skids.

3.02 TREATMENT SYSTEM CONTROL PANEL

- A. The treatment system controls shall consist of Local Control Panel (LCP) on the skid. The control panel shall be supplied in a NEMA 4/12 steel enclosure suitable for indoor use. The front panel of the cabinet shall contain all push buttons, and Human Machine Interface as detailed within this specification. The internal portion of the cabinet shall contain all rail-mounted PLC equipment, power supply, processor, and interface cards. Relays and terminals shall also be contained within the cabinet. The PLC subsystem shall be Siemens S7/200 model CPU224XP. Terminal strips for all field wiring shall be furnished within the panel.
- B. Fuses and simplex outlet shall be provided within the panel.
- C. All digital outputs shall be provided with relay contacts.

3.03 VARIABLE FREQUENCY DRIVE (VFD)

- A. The drive for the booster pump shall consist of an adjustable frequency AC motor controller.
- B. The VFD shall provide continuously adjustable settings over a range of not less than 10 to 1. The controller shall be solid state.
- C. The VFD shall be mounted in the instrument control panel.

3.04 DEVICES FOR OPERATOR INTERFACE

External face mounted devices for operator interface shall be as follows:

- A. Human Machine Interface

The HMI shall be touch screen type with 6 in. diagonal monochrome display. The HMI shall be fully programmed with shall allow the operator to view and modify system variables within the PLC. It shall allow the operator to set process

flow rate, run status and CIP operation through the use of virtual switches/pushbuttons. The HMI shall be Siemens model TP177A.

B. Pushbuttons

1. Pushbuttons shall be Siemens. Panel Mounted Pushbuttons shall be provided to perform the following functionality:
 - a. Emergency Stop

3.05 PROCESS CONTROL SYSTEM FUNCTIONS

A. The LCP shall automatically control the treatment process.

B. The HMI shall provide operator adjustable set points for the following parameters:

1. RO selector Man/Auto
2. RO selector Start/Stop
3. Permeate Flow Rate Setpoint
4. Auto flush selector On/Off
5. Alarm silence
6. Alarm reset
7. CIP Start/Stop
8. CIP Flow rate set

C. The PLC shall, via the HMI, provide the following status indicators at a minimum:

1. Feed flow, reject flow, product flow, % recovery
2. Total run time
3. RO operating mode
4. Pump status
5. Inlet, reject, product to tank, product to drain valve status
6. Pretreatment lockout
7. Storage tank full (Standby – no call for water)

D. The following alarm conditions shall be monitored by LCP. All alarms shall be visible via the HMI Display.

1. Low quality product
2. Low feed pressure
3. Low reject flow
4. High product flow
5. Low feed flow
6. High pump discharge pressure
7. High feed water temperature
8. ORP alarm
9. Emergency Stop
10. VFD fault
11. CIP low flow

E. The following additional features shall be provided in the LCP.

1. Alarm horn and alarm pilot light
2. Chemical injection pump terminals
3. Auxiliary contacts for pump running & fault

3.06 INSTRUMENTS

A. Pressure Sensors and Gauges

1. Pressure gauges shall be 316 stainless steel bourdon tube and socket with a 63mm glycerin filled dial. Pressure gauges shall be Ashcroft series 1009.
2. Pressure switches shall be provided for low feed pressure and high discharge pressure. The pressure switches shall have a 15 amp switching power at 120 volts. The low pressure switch shall have an adjustable range between 4 and 50 psig. The high pressure switch shall have an adjustable range between 30 and 600 psig. Units shall have a BUNA N primary wetted diaphragm and a 1/8" 316 stainless steel wrought casing.

B. Conductivity Sensors

1. Conductivity shall be continuously monitored by the control system. The monitor shall be NEMA 4 and be panel mounted. Conductivity monitors shall be Signet 8900 Series Multi-parameter.
2. Conductivity probes shall have 316 stainless steel electrodes, 316 stainless steel body, and FPM O-rings. Units shall thread into a 3/4" NPT connection and be rated to 100 psig. Probes shall be Signet 2850 Series.

C. Flow Sensors/Indicators

1. Each skid will be equipped with two flow sensors for feed and reject flow monitoring and control. The sensors shall be paddlewheel style and shall be polypropylene and mount in a T fitting in the process piping. The flow sensor will be Signet 2536 series.
2. Each skid shall have an acrylic rotameter for flow determination in the product blend line. The rotameter shall have 316 stainless steel end connections. The rotameter shall be manufactured by King Products.

D. PH/ORP Sensors

1. PH and ORP of the raw water shall be continuously monitored by the control system. A sample shall be taken from a high pressure point, fed to the sensors, and returned to a low pressure point so that no waste stream is generated from the sampling. The monitor shall be NEMA 4 and be panel mounted. The monitor shall be Signet 8900 Series Multi-parameter.

2. PH probe shall be Signet model 2774 and ORP probe shall be Signet model 2775.

Section 4 - Execution

4.01 DELIVERY OF EQUIPMENT

- A. The membrane skids shall be shipped to site as a complete unit with the exception of the blend line and membrane elements, which will be installed on-site by the contractor.
- B. The CIP tank and hose kit shall be shipped loose for placement and field installation by others.

4.02 INSTALLATION AND TRAINING

The Vantage Series Reverse Osmosis System shall be installed as shown on the Contract Drawings and specified herein.

The Manufacturer shall inspect the installation of all equipment in this section prior to start-up in order to verify that the equipment has been properly installed and operates properly as a system and individually.

After the equipment has been properly installed, the Manufacturer shall calibrate the equipment with the Owner's operator present.

The Manufacturer shall furnish the service of a competent technical service representative after Contractor's start-up to instruct the Owner's personnel in the operation and maintenance of the equipment.

The Manufacturer's representative shall be present for six (6) days in three (3) trips total to provide services described above.