Affordable Desalination Collaboration
Monthly Technical Progress Report
Covering the Month of May-2010

TWDB Contract No. 0804830845

CONTRACTOR – Affordable Desalination Collaboration
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Attention: Contract Administrator
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RESEARCH PROJECT – Optimizing Brackish Water Reverse Osmosis for Affordable Desalination

BOARD APPROVAL DATE – April 21, 2008

CONTRACT INITIATION DATE – September 15, 2008

STUDY COMPLETION DATE – June 13, 2011

FINAL REPORT DEADLINE – June 13, 2011

TOTAL STUDY COSTS – $ 1,356,683

BOARD SHARE OF THE TOTAL STUDY COSTS- the lesser of $496,783 or the total combined amount corresponding to the percentages of TWDB funding for each of the tasks shown in exhibit C.

LOCAL SHARE OF THE TOTAL STUDY COSTS - $859,900 in cash and $0.00 in-kind services or the amount remaining after the total combined amount corresponding to the percentages of TWDB funding for each of the tasks shown in Exhibit C.

PAYMENT SUBMISSION SCHEDULE - Monthly

Date Submitted: 6-7-10

Signed, Reviewed by designated representative

1. **Project Objective:** The objectives of the Affordable Desalination Collaboration (ADC) are to demonstrate affordable, reliable and environmentally responsible reverse osmosis desalination technologies and to provide a platform by which cutting edge technologies can be tested and measured for their ability to reduce the overall cost of the reverse osmosis (RO) treatment process

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2. **Project Description / Background:** A key challenge facing inland desalination today is to develop a new generation of reverse osmosis plants that deliver high-quality, fresh water at reduced economic and environmental cost. Two key areas of focus that will help achieve these goals are the energy consumption and the achievable RO recoveries of inland brackish water systems.

   The ADC was formed in 2004 to fund and execute the first part (ADC I), which became a multiple phase project funded under the California Department of Water Resources Proposition 50 program. Under the program the ADC built and operated a demonstration plant at the United States Navy's Seawater Desalination Test Facility in Pt. Hueneme, California. The ADC achieved remarkable results by desalinating seawater at energy levels between 6.0-6.9 kWh/kgal (1960-2250 kWh/acre-ft).

   This project funded by the Texas Water Development Board (TWDB) and titled "Optimizing Brackish Water Reverse Osmosis for Affordable Desalination" will pursue the following demonstration, and development tasks.

   1. Test and demonstrate state of the art isobaric energy recovery technology in an optimized brackish water design. The ADC expects to achieve 15-30% energy savings over traditional brackish water systems even where energy recovery turbines are applied.
   2. Develop and demonstrate new process designs that are possible as a result of the isobaric energy recovery technologies. As a natural result of the pressure exchanger (PX) technology in particular, there are new kinds of flow schemes that can improve the performance of higher recovery brackish water systems. We will use the ADC pilot system to test and demonstrate these new flow schemes in order to push the recoveries beyond what has been traditionally achievable.

   The ADC represents a unique collaboration leading government agencies, municipalities, RO manufacturers, consultants and professionals that are working together to improve the designs and technology applied in state of the art desalination systems. Our demonstration plant, processes and personnel have been pre-qualified and proven to meet project goals and produce valid data on the operation of desalination systems. Our outreach and information sharing efforts have been extensive and reached a wide range of audiences. In short, the ADC is an established leader in the field of reverse osmosis technology and we are uniquely qualified to conduct the proposed project and disseminate the results to the appropriate audiences.

3. **April Progress and Status:**

   In May-10 we were able to correct all the deficiencies that led to the scaling problems including replacement of the product flow meter and correct operational balancing of the PX. In addition we reconfigured some permeate piping to reduce permeate back pressure to ~6 psi in order to match the main plants operating parameters. Hydranautics also recommended that we perform a cleaning of the membranes due to a 15% drop in normalized permeate production that was probably caused during our scaling episode. After membrane cleaning the system was re-started on May 20th. The system operated very well throughout the rest of the month with a specific power of 0.58 kWh/m3 (2,2 kWh/kgal) to 0.62 kWh/m3 (2.3 kWh/kgal) and total permeate quality averaging 175 TDS at the same operating conditions as the main plant of 15 gfd and 80% recovery. Finishing up in April we completed 2 of the 9 variable flux and recovery points and operated continuous for approximately 1 week at a demonstration point of 15 gfd and 80% recovery.

4. **Percent Complete of Total Project:** ~ 49 %

5. **Deliverables:**

Trade Show/Conference/Publication	Date(s)	Author(s)	Presenter	TWDB Submittal
Joint ADC-AMTA workshop, Annual Conference, Austin, Texas	July 2009	n/a	Various	Q2-09
Innovative Designs to Be Tested in ADC	Sept/Nov 2007	John P. MacHarg	n/a	Q2-09
Q2 and Q3 2009 Progress Report	Nov 2009	John MacHarg	n/a	Nov-2009
October 2009 Progress Report	Oct-2009	John MacHarg	n/a	April-2010
November 2009 Progress Report	Nov-2009	John MacHarg	n/a	April-2010
December 2009 Progress Report	Dec-2009	John MacHarg	n/a	April-2010
January 2010 Progress Report	Jan-2010	John MacHarg	n/a	April-2010
February 2010 Progress Report	Feb-2010	John MacHarg	n/a	April-2010
March 2010 Progress Report	Mar-2010	John MacHarg	n/a	April-2010
April 2010 Progress Report	May-2010	John MacHarg	n/a	May-2010
May 2010 Progress Report	June-2010	John MacHarg	n/a	June-2010

6. **Schedule Status:** Currently we are approximately 15 days behind schedule and anticipate that we will be able to catch up through the remaining variable point and demonstration phases of the protocol.

7. **Plans for Next Month:** Due to the scaling issue we experienced in April/May we are consulting with various anti-scalant providers to best optimize our chemical dosage before attempting the higher recovery points of our variable recovery and flux matrix.

In the mean-time we are operating at the 80% recovery and 15 gfd flux demonstration point, which provides a direct comparison to the main plants operation.

8. **Attachments:** See attached power models showing an early start up data point and a point from 5/24/10.

Task and % Complete Progress Table

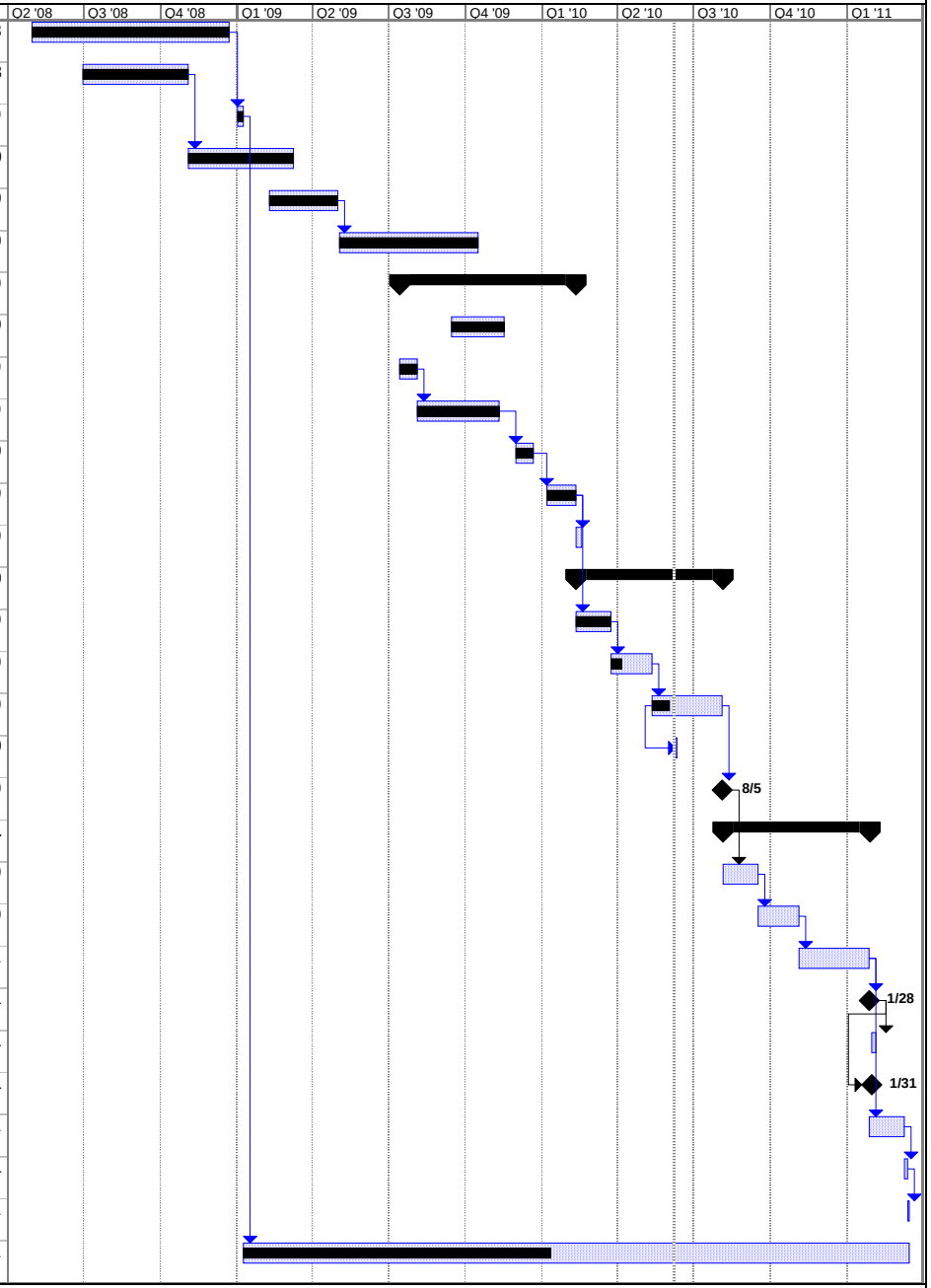
Agreement Number 0804830845	Starting Date: 1-7-09	Completion Date: 6-13-11	Month-Year May-10	Report Number 9	PERCENT OF
Grantee Agency Name: Affordable Desalination Collaboration		% Time Elapsed 45%	Total Grant Funds used $ 121,931	Billing this report $ -	
Name of Project: Optimizing Brackish Water Reverse Osmosis for Affordable Desalination					

