APPENDIX D

MAIN UNIT PERIOD 1 OPERATIONS

Ion-Exchange System
June, July, and August 1985

Sodium Chloride Regeneration
Operation Parameters and Results
Test Plan

OPERATIONS LOG - 1985

Date	Time	Unit	Operation	Data Sheet	Regeneration and Service Information
May 31	1143	2	Regeneration start	yes	Regen: 12.0% brine,50 min. for 3520 gal.
	1311	2	Regeneration finished, to drain		= 70 gpm, Drain for 3 min to .75 full column
	1337	2	to CW 4, Ca 50		reading at 150 gpm, RinA 5 min, RinB 10 min
	1405	2	to drain		Ca 56 at Ser0, Ca 56 at 30 min., 52 at 60,
	1640	1	Regeneration start 12.5% brine	no	58 at 90, 54 at 120, 60 at 150, 104 at 180
	1815		Regeneration finished - in service		
			Gravity to RO		
June 2	1320	1	Regeneration start 11.0% brine	no	
	1435		" " finished		
			Gravity to RO		
June 3	1612	1	Regeneration start 12.0% brine	no	
	1720		" " finished		
	1725		Gravity to RO		
June 4	920		Shut down RO and acid pump	no	
	1250		Restart RO with new membrane		
	1320		RO feed 7 gpm		
June 5	1030	2	Regeneration start 12.0% brine	yes	Regen.: 12.0% brine, 53 min. for 3630 gal.
	1203	2	" " finished		= 68 gpm
	1206	2	to RO		RinC Ca level: 124 at 0 min, 60 at 5, 34 at 10
	1206	1	Shut down		Service: not available
	1235	1	Regeneration start 13.5% brine	yes	Regen.: 13.5% brine, 55 min. for 3630 gal.
	1402	1	" " finished		= 67 gpm.
	1405	1	Gravity to RO		RinC Ca level: 80 at 0 min., 40 at 5,
	1410	2	to CW 4		Service: 20580 gal., Ca leakage 29
	1740	2	to RWPS		
	2030	2	Backwash and slow rinse		
June 7	735	1	Regeneration start 12.0% brine	yes	Regen.: 12.0% brine, 54 min. for 3740 gal.
	855	1	" " finished		= 69 gpm
	900	1	to RO, CW 4 S/O		RinC Ca level: 66 at 0 min., 36 at 5
					Service: 20510 gal., Ca leakage 31
	1040	2	Regeneration start	no	
	1130	2	" " finished		
June 8	1630	2	Backwashed and filled w/brine f/T 4		
June 9	5	1	RO feed Ca = 100		
	55	1	Regeneration start 15.0% brine	yes	Regen.: 15.0% brine, 50 min. for 3475 gal.
	215	1	" " finished		= 69 gpm
	225	1	RO placed back into service		RinC Ca level: 55 at 0 min.
	1600	1	Unit and RO S/D, Ca = 100		Service: 4500 gal., Ca leakage 31
	1700	1	IV 7 failed to operate		
	1800	1	IV 7 adjusted		
	1800	1	Regeneration start	no	Service: 19300 gal.
	1820	1	" " finished, to RO		

Note: Ca TH stated in mg/l as CACO3, Leakages are average

OPERATIONS LOG - 1985 (Continued)