TASKS	YEAR / MONTH	2009 Qtr 3	2009 Qtr 4	2010 Qtr 1	2010 Qtr 2	2010 Qtr 3	2010 Qtr 4	Project	Task Complete Last Report	Task Complete This Report	Project Complete
Task 1: Finalize Agreements with local test site/agency								7%	100%	0%	7%
Task 2: Attain permits								7%	100%	0%	7%
Task 3: Reconfigure system for interstage optimized design								13%	100%	0%	13%
Task 4: Decommission equipment at Port Hueneme								8%	100%	0%	8%
Task 5: Install and commission equipment on site.								8%	100%	0%	8%
Task 6: Execute multiple point optimization search								10%	15%	20%	3%
Task 7: Run 2 month demo at most affordable point								17%	0%	15%	3%
Task 8: Execute unbalanced multiple point optimization search								10%	0%	0%	0%
Task 9: Run 2 month demo at unbalanced most affordable point								17%	0%	0%	0%
Task 10: Member/general workshop								3%	0%	0%	0%
Show Progress by Use of Bar Chart	**Scheduled =**							100%			49%
	Completed =										

Schedule

Project Schedule Gant Chart.

ID	Task Name	Duration	Start	Finish
1	TWDB Agreement development	168 days	Thu 5/1/08	Mon 12/22/08
2	Develop tentative agreement with local water agency/test site	90 days	Tue 7/1/08	Mon 11/3/08
3	Final TWDB agreement signed / Project Begins	5 days	Fri 1/2/09	Thu 1/8/09
4	Detailed negotiations and planning with local agency/test site	90 days	Tue 11/4/08	Mon 3/9/09
5	Develop detailed test protocol	60 days	Mon 2/9/09	Fri 5/1/09
6	Permitting/agreements	120 days	Mon 5/4/09	Fri 10/16/09
7	**Install and commission Equipment on site**	**151 days**	**Wed 7/15/09**	**Wed 2/10/10**
8	Prepare site, wells, piping for ADC equipment	45 days	Tue 9/15/09	Mon 11/16/09
9	Decomission and reconfigure equipment at Port Hueneme	15 days	Wed 7/15/09	Tue 8/4/09
10	Reconfigure system for Interstage-PX hybrid design	70 days	Wed 8/5/09	Tue 11/10/09
11	Ship equipment to Texas	15 days	Tue 12/1/09	Mon 12/21/09
12	Install and commission equipment on site	25 days	Thu 1/7/10	Wed 2/10/10
13	Submit project update report to TWDB	5 days	Thu 2/11/10	Wed 2/17/10
14	**Optimized Isobaric Energy Recovery Demonstration**	**126 days**	**Thu 2/11/10**	**Thu 8/5/10**
15	Flush and base line membranes	30 days	Thu 2/11/10	Wed 3/24/10
16	variable flux and recovery optimization search	35 days	Thu 3/25/10	Wed 5/12/10
17	Most affordable point (24/7 for 2 months)	60 days	Thu 5/13/10	Wed 8/4/10
18	Clean membranes	2 days	Thu 6/10/10	Fri 6/11/10
19	Complete Interstage-PX Hybrid testing	1 day	Thu 8/5/10	Thu 8/5/10
20	**High Recovery Process Design Testing**	**126 days**	**Fri 8/6/10**	**Fri 1/28/11**
21	Flush and base line membranes	30 days	Fri 8/6/10	Thu 9/16/10
22	Unbalance variable flux and recovery search	35 days	Fri 9/17/10	Thu 11/4/10
23	PX unbalanced most affordable point (24/7 for 2 months)	60 days	Fri 11/5/10	Thu 1/27/11
24	Complete Unbalanced PX testing	1 day	Fri 1/28/11	Fri 1/28/11
25	Submit project update report to TWDB	5 days	Mon 1/31/11	Fri 2/4/11
26	Complete testing	1 day	Mon 1/31/11	Mon 1/31/11
27	Write final report	30 days	Fri 1/28/11	Thu 3/10/11
28	Submit final report, billing, conclude project	2 days	Fri 3/11/11	Mon 3/14/11
29	Member/general workshop and publish results	2 days	Tue 3/15/11	Wed 3/16/11
30	Project Duration	569 days	Fri 1/9/09	Wed 3/16/11



Project: ADC TWDB Brackish Demons
Date: Mon 6/7/10

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress
Split
External Tasks
Project Summary
Group By Summary
Deadline

Data

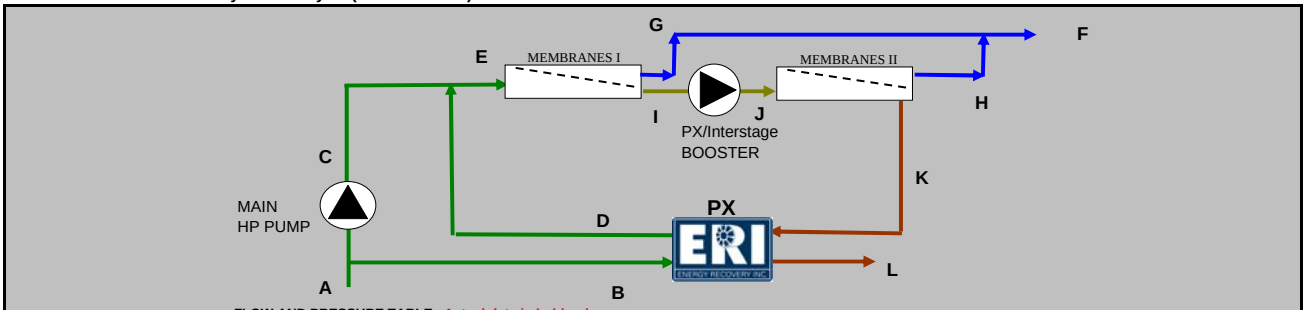
Water Quality Data

TIME			pH			CONDUCTIVITY										TDS										TURBIDITY		SDI	OTHER					
				pH					Conductivity (mS/cm)									TDS (mg/L)										Turbidity (NTU)				Inhibitor				
Date MM/DD/YY	Time hh:mm	Operation Time hh.hh	$pH_{F\text{-}sys}$ SC5	$pH_{P\text{-}sys}$ SC11	$pH_{C\text{-}sys}$ SC7	$C_{CF\text{-}out}$ SC3	$C_{F\text{-}PX\text{-}out}$ SC6	$C_{F\text{-}sys}$ SC5	$C_{P\text{-}total\ sys}$ SC11	$C_{P\text{-}1st\ stage\ 1}$ SC14	$C_{P\text{-}1st\ stage\ 2}$	$C_{P\text{-}2nd\ stage}$ SC10	$C_{*\ Interstage}$ SC 13	$C_{C\text{-}sys}$ SC12	$C_{C\text{-}PX\text{-}out}$ SC7	$TDS_{CF\text{-}out}$ SC3	$TDS_{F\text{-}PX\text{-}out}$ SC6	% Inc @ memb in	$TDS_{F\text{-}sys}$ SC5	$TDS_{P\text{-}sys}$ SC11	$TDS_{P\text{-}1st\ stage}$	$TDS_{P\text{-}1st\ stage}$	$TDS_{P\text{-}2nd\ stage}$ SC10	$TDS_{Interstage}$ SC 13	$TDS_{C\text{-}sys}$ SC12	$TDS_{C\text{-}PX\text{-}out}$ SC7	$NTU_{MF\text{-}in}$ SC1	$NTU_{CF\text{-}out}$ meter	Density Index $SDI_{CF\text{-}out}$ CART	V_{TANK} (gallons)	Pump Speed (gph)	HP VFD Speed (Hertz)	PX VFD Speed (Hertz)	FEED VFD Speed (Hertz)	Notes
			25	26	27	28	29	30	31	32	33	34	35	36	37	28	29		30	31	32	33	34	35	36	37	30	38		39	40	41-02	42-02	43-02	
Optimized Isobaric Energy Recovery Demonstration - Hydranautics ESPA 1 Membranes																**Membrane Ripening Period**																		
02/11/10	16:15	12338.00	7.90	6.50	7.99	4490	nd	4529	237.2	139.6	135.4	473.5	9470	18.26	13.45		nd	nd		nd	nd	nd	nd	nd	nd	nd	nd	0.037	nd	20	20/30	53.35	42.51	51.32	
02/11/10	17:16	12339.00	7.98	6.50	8.12	4514	nd	4626	294	166.3	160.8	659.7	10.11	18.52	15.5		nd	nd		192.10	106.60	102.80	447.40	8487.00	16.98	13.85	nd	0.032	nd	20	20/30	45.79	35.86	45.07	
02/12/10	9:11	12355.30	7.86	6.88	6.86	4477	nd	4505	274.1	158.1	155	559.2	9539	18.62	15.04	3461.00	nd	0.8%	3487.00	177.90	101.00	98.84	376.50	7958.00	17.11	13.33	nd	0.029	nd	20	20/30	53.50	41.54	52.58	
02/18/10	15:52	12357.60	7.77	6.60	7.99	4464	nd	4617	293.7	170.6	167.8	597.7	9633	18.53	16.27	3446.00	nd	3.9%	3581.00	191.80	109.20	107.10	404.20	802.00	17.09	14.53	nd	0.035	nd	20	20/30	53.58	41.72	47.18	
02/25/10	13:22	12375.40	7.88	6.50	8.14	4490	nd	4651	304.6	178.5	175.1	625.4	9679	18.62	16.22	3477.00	nd	4.4%	3629.00	201.30	114.70	112.40	423.80	8085.00	17.05	14.51	nd	0.037	nd	20	20/30	53.67	41.46	40.60	
02/26/10	15:54	12400.20	7.84	6.51	7.99	4499	nd	4622	300	176.7	174.1	613.1	9680	18.65	16.3	3463.00	nd	3.2%	3573.00	196.20	113.30	111.70	414.80	8046.00	17.09	14.59	nd	0.055	nd	19.5	20/30	53.70	41.54	42.60	
02/27/10	12:35	12420.90	7.85	6.52	7.95	4492	nd	4649	299.9	176.8	174.1	612.7	9727	18.67	16.32	3482.00	nd	3.9%	3619.00	196.00	113.50	111.60	415.70	8090.00	17.16	14.59	nd	0.029	nd	19.5	20/30	53.64	41.42	41.10	
02/28/10	12:04	12444.30	7.87	6.53	7.97	4495	nd	4650	296.1	175.9	173.1	598.2	9707	18.55	16.22	3478.00	nd	4.2%	3624.00	193.70	113.30	111.00	405.30	8095.00	17.04	14.52	nd	0.029	nd	19	20/30	53.70	41.57	42.51	
03/01/10	14:20	12470.60	7.85	6.54	8.09	4488	nd	4655	297.5	177.5	173.9	604.1	9714	18.19	16.21	3464.00	nd	4.1%	3605.00	194.70	113.90	111.50	409.10	8089.00	16.61	14.51	nd	0.028	nd	19	20/30	53.64	41.46	40.61	
03/02/10	12:18	12492.60	7.87	6.56	8.05	4478	nd	4603	301.5	178.1	175.2	622.2	9813	18.71	16.21	3452.00	nd	3.2%	3563.00	197.20	114.30	112.40	421.40	8176.00	17.18	14.49	nd	0.026	nd	19	20/30	53.64	41.04	44.27	
03/03/10	15:14	12519.50	7.78	6.47	7.88	4479	nd	4615	299.8	179.1	176	614.5	9759	18.48	16.19	3449.00	nd	4.0%	3588.00	197.30	114.90	112.80	415.70	8124.00	16.89	14.48	nd	0.026	nd	18.5	20/30	53.58	41.25	43.07	
03/04/10	12:40	12540.90	7.76	6.46	7.99	4472	nd	4597	298.6	179.2	176	612.7	9768	18.44	16.18	3443.00	nd	3.0%	3548.00	195.00	115.00	112.90	414.10	8116.00	16.82	14.42	nd	0.027	nd	18.5	20/30	53.58	41.34	43.00	
03/05/10	14:39	12564.10	7.75	6.46	7.82	4472	nd	4605	299.6	179.9	176.3	611.2	9737	18.36	16.09	3444.00	nd	3.1%	3551.00	195.60	115.60	113.00	413.90	8120.00	16.74	14.35	nd	0.027	nd	18.5	20/30	53.67	41.46	40.86	
03/06/10	11:33	12585.00	7.83	6.50	7.92	4510	nd	4631	298.4	180	176.4	606.8	9728	17.96	16.02	3481.00	nd	3.0%	3586.00	195.10	115.60	113.40	410.90	8084.00	15.64	14.28	nd	0.027	nd	18	20/30	53.64	41.48	39.36	
03/07/10	13:55	12611.30	7.77	6.47	7.86	4470	nd	4622	297.8	180.4	177.5	608.6	9747	18.21	15.98	3441.00	nd	3.6%	3566.00	194.80	115.80	113.90	411.50	8105.00	16.57	14.26	nd	0.028	nd	17.8	20/30	53.58	41.46	37.80	
03/08/10	15:33	12637.00	7.86	6.36	7.85	4476	nd	4613	299.1	180.1	176	615.4	9828	18.37	16.07	3454.00	nd	3.2%	3566.00	196.50	115.80	112.90	417.80	8181.00	16.76	14.10	nd	0.028	nd	17.8	20/30	53.67	41.13	40.79	
03/09/10	14:14	12659.70	7.76	6.15	7.97	4612	nd	4789	311.1	-	-	-	-	-	-	3579.00	nd	4.0%	3721.00	204.30	-	-	-	-	-	-	nd	-	nd	-	-	-	-	-	Plant shut down during data collection due to
03/10/10	13:07	12681.90	7.77	6.33	7.96	4481	nd	4649	298.6	180.8	177.2	611.3	9849	18.27	16.1	3440.00	nd	5.1%	3614.00	195.40	116.00	113.70	414.20	8254.00	16.68	14.37	nd	0.028	nd	17.8	20/30	53.70	41.37	41.23	
03/16/10	16:04	12706.10	7.79	6.53	7.91	4487	5038	4510	332.8	195.7	192.3	768.4	10.64	18.84	16.33	3470.00	3920.00	13.0%	3477.00	219.20	126.30	124.20	524.50	8954.00	17.27	14.61	nd		nd	17.8	20/30	55.34	40.08	35.04	
03/26/10	16:29	12718.20	7.80	6.60	7.85	5250	6456	5419	388.2	235.7	232	870.7	12.19	20.28	18.22	4103.00	5166.00	25.9%	4245.00	257.20	152.90	150.50	598.80	10.43	18.84	16.60	nd	0.034	nd	17.8	20/30	54.80	41.95	30.00	
03/27/10	16:28	12720.58	7.80	6.69	7.75	5274	5705	5286	407.1	242.9	237.9	978.4	12.4	20.56	16.71	4140.00	4510.00	8.9%	4133.00	270.50	157.60	154.50	677.30	10.62	19.20	15.01	nd	0.030	nd	17.8	20/30	52.62	38.79	30.00	
04/02/10	15:35	12726.22	7.79	6.78	7.80	4134	4787	4197	255.9	182.4	178.7	444.6	8147	12.96	11.48	3168.00	3709.00	17.1%	3206.00	165.90	117.30	114.60	297.50	6647.00	11.16	9740.00	nd	0.033	nd	17.6	50/90	46.28	45.73	35.73	
04/02/10	17:57	12728.58	7.65	6.69	7.77	4072	4247	4098	232.6	166.1	163.3	396.4	7633	12.2	9857	3118.00	3282.00	5.3%	3125.00	151.10	106.20	104.40	263.00	6183.00	10.43	8204.00	nd	0.033	nd	17.5	50/90	46.26	46.20	33.38	
04/08/10	14:50	12731.97	7.60	6.60	7.66	4060	4242	4092	240.3	169.6	167	409.9	7705	12.4	10.01	3071.00	3215.00	4.7%	3075.00	154.40	107.40	105.70	269.80	6205.00	10.51	8265.00	nd	0.029	nd	17	50/90	46.29	46.11	33.26	
04/09/10	15:10	12740.34	7.70	6.38	7.73	4003	4175	4035	235	166.7	164.1	401.3	7545	12.22	9887	3017.00	3171.00	5.1%	3029.00	151.00	105.50	103.70	263.70	6054.00	10.33	8143.00	nd	0.033	nd	16.1	50/90	46.26	46.14	48.02	
04/10/10	12:11	12761.37	7.66	6.41	7.64	4011	4187	4040	230.8	164.9	162.5	388.6	7499	12.12	9845	3021.00	3165.00	4.8%	3044.00	148.40	104.30	102.70	255.00	5997.00	10.25	8115.00	nd	0.027	nd	14.2	50/90	46.25	46.55	46.67	
04/11/10	13:17	12786.47	7.65	6.43	7.65	4009	4169	4054	231	165.2	162.4	386.9	7510	12.1	9836	3026.00	3149.00	4.1%	3051.00	148.50	104.50	102.60	253.80	6007.00	10.22	8097.00	nd	0.032	nd	12	50/90	46.20	46.88	50.79	
04/12/10	17:15	12814.43	7.73	6.46	7.75	4053	4222	4088	232.8	167.1	164.4	389.6	7562	12.13	9951	3053.00	3193.00	4.6%	3079.00	149.70	105.70	103.90	255.60	6047.00	10.24	8200.00	nd	0.028	nd	23	50/90	46.23	46.96	43.79	Filled up anti-scallent tank with 10:1 dilution
04/21/10	15:44	12833.22	7.49	6.21	7.65	4065	4249	4121	241.2	172.1	169.6	406.8	7598	12.26	10.01	3063.00	3216.00	5.0%	3107.00	155.00	109.10	107.40	267.40	6079.00	10.37	8253.00	nd	0.032	nd	21.3	50/90	46.26	46.73	46.90	
04/23/10	16:00	12853.47	7.62	6.31	7.72	4035	4148	4051	234.2	168.1	165.5	391.8	7522	12.09	10.04	3033.00	3141.00	3.6%	3062.00	150.70	106.40	104.80	257.60	6039.00	10.22	8266.00	nd	0.035	nd	19.3	50/90	46.41	47.29	46.65	
04/24/10	11:46	12873.25	7.54	6.33	7.65	4059	4274	4131	238.7	171.2	168.2	400.6	7607	12.15	9979	3068.00	3248.00	5.9%	3120.00	153.50	108.50	106.50	263.30	6091.00	10.27	8231.00	nd	0.033	nd	17.4	50/90	46.32	46.99	46.77	
04/25/10	11:03	12896.51	7.53	6.30	7.63	4055	4196	4091	238.1	171.4	168.4	402.4	7614	12.11	9916	3058.00	3171.00	3.7%	3084.00	153.10	108.60	106.60	264.50	6096.00	10.23	8172.00	nd	0.037	nd	15.5	50/90	46.29	46.99	46.86	
04/26/10	17:16	12926.28	7.37	6.22	7.37	4044	4212	4081	238.4	171.5	168.7	408.5	7650	12.14	9929	3040.00	3184.00	4.7%	3073.00	153.10	108.60	106.70	268.50	6125.00	10.25	8179.00	nd	0.035	nd	12.2	50/90	46.26	46.85	46.97	
04/27/10	13:39	12946.67	7.55	6.33	7.66	3880	4037	3915	219.6	156.3	153.7	378.7	7495	11.77	9598	2913.00	3047.00	4.6%	2938.00	141.10	98.72	97.02	248.40	5902.00	9920.00	7891.00	nd	0.032	nd	20.2	50/90	46.32	46.49	37.58	Filled up anti-scallent tank with 10:1 dilution
04/28/10	16:40	12973.68	7.39	6.13	7.41	4024	4223	4032	268	164.9	162.9	594.3	9134	15.74	12.33	3021.00	3138.00	3.9%	3032.00	171.90	104.30	102.30	397.60	7489.00	13.83	10.43	nd	0.032	nd	17.6	50/90	52.53	41.07	44.58	
04/29/10	12:43	12993.73	7.55	6.21	7.57	4131	4275	4141	277	171.5	168.5	620.4	9452	16.07	12.63	3118.00	3238.00	3.8%	3124.00	178.10	108.70	106.60	415.60	7746.00	14.18	10.72	nd	0.030	nd	15.5	50/90	52.59	41.16	44.17	
04/30/10	5:09	13017.66	7.68	6.29	7.59	4280	4438	4287	298.2	181.6	178.1	696.9	10.06	17.01	13.14	3253.00	3375.00	3.8%	3250.00	192.90	115.50	113.10	470.60	8308.00	15.13	11.22	nd	0.029	nd	13.2	50/90	52.57	40.08	30.77	Had to adjust % salinity, main plant had switc
05/01/10	12:17	13036.81	7.59	6.26	7.63	4329	4442	4343	301	185.6	182.1	711.6	10.17	17.05	13.17	3288.00	3354.00	2.0%	3297.00	194.80	118.20	115.90	478.80	8418.00	15.18	11.26	nd	0.030	nd	11.6	50/90	52.45	40.05	32.22	During data collection 5 salinity was low. 5 r
05/02/10	13:14	13061.76	7.65	6.36	7.65	4366	4505	4372	301.6	186.9	183	721.4	10.32	17.07	13.4	3320.00	3431.00	3.3%	3320.00	195.20	119.10	116.50	485.40	8555.00	15.24	11.47	nd	0.030	nd	9.2	50/90	52.44	40.16	30.73	After data collection, filled up anti-scallent ta
05/03/10	17:25	13089.94	7.55	6.34	7.61	4377	4581	4387	303.1	188.1	184.3	721.4	10.33	16.98	13.32	3325.00	3495.00	5.1%	3331.00	196.10	120.00	117.30	485.80	8560.00	15.08	11.39	nd	0.031	nd	21.5	50/90	52.41	40.31	33.44	
05/05/10	16:14	13112.90	7.52	6.36	7.52	4391	4585	4418	309.2	191.5	187.5	742.8	10.35	16.97	12.83	3342.00	3488.00	4.4%	3352.00	200.20	122.00	119.40	500.10	8552.00	15.06	10.91	nd	0.032	nd	19	50/90	52.38	40.32	30.00	
05/06/10	16:39	13137.32	7.35	6.30	7.35	4390	4512	4407	306	190.8	187.1	739.6	10.41	16.94	13.34	3318.00	3433.00	3.5%	3343.00	198.00	121.60	119.10	497.60	8622.00	15.03	11.42	nd	0.032	nd	16.8	50/90	52.32	40.17	34.96	
05/07/10	15:09	13155.95	7.62	6.38	7.52	4405	4587	4428	309.8	192.8	188.8	755.2	10.55	17.1	13.44	3342.00	3497.00	4.6%	3361.00	200.60	122.90	120.20	508.80	8758.00	15.20	11.53	nd	0.029	nd	15	50/90	52.38	40.17	31.56	
05/08/10	13:21	13178.14	7.67	6.39	7.52	4397	4591	4408	305.7	190.2	186.3	748.2	10.56	17.01	13.4	3343.00	3501.00	4.7%	3349.00	198.00	121.30	118.60	504.20	8774.00	15.13	11.48	nd	0.031	nd	12.8	50/90	52.38	40.02	38.78	
05/09/10	14:12	13203.00	7.48	6.22	7.42	4396	4549	4423	304.3	191.2	187.2	749.3	10.59	16.96	13.45	3335.00	3464.00	3.9%	3357.00	196.80	121.80	119.10	504.60	8785.00	15.08	11.51	nd	0.031	nd	10.3	50/90	52.32	40.11	35.45	
05/10/10	17:50	13230.63	7.53	6.32	7.46	4389	4576	4421	302.2	190.6	186.6	750.6	10.65	16.94	13.48	3329.00	3487.00	4.7%	3350.00	195.40	121.40	118.80	505.70	8849.00	15.08	11.54	nd	0.031	1.22	22	50/90	52.35	40.11	31.42	Filled up anti-scallent tank with 10:1 dilution
05/11/10	14:58	13251.77	7.54	6.29	7.42	4400	4575	4431	302.8	191.5	187.7	758.3	10.7	16.93	13.47	3336.00	3486.00	4.5%	3364.00	195.80	122.00	119.50	511.10	8895.00	15.07	11.54	nd	0.026	1.33	20.1	50/90	52.35	40.05	32.02	
05/12/10	16:03	13276.85	7.54	6.31	7.50	4402	4585	4417	300.8	190.5	186.7	757.7	10.76	16.94	13.4	3347.00	3507.00	4.8%	3355.00	194.50	121.50	118.90	511.20	8961.00	15.05	11.47	nd	0.026		17.5	50/90	52.38	39.99	33.03	
05/13/10	14:25	13299.21	7.55	6.29	7.56	4401	4546	4423	302.6	192.3	188.2	767.3	10.78	16.86	13.36	3342.00	3473.00	3.9%	3362.00	195.70	122.60	119.80	517.70	8998.00	15.01	11.47	nd	0.026	1.68	15.6	50/90	52.35	39.81	38.08	
05/20/10	12:25	13327.52	7.44	6.39	7.59	4342	4450	4352	241.2	146.6	142.4	500.3	9385	17.09	13.31	3293.00	3383.00	2.7%	3300.00	155.00	92.44	89.72	331.60	7690.00	15.18	11.37	nd	0.031	nd	12.5	50/90	52.32	41.72	43.42	
05/22/10	12:55	13360.50	7.50	6.27	7.42	4304	4462	4320	257.6	152.5	147.5	560.2	9708	18.02	13.77	3252.00	3394.00	4.4%	3270.00	165.20	96.04	92.82	372.50	7980.00	16.17	11.91	nd	0.032	nd	9.3	50/90	55.02	41.40	34.15	After data collection, filled up anti-scallent ta
05/23/10	13:44	13385.34	7.50	6.29	7.45	4321	4473	4345	262.6	155.5	151.2	575.6	9797	18.06	13.79	3274.00	3403.00	3.9%	3291.00	168.50	98.06	95.23	383.00	8057.00	16.20	11.94	nd	0.029	nd	22	50/90	55.02	41.40	41.31	
05/24/10	12:37	13408.19	7.61	6.33	7.56	4330	4505	4358	264.2	156.9	152.3	580.5	9813	18.08	13.83	3286.00	3434.00	4.5%	3306.00	169.60	99.04	96.10	386.60	8077.00	16.26	11.98	nd	0.029	1.12	19.7	50/90	55.08	41.43	42.56	
Optimized Isobaric Energy Recovery Demonstration - Hydranautics ESPA 1 Membranes																**12 gfd flux**																		
05/25/10	12:46	13432.34	7.56	6.32	7.59	4310	4446	4351	321.1	189.8	184.7	771.5	10.16	17.41	12.95	3265.00	3391.00	3.9%	3300.00	208.40	120.90	117.40	520.90	8403.00	15.54	11.03	nd	0.028	1.13	17.3	50/90	44.93	34.63	30.00	
Optimized Isobaric Energy Recovery Demonstration - Hydranautics ESPA 1 Membranes																**BASELINE**																		
05/26/10	12:03	13455.64	7.57	6.33	7.55	4293	4446	4318	262.6	157.5	153.1	576.9	9742	17.78	13.69	3246.00	3379.00	4.1%	3270.00	168.40	99.34	96.51	382.90	8022.00	15.66	11.84	nd	0.027	0.998	15	50/90	55.28	41.92	41.55	
Optimized Isobaric Energy Recovery Demonstration - Hydranautics ESPA 1 Membranes																**14.9 gfd flux**																		
Optimized Isobaric Energy Recovery Demonstration - Hydranautics ESPA 1 Membranes																**BASELINE**																		
Optimized Isobaric Energy Recovery Demonstration - Hydranautics ESPA 1 Membranes																**16 gfd flux**																		
05/27/10	9:27	13477.02	7.53	6.26	7.54	4289	4441	4296	251.8	147.9	143.7	558.1	9826	18.39	14.02	3248.00	3376.00	3.9%	3253.00	161.50	93.18	90.50	371.10	8089.00	16.59	12.16	nd	0.025	0.922	12.7	50/90	59.56	43.62	43.10	
Optimized Isobaric Energy Recovery Demonstration - Hydranautics ESPA 1 Membranes																**BASELINE**																		
05/27/10	19:11	13486.77	7.46	6.27	7.42	4303	4418	4324	269.6	159.8	155.4	608.2	9929	17.99	13.75	3247.00	3351.00	3.2%	3273.00	172.70	100.80	97.96	406.80	8161.00	16.14	11.89	nd	0.027	nd	11.8	50/90	55.14	41.25	35.20	
05/29/10	11:41	13508.21	7.52	6.30	7.45	4359	4498	4391	280.8	166.5	161.7	637.5	10.1	18.17	13.98	3298.00	3428.00	3.9%	3332.00	180.60	105.20	102.10	427.20	8379.00	16.33	12.12	nd	0.027	nd	24.8	50/90	55.17	41.31	42.70	
05/30/10	11:45	13532.27	7.51	6.33	7.46	4359	4509	4381	280.7	166.6	161.9	637.7	10.07	18.05	13.87	3303.00	3432.00	3.9%	3323.00	180.50	105.30	102.30	427.20	8282.00	16.19	12.01	nd	0.024	nd	22.4	50/90	55.20	41.31	41.25	
05/31/10	11:05	13555.60	7.50	6.25	7.45	4368	4496	4397	280.9	167.6	162.7	642.5	10.11	17.95	13.84	3309.00	3418.00	3.3%	3336.00	180.60	106.00	102.80	430.50	8348.00	16.10	11.98	nd	0.025	nd	20.2	50/90	55.20	41.31	41.06	

TIME				CALCULATED PARAMETERS					TEMP	PRESSRE									FLOWS						MAIN PANEL KW METER				VFD KW METER			
		Operation	System	RO	Ave. Sys. Flux	1st Stage Flux	2nd Stage Flux	Power	Influent	P_{CF-in}	P_{CF-out}	$P_{PX-Feed\ In}$	$P_{PX-conc\ out}$	$P_{PX-HP\ out\ RO\ 1\ feed}$	$P_{RO\ 2\ feed}$	$P_{C-RO1\ PX\ Booster\ inlet}$	P_{C-RO2}	P_{P-SYS}	$Q_{F-HP\ Pump}$	$Q_{PX\ HP-out}$	$Q_{Feed\ PX-In}$	$Q_{P-Stage\ 1}$	$Q_{P-Stage\ 2}$	Q_{P-SYS}	A_{sys}	P HP/PX	P booster	Power	PX power	HP Power	Feed Pump	
Date	Time	Time	Recovery %	Recovery %	Gfd	Gfd	Gfd	kWh/m3	Temp F	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	amp	(kw)	(kw)	Factor	(kw)	(kw)	(kw)	Notes
MM/DD/YY	hh:mm	hh.hh							17	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Optimized Isobaric Energy Recovery Demonstration - Hydranautics ESPA 1 Membranes											**Membrane Ripening Period (BASELINE)**														1							
02/11/10	13:00	12335.8	69.0%	79.7%	14.14	14.91	12.60	0.69	70.0	32.5	30.5	29.0	23.8	175	200	150	178	21.3	80.0	21.00	37.02	58.00	24.50	82.50	19.50	12.90	4.1	0.700	1.70	10.1	3.4	
02/11/10	17:06	12339	74.4%	80.0%	12.09	13.37	9.51	0.59	71.0	31.5	29.7	29.0	26.5	155	170	133.7	158	14.5	70.5	17.62	24.26	52.00	18.50	70.50	14.50	9.48	3.3	0.753	1.10	7.5	2.2	
02/12/10	9:01	12355.1	73.2%	79.9%	14.06	14.91	12.34	0.67	70.5	32.5	30.0	29.2	25.5	175	195	150	178	20.5	80.0	20.64	30.01	58.00	24.00	82.00	19.40	12.54	4.3	0.775	1.60	9.9	3.6	
02/18/10	15:41	12357.5	76.1%	80.5%	14.14	14.91	12.60	0.67	71.0	32.5	30.0	29.2	26.5	170	190	148	172	17.2	80.0	20.02	25.97	58.00	24.50	82.50	19.15	12.49	3.86	0.771	1.60	9.8	2.6	Total product data is calculated.
02/25/10	13:10	12375.3	76.0%	80.2%	14.14	15.04	12.34	0.66	70.0	32.3	30.0	29.3	26.5	171	190	149	172	17.2	81.0	20.40	26.02	58.50	24.00	82.50	18.77	12.40	3.12	0.779	1.60	9.7	2.4	
02/26/10	15:41	124000	76.3%	80.2%	14.23	15.17	12.34	0.66	70.5	32.5	30.0	29.2	26.3	172	190	150	172.5	17.3	80.5	20.50	25.78	59.00	24.00	83.00	18.94	12.52	3.36	0.777	1.60	9.8	1.9	Plant was shut off when arrived due to l
02/27/10	12:27	12420.7	76.0%	80.0%	14.13	15.04	12.29	0.66	72.0	32.3	30.0	29.3	26.2	172	191	150	175	17.2	81.0	20.66	26.03	58.50	23.90	82.40	19.30	12.29	3.19	0.778	1.60	9.7	1.9	
02/28/10	12:00	12444.2	76.1%	79.9%	14.23	15.17	12.34	0.65	71.5	32.5	30.2	29.3	26.5	172	191	150	175	17.3	80.0	20.93	26.03	59.00	24.00	83.00	19.23	12.27	3.27	0.776	1.50	9.6	2	
03/01/10	14:04	12470.4	76.1%	80.1%	14.13	15.04	12.29	0.65	71.0	32.5	30.0	29.5	26.3	172	191	150	175	17.2	80.0	20.48	25.89	58.50	23.90	82.40	18.86	12.21	3.147	0.787	1.50	9.6	1.8	
03/02/10	12:05	12492.4	76.1%	80.3%	14.23	15.30	12.09	0.65	71.0	32.2	31.0	29.4	26.5	172	191	150	175	17.0	81.0	20.37	26.05	59.50	23.50	83.00	18.76	12.24	3.43	0.784	1.40	9.7	2.2	
03/03/10	15:06	12519.4	75.8%	80.0%	14.09	15.17	11.93	0.65	73.0	32.2	30.1	29.3	26.2	173	191	150	175	17.3	80.0	20.56	26.22	59.00	23.20	82.20	19.44	12.19	3.33	0.780	1.50	9.7	2.1	Vessel 1 is leaking water from end cap
03/04/10	12:21	12540.6	76.0%	79.9%	14.19	15.30	11.98	0.65	73.0	32.5	30.2	29.3	26.3	172	191	150	176	17.2	81.0	20.84	26.12	59.50	23.30	82.80	19.28	12.27	3.44	0.784	1.50	9.7	2.3	
03/05/10	14:25	12563.8	75.8%	79.9%	14.23	15.38	11.93	0.66	73.0	32.5	30.0	29.2	29.2	172	191	150	177	17.3	80.0	20.94	26.54	59.80	23.20	83.00	18.88	12.37	3.14	0.790	1.50	9.8	1.6	Plant was shut off when arrived due to l
03/06/10	11:20	12584.8	76.1%	80.1%	14.14	15.17	12.09	0.65	73.0	32.3	29.9	29.4	26.3	174	192	151	178	17.4	80.0	20.51	25.95	59.00	23.50	82.50	18.60	12.22	3.11	0.783	1.50	9.7	1.8	
03/07/10	13:42	12611.1	75.7%	79.7%	14.09	15.17	11.93	0.65	74.0	32.5	30.1	29.3	26.2	174	192	150	178	17.3	80.0	20.97	26.34	59.00	23.20	82.20	18.89	12.21	3.15	0.782	1.50	9.7	1.7	
03/08/10	15:20	12636.8	76.0%	80.2%	14.40	15.43	12.34	0.64	73.0	32.5	30.0	29.2	26.3	175	193	151	179	17.2	79.0	20.74	26.49	60.00	24.00	84.00	18.44	12.28	3.36	0.784	1.40	9.8	1.9	
03/09/10	14:02	12659.5	76.2%	80.4%	14.38	15.43	12.29	0.64	73.0	33.0	30.1	29.4	26.2	175	193	151	179	17.1	80.0	20.48	26.23	60.00	23.90	83.90	18.66	12.25	3.25	0.784	1.50	9.7	1.8	
03/10/10	12:55	12681.7	76.5%	80.3%	14.57	15.69	12.34	0.64	71.0	32.5	29.9	29.3	26.1	176	194	152	178	17.1	80.0	20.90	26.04	61.00	24.00	85.00	18.95	12.30	3.36	0.773	1.50	9.7	1.9	
03/11/10	12:45	12702.8																														Plant was shut off when arriaved due to
03/12/10	15:45																															Plant down for new piping. Up and runn
03/13/10	13:00	12705.2																														Plant was shut down when arriaved due
03/16/10	15:50	12705.8	76.3%	80.6%	14.71	16.71	10.70	0.67	70.0	32.8	30.1	29.2	26.5	179	196	158	180	18.0	88.0	20.66	26.60	65.00	20.80	85.80	19.89	13.07	2.7	0.775	1.40	10.6	1	Plant start up after replacing old rotor an
03/26/10	16:18	12718.1	75.8%	79.7%	14.43	16.51	10.29	0.70	74.0	32.2	30.0	29.5	26.5	186	207	162	190	17.6	87.0	21.45	26.88	64.20	20.00	84.20	20.06	13.47	2.722	0.782	1.50	10.8	0.8	plant start up after new filters, cleaned o
03/27/10	16:20	12720.45	72.2%	79.7%	13.89	16.20	9.26	0.67	72.0	31.0	28.0	29.2	25.8	182	200	165	188	17.5	85.0	20.68	31.13	63.00	18.00	81.00	18.85	12.27	2.566	0.773	1.20	10.1	1	Cartridge Filget Pressure Gause has a cr
04/02/10	15:26	12726	67.1%	71.3%	12.17	12.86	10.80	0.62	72.0	32.2	30.0	29.3	25.0	142	171	120	149	15.0	73.0	28.64	34.88	50.00	21.00	71.00	15.41	9.92	2.7	0.765	2.00	6.9	1.1	
04/02/10	17:50	12728.4	61.2%	71.0%	12.17	12.86	10.80	0.61	72.0	33.0	30.2	29.0	22.0	141	170	119	145	15.0	73.0	28.93	45.04	50.00	21.00	71.00	15.32	9.81	2.723	0.765	2.00	6.8	1.2	
04/08/10	14:43	12731.8	62.0%	71.8%	12.17	12.86	10.80	0.60	73.0	32.9	30.2	29.3	22.5	135	165	111	140	10.7	74.0	27.88	43.53	50.00	21.00	71.00	15.14	9.64	2.69	0.768	2.10	6.6	1.1	
04/09/10	15:00	12740.1	62.1%	72.4%	12.26	12.86	11.06	0.60	75.0	32.9	30.1	29.2	22.5	135	165	111	139	11.0	73.0	27.23	43.61	50.00	21.50	71.50	15.50	9.70	3.921	0.752	2.00	6.6	3.2	
04/10/10	12:00	12761.2	62.1%	71.6%	12.26	12.86	11.06	0.60	75.0	32.8	30.2	29.3	22.7	136	165	111	139	10.9	74.0	28.42	43.61	50.00	21.50	71.50	15.32	9.68	3.709	0.754	2.10	6.6	2.9	
04/11/10	13:11	12786.3	62.0%	71.7%	12.27	12.86	11.11	0.60	76.0	32.9	30.3	29.2	23.3	135	165	111	139	11.0	73.0	28.21	43.85	50.00	21.60	71.60	16.19	9.71	3.14	0.753	2.10	6.6	2.8	
04/12/10	17:07	12814.3	62.1%	71.5%	12.26	12.86	11.06	0.60	77.0	32.9	30.3	29.2	22.5	135	165	111	140	11.1	73.0	28.49	43.68	50.00	21.50	71.50	14.90	9.78	3.649	0.751	2.20	6.7	2.9	
04/21/10	15:33	12833	62.2%	71.7%	12.26	12.86	11.06	0.59	76.0	32.9	30.3	29.3	22.6	130	160	108	135	11.2	73.0	28.17	43.37	50.00	21.50	71.50	14.85	9.55	3.344	0.756	2.10	6.4	2.5	
04/23/10	15:50	12853.3	62.6%	70.6%	12.31	12.86	11.21	0.60	70.0	33.0	30.3	29.5	22.8	131	161	109	136	11.3	73.0	29.94	42.98	50.00	21.80	71.80	15.59	9.74	3.915	0.750	2.20	6.6	2.7	
04/24/10	11:38	12873.1	62.5%	71.1%	12.31	12.93	11.06	0.59	73.0	32.9	30.2	29.4	22.6	131	161	109	136	11.2	73.0	29.16	43.11	50.30	21.50	71.80	15.64	9.65	3.883	0.750	2.10	6.5	2.7	
04/25/10	10:55	12896.4	62.5%	71.4%	12.34	13.11	10.80	0.59	74.0	33.0	30.2	29.3	22.6	131	161	109	138	11.0	73.0	28.84	43.22	51.00	21.00	72.00	15.47	9.60	3.808	0.750	2.20	6.5	2.7	
04/26/10	17:11	12926.2	62.1%	71.6%	12.17	12.86	10.80	0.59	78.0	32.9	30.3	29.5	22.7	131	161	109	138	11.0	73.0	28.13	43.41	50.00	21.00	71.00	15.15	9.56	3.768	0.746	2.10	6.5	2.6	
04/27/10	13:32	12946.5	62.8%	72.0%	12.53	13.11	10.75	0.57	75.0	32.9	30.3	29.4	22.5	132	162	109	138	11.3	74.0	28.37	43.26	51.00	20.90	73.10	14.94	9.46	3.254	0.755	2.10	6.4	1.7	New flow rate/totalizer fixed and registe
04/28/10	16:24	12973.4	71.4%	79.8%	14.18	15.69	10.18	0.60	78.0	32.9	30.2	29.5	25.1	159.0	178.0	137.0	161.0	14.3	85.0	20.87	33.16	61.0	19.8	82.70	18.10	11.24	3.513	0.765	1.40	8.8	2.4	Adjusted flows to baseline 80% recovery
04/29/10	12:25	12993.4	71.3%	80.0%	14.21	15.94	9.93	0.60	76.0	33.0	30.2	29.4	25.3	160.1	180	138	163	13.8	84.5	20.68	33.29	62.00	19.30	82.90	17.75	11.31	3.457	0.769	1.40	8.9	2.3	
04/30/10	17:02	13017.5	71.3%	79.8%	14.16	16.20	9.51	0.60	72.0	33.0	30.3	29.4	25.2	162.0	180.0	141.0	165.0	11.5	84.5	20.88	33.20	63.00	18.5	82.60	17.10	11.28	2.814	0.769	1.30	9.0	1.1	
05/01/10	12:09	13036.6	71.4%	79.8%	14.14	16.25	9.41	0.60	73.0	32.8	30.1	29.5	25.2	167.0	183.0	144.0	170.0	13.8	84.5	20.86	33.10	63.20	18.3	82.50	16.85	11.27	2.524	0.772	1.30	8.9	0.8	
05/02/10	13:07	13061.6	71.2%	79.4%	14.09	16.28	9.21	0.60	74.0	32.9	30.0	28.8	24.5	168.0	185.0	145.0	170.0	13.8	84.5	21.33	33.18	63.30	17.9	82.20	17.66	11.27	2.94	0.770	1.30	9.0	1.6	
05/03/10	17:06	13089.6	71.2%	79.6%	14.18	16.35	9.05	0.60	76.0	33.0	30.0	29.4	25.0	168.0	186.0	145.0	170.0	13.6	84.5	21.22	33.38	63.60	17.6	82.70	17.26	11.25	2.487	0.772	1.30	9.8	0.8	
05/05/10	16:00	13112.6	70.9%	79.8%	14.14	16.38	9.15	0.60	77.0	34.5	32.0	31.0	27.0	168.0	185.0	145.0	170.0	13.8	84.0	20.86	33.91	63.70	17.8	82.50	16.50	11.28	2.52	0.781	1.30	9.1	1.2	
05/06/10	16:32	13137.2	70.3%	79.6%	14.07	16.41	8.85	0.60	78.0	35.0	32.2	31.0	26.8	169.0	186.0	145.0	171.0	14.0	84.0	21.10	34.74	63.80	17.2	82.10	17.42	11.27	2.473	0.781	1.30	8.9	0.9	
05/07/10	15:03	13155.8	71.2%	79.6%	14.14	16.46	8.85	0.59	79.0	33.2	30.1	29.5	25.1	161.0	180.0	139.0	165.0	6.1	84.5	21.17	33.38	64.00	17.2	82.50	16.34	11.02	2.537	0.785	1.30	8.7	1	Pressures reflect permeate deflection to
05/08/10	13:15	13178	71.2%	79.7%	14.09	16.71	8.74	0.59	76.0	33.0	30.2	29.5	25.3	162.0	181.0	140.0	165.0	5.7	85.0	20.98	33.19	65.00	17.0	82.20	16.92	11.06	2.598	0.774	1.20	8.8	1.1	
05/09/10	14:06	13202.8	71.1%	79.1%	14.13	16.53	8.69	0.59	79.0	33.1	30.1	29.4	25.2	161.0	181.0	140.0	166.0	5.8	85.0	21.76	33.44	64.30	16.9	82.40	15.61	11.02	2.45	0.776	1.30	8.7	0.9	
05/10/10	17:44	13230.5	71.2%	79.2%	14.09	16.66	8.38	0.59	79.0	33.2	30.1	29.6	25.2	162.0	181.0	141.0	167.0	5.9	84.5	21.64	33.29	64.80	16.3	82.20	15.53	11.06	2.508	0.776	1.30	8.8	0.9	
05/11/10	14:52	13251.6	71.2%	79.1%	14.11	16.71	8.33	0.59	79.0	33.3	30.2	29.4	25.2	163.0	182.0	141.0	168.0	5.7	84.0	21.68	33.21	65.00	16.2	82.30	16.10	11.04	2.597	0.779	1.20	8.9	1.1	
05/12/10	16:00	13276.7	71.3%	79.4%	14.13	16.84	8.28	0.59	77.0	33.5	30.3	29.5	25.2	165.0	182.0	142.0	168.0	5.8	84.3	21.42	33.20	65.50	16.1	82.40	17.17	11.10	2.62	0.778	1.20	8.8	1.1	
05/13/10	14:20	13299.2	71.1%	79.2%	14.09	16.92	8.18	0.60	78.0	33.7	30.2	29.5	25.1	165.0	183.0	142.0	169.0	5.7	84.0	21.55	33.41	65.80	15.9	82.20	17.28	11.13	2.971	0.773	1.20	8.8	1.6	
05/20/10	12:18	13327	70.8%	79.6%	14.11	15.22	11.31	0.58	78.0	32.8	30.2	29.3	25.0	151.0	171.0	129.0	154.0	5.8	85.0	21.05	33.96	59.20	22.0	82.30	17.01	10.92	2.922	0.773	1.50	8.4	2.1	Data reflects 19 hrs running after cleanir
05/22/10	12:49	13360.4	72.4%	80.8%	14.85	16.41	11.52	0.61	79.0	33.0	30.2	29.3	25.2	160.0	179.0	138.0	162.0	6.8	88.0	20.53	33.03	63.80	22.4	86.60	17.90	11.91	2.905	0.774	1.40	9.3	2	
05/23/10	13:39	13385.2	72.2%	81.0%	14.86	16.38	11.42	0.60	79.0	33.1	30.2	29.2	25.1	161.0	180.0	138.0	163.0	6.7	88.0	20.32	33.31	63.70	22.2	86.70	18.02	11.88	2.513	0.781	1.50	9.4	1.4	
05/24/10	12:32	13408.1	72.4%	81.1%	14.85	16.46	11.42	0.61	78.0	33.1	30.2	29.4	25.0	161.0	180.0	138.0	164.0	6.8	88.0	20.20	33.01	64.00	22.2	86.60	17.71	11.93	2.593	0.781	1.40	9.4	1.3	
Optimized Isobaric Energy Recovery Demonstration - Hydranautics ESPA 1 Membranes											**12 gfd flux**																				
05/25/10	12:40	13432.2	70.9%	81.2%	12.10	13.89	8.23	0.50	78.0	32.0	29.9	29.3	26.0	138	151	120	139	3.5	71.7	16.36	28.92	54.00	16.00	70.6	11.08	7.96	2.105	0.740	0.80	6.1	0.9	
Optimized Isobaric Energy Recovery Demonstration - Hydranautics ESPA 1 Membranes											**BASELINE**																				
05/26/10	12:00	13455.5	72.0%	80.8%	14.88	16.46	11.31	0.61	79.0	33.1	30.2	29.5	25.1	162	181	139	165	6.9	88.1	20.60	33.75	64.00	22.00	86.8	17.67	12.05	2.612	0.786	1.50	9.5	1.4	
Optimized Isobaric Energy Recovery Demonstration - Hydranautics ESPA 1 Membranes											**14.9 gfd flux**																				

TIME				CALCULATED PARAMETERS					TEMP	PRESSRE									FLOWS						MAIN PANEL KW METER					VFD KW METER			
		Operation	System	RO	Ave. Sys. Flux	1st Stage Flux	2nd Stage Flux	Power	Influent	P_{CF-in}	P_{CF-out}	$P_{PX-Feed\ In}$	$P_{PX-conc\ out}$	$P_{PX-HP\ out\ RO\ 1\ feed}$	$P_{RO\ 2\ feed}$	$P_{C-RO1\ PX\ Booster\ inlet}$	P_{C-RO2}	P_{P-SYS}	$Q_{F-HP\ Pump}$	$Q_{PX\ HP-out}$	$Q_{Feed\ PX-In}$	$Q_{P-Stage\ 1}$	$Q_{P-Stage\ 2}$	Q_{P-SYS}	A_{sys}	P HP/PX	P booster	Power	PX power	HP Power	Feed Pump	
Date	Time	Time	Recovery %	Recovery %	Gfd	Gfd	Gfd	kWh/m3	Temp F	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(psi)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	amp	(kw)	(kw)	Factor	(kw)	(kw)	(kw)	Notes
MM/DD/YY	hh:mm	hh.hh							17	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Optimized Isobaric Energy Recovery Demonstration - Hydranautics ESPA 1 Membranes											**BASELINE**																					
Optimized Isobaric Energy Recovery Demonstration - Hydranautics ESPA 1 Membranes											**16 gfd flux**																					
05/27/10	9:19	13476.8	72.9%	81.5%	15.98	20.47	12.34	0.66	78.0	33.5	30.2	29.5	24.9	177	197	150	180	8.5	95.0	21.20	34.56	79.60	24.00	93.2	20.65	13.98	3.374	0.793	1.70	11.2	2.6	
Optimized Isobaric Energy Recovery Demonstration - Hydranautics ESPA 1 Membranes											**BASELINE**																					
05/27/10	19:05	13486.6	72.4%	80.8%	14.88	16.46	10.95	0.61	79.0	33.1	30.2	29.5	25.1	163	182	140	168	6.7	88.1	20.57	33.09	64.00	21.30	86.8	15.39	11.98	2.984	0.765	1.40	9.5	2	
05/29/10	11:37	13508.1	72.5%	80.8%	14.90	16.59	10.90	0.61	80.0	33.0	0.2	29.4	25.2	164	183	141	178	7.0	88.3	20.64	32.90	64.50	21.20	86.9	16.89	12.03	2.779	0.776	1.40	9.4	1.7	
05/30/10	11:40	13532.2	72.4%	80.8%	14.86	16.51	10.80	0.61	80.0	33.1	30.2	29.6	25.1	165	184	141	178	6.9	88.2	20.55	33.04	64.20	21.00	86.7	17.38	12.10	2.882	0.776	1.40	9.5	1.9	
05/31/10	11:00	13555.5	72.4%	81.2%	14.86	16.71	10.75	0.61	79.0	33.0	30.1	29.4	25.1	166	185	141	170	7.0	88.0	20.13	33.07	65.00	20.90	86.7	17.97	12.09	2.997	0.777	1.40	9.6	2.1	

TWDB ADC III Power Model System Analysis (PRELIMINARY)



FLOW AND PRESSURE TABLE Actual data in bold red

		A	B	C	D	E	F	G	H	I	J	K	L
FLOW	US gpm	112	**30.0**	83	**20.6**	103	82	**58**	**24**	45	45	22	31
	m^3/hr	25.5	6.8	18.9	4.7	23.3	18.6	13.2	5.5	10.1	10.1	4.9	7.0
	m^3/day	610	164	452	112	559	447	316	131	243	243	118	169
PRESSURE	psi	**30.0**	**29.2**	**175**	175	175	**20.5**	20.5	20.5	**150.0**	**195.0**	**178**	**25.5**
	Bar	2.1	2.0	12.1	12.1	12.1	1.4	1.4	1.4	10.3	13.4	12.3	1.8
QUALITY	uS	**4477**	4477	4477	**nd**	**4505**	**177.9**	**99.9**	**376.5**	**9539**	9539	**18.62**	**15.04**

PX PERFORMANCE

PX model	n/a	**PX-45**
Number of units	n/a	**1**
PX HP unit flow	gpm	20.6
PX LP unit flow	gpm	30.0
PX lubricant per array	gpm	**1.0**
PX differential HP side	psi	3
PX differential LP side	psi	3.7
PX efficiency	%	93.1%

HIGH PRESS. PUMP POWER

HP pump efficiency	%	73%
Motor efficiency	%	88%
HP pump flow rate	gpm	83.0
Differential pressure	psi	175
Power	kW	9.9

PX BOOSTER PUMP POWER

ERI PX booster model	HP	**8503**
Number of units	n/a	**1**
PX booster efficiency	%	62%
Motor Efficiency	%	90%
Total PX booster flow rate	gpm	44.6
Differential pressure	psi	45
Total booster power	kW	1.6

RO AND SYSTEM PERFORMANCE

Permeate flow	gpm	118,080
RO recovery rate	%	79.9%
RO flux	GFD	14.1
RO feed pressure	psi	175.0
Membrane I DP	psi	25
Membrane II DP	psi	17
Main HP Pump efficiency	%	**73%**
Main HP Pump motor efficiency	%	**88%**
PX Booster efficiency	%	**62%**
PX booster motor efficiency	%	**90%**

INPUTS

POWER RESULTS

Total RO process (kW)	11.5
kWh/m^3 permeate	0.62
kWh/Kgal permeate	2.33

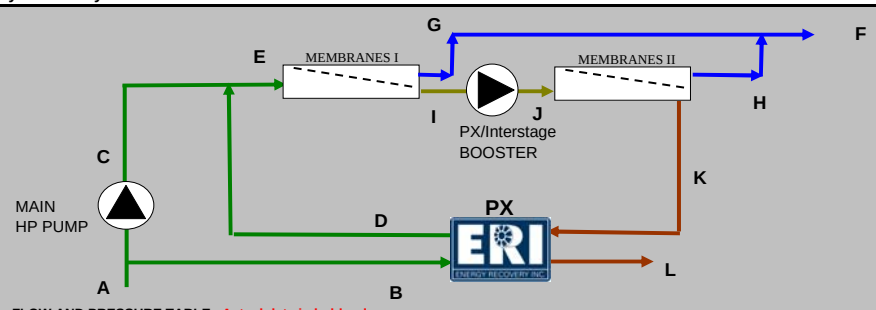
$ SAVINGGS

Power savings per year @ $0.10/kWh	$ 2,050

TWDB ADC III Energy Savings Analysis (PRELIMINARY)

	Std	Turbo	ERI
HP Feed pump efficiency	73%	73%	73%
HP Feed pump motor efficiency	88%	88%	88%
HP feed pump flow (gpm)	102.6	102.6	83.0
HP feed pump delta P (psi)	175	175	175
HP Feed pump power, kW	12.2	12.2	9.9
Interstage booster pump efficiency	62%	62%	62%
Interstage booster motor efficiency	90%	n/a	90%
Interstage booster flow (gpm)	44.6	44.6	44.6
Interstage booster delta P (psi)	45.0	45.0	45.0
Interstage booster pump power, kW	1.6	0.0	1.6
RO Feed Pressure, PSI	175	175	175
RO Recovery, %	80%	80%	80%
Total RO Process kW	13.8	12.2	11.5
KWh/kgal	2.81	2.49	2.33
% Energy Savings	**0%**	**11%**	**17%**

TWDB ADC III Power Model System Analysis 5-24-10



FLOW AND PRESSURE TABLE Actual data in bold red

5/24/2010		A	B	C	D	E	F	G	H	I	J	K	L
FLOW	US gpm	119	**33.0**	87	**20.2**	106	86	**64**	**22**	42	42	21	34
	m^3/hr	27.1	7.5	19.8	4.6	24.2	19.6	14.5	5.0	9.6	9.6	4.8	7.7
	m^3/day	650	180	475	110	580	470	349	121	231	231	116	185
PRESSURE	psi	**30.2**	**29.4**	**161**	161	161	**6.8**	6.8	6.8	**138.0**	**180.0**	**164**	**25.0**
	Bar	2.1	2.0	11.1	11.1	11.1	0.5	0.5	0.5	9.5	12.4	11.3	1.7
QUALITY	uS	**4303**	4303	4303	**nd**	**4324**	**264.2**	**155.0**	**58.5**	**9813**	9813	**18.08**	**13.83**

PX PERFORMANCE

PX model	n/a	**PX-45**
Number of units	n/a	**1**
PX HP unit flow	gpm	20.2
PX LP unit flow	gpm	33.0
PX lubricant per array	gpm	**1.0**
PX differential HP side	psi	3
PX differential LP side	psi	4.4
PX efficiency	%	92.2%

HIGH PRESS. PUMP POWER

HP pump efficiency	%	68%
Motor efficiency	%	88%
HP pump flow rate	gpm	87.2
Differential pressure	psi	161
Power	kW	10.2

PX BOOSTER PUMP POWER

ERI PX booster model	HP	**8503**
Number of units	n/a	**1**
PX booster efficiency	%	50%
Motor Efficiency	%	90%
Total PX booster flow rate	gpm	42.4
Differential pressure	psi	42
Total booster power	kW	1.7

RO AND SYSTEM PERFORMANCE

Permeate flow	gpm	124,128
RO recovery rate	%	81.0%
RO flux	GFD	14.8
RO feed pressure	psi	161.0
Membrane I DP	psi	23
Membrane II DP	psi	16
Main HP Pump efficiency	%	**68%**
Main HP Pump motor efficiency	%	**88%**
PX Booster efficiency	%	**50%**
PX booster motor efficiency	%	**90%**

INPUTS

POWER RESULTS

Total RO process (kW)	11.9
kWh/m^3 permeate	0.61
kWh/Kgal permeate	2.31

$ SAVINGGS

Power savings per year @ $0.10/kWh	$ 1,970

TWDB ADC III Energy Savings Analysis 5-24-10

	Std	Turbo	ERI
HP Feed pump efficiency	68%	68%	68%
HP Feed pump motor efficiency	88%	88%	88%
HP feed pump flow (gpm)	106.4	106.4	87.2
HP feed pump delta P (psi)	161	161	161
HP Feed pump power, kW	12.5	12.5	10.2
Interstage booster pump efficiency	50%	50%	50%
Interstage booster motor efficiency	90%	n/a	90%
Interstage booster flow (gpm)	42.4	42.4	42.4
Interstage booster delta P (psi)	42.0	42.0	42.0
Interstage booster pump power, kW	1.7	0.0	1.7
RO Feed Pressure, PSI	161	161	161
RO Recovery, %	81%	81%	81%
Total RO Process kW	14.2	12.5	11.9
KWh/kgal	2.74	2.41	2.31
% Energy Savings	**0%**	**12%**	**16%**