Date	Time	Unit	Operation	Data Sheet	Regeneration and Service Information
June 10	1035	2	IV 111 leaking, reg. S/D		
continued	1400	2	Regeneration finished		
	1435	2	to CW 4 for flushing		
	1640	2	S/D		
	1740	2	Regeneration start	no	
	2050	2	S/D, Ca above 200		
	2130	2	regeneration complete, Ca 240		
	2200	2	to CW 4 to 5 feet with Ca 240, for RED		
June 11	705	1	to RO and CW 3		
	743	1	S/D, RO feed from CW 3		
	800		CW 3 Ca 360, RO S/D		
	819	1	Regeneration start, 14.0% brine	yes	Regen.: 14.0% brine, 56 min. for 3740 gal.
	915	1	Regeneration finished		= 67 gpm
	945	1	to RO		RinC Ca level: 42 at 0 min., 35 at 5, 26 at 10
					Service: 11070 gal., Ca leakage 26
	1338	2	Regeneration start, 13.5% brine	yes	Regen.: 13.5% brine, 59 min. for 3740 gal.
	1437	2	Regeneration finished		= 63 gpm
	1930	2	to CW 4 with drain open		RinC Ca level: 48 at 0 min, 32 at 5, 24 at 10,
	2000	2	CW 4 drain closed		18 at 15
	2130	2	CW 4, 7 feet water, Ca 50		Service: 24640 gallons, Ca leakage 23
	2130	2	Ca 24		
	2314	2	Ca 51, S/D		
June 12	600	1	to RO, Ca 64		
	605		feed to RO from CW 3, Ca 21		
			CW 3 at 7 feet 11 inches		
	739	1	Regeneration start	yes	Regen.: 13.0% brine, 55 min. for 3740 gal.
	940	1	to CW 3, Ca 33		= 68 gpm
	1142	1	to RO, CW 3 valve closed		RinC Ca level: 40 at 0 min., 33 at 5
					Service: volume not available, Ca leakage 23
June 13	1300	1	S/D, Ca 90, RO feed from CW 3		
	1320	1	Regeneration start	yes	Regen.: 13.0% brine, 60 min. for 3740 gal.= 62
	1605	1	to RO feed only		= 62 gpm
					RinC Ca level: 54 at 0 min., 39 at 5, 30 at 10
					Service: 18750 gal., Ca leakage 28
June 15	310	1	S/D, Ca 90, RO feed from CW 3		
	320	2	Regeneration start	yes	Regen.: 13.0% brine, 50 min. for 3025 gal.
	620	2	Regen. finished, unable to soften water		= 61 gpm
	710	2	Regeneration start	no	
	905	2	Regen. finished, unable to soften water		
	1045	1	Regeneration start	no	Service: 14040 gal.
	1220	1	Regeneration finished, Ca 44		
June 16	1428	1	S/D, Ca 55, RO feed from CW 3		
	1430	1	Regeneration start	yes	Regen.: 12.0% brine, 55 min. for 3740gal.
	1800	1	to RO only, Ca 25		= 68 gpm

Note: Ca TH stated in mg/l as CACO3, Leakages are average

OPERATIONS LOG - 1985 (Continued)

Date	Time	Unit	Operation	Data Sheet	Regeneration and Service Information
June 16 continued	1930		T 6 filled and recirculated, 12.0% brine		RinC Ca level: 50 at 0 min., 37 at 5, 25 at 10 Service: 12910 gal., Ca Leakage 28
	1945		T 5 filled with city water		
June 17	1845	1	S/D, Ca 54, RO feed from CW 3		
	1850	1	Regeneration start	yes	Regen.: 12.0% brine, 53 min. for 3740 gal. = 71 gpm
	2055	1	to RO only, Ca 34		
	2215		T 6 filled and recirculated, 12.0% brine		RinC Ca level: 60 at O min., 48 at 5, 34 at 10 Service: 17930 gal., Ca leakage 25
June 19	600	1	Ca 56		
	604	1	S/D	yes	Regen.: 12.5% brine, 54 min. for 3740 gal. = 69 gpm
	628	1	Regeneration start		
	802	1	to RO, Ca 27		RinC Ca level: 73 at 0 min., 36 at 5, 27 at 10 Service: 21950 gal., Ca leakage 26
June 20	928	1	to RO, Ca22		
June 21	820	1	Ca 56, S/D		
	910	1	Regeneration start	yes	Regen.: 12.0% brine, 54 min. for 3740 gal. = 69 gpm
	1046	1	to RO, Ca 37		
	1300	2	stored resin in 15.0% brine		RinC CA level: 60 at 0 min., 40 at 5, 32 at 10 Service: 17800 gal., Ca leakage 29
June 22	2030	1	Ca 51, RO feed from CW 4		
	2100	1	Regeneration start	yes	Regen.: 12.0% brine, 50 min. for 3520 gal. = 70 gpm
	2225	1	Regeneration finished, to RO, Ca 43		RinC Ca level: 54 at 0 min., 43 at 3 Service: 18010 gal., Ca leakage 28
June 24	842	1	S/D, Ca 51, CW 4 to RO		
	845	1	Regeneration start	yes	Regen.: 12.0% brine, 57 min. for 3740 gal. = 66 gpm
	1043	1	Regeneration finished, to CW 3 and RO Cl2 to CW3 @ 4#/24 hrs.		RinC Ca level: 60 at 0 min., 35 at 5
	1345	1	to RO only		Service: 7500 gal., Ca leakage 23
June 25	602	1	S/D, Ca 57		
	630	1	Regeneration start	yes	Regen.: 12.0% brine, 55 min. for 3740 gal. = 68 gpm
	844	1	Regeneration finished, not in service till acid pump change		RinC Ca level: 85 at 0 min., 59 at 5, 36 at 10
	935	1	to RO		Service: 18640 gal., Ca leakage 32
June 26	1815	1	S/D, RO feed from CW4 level 13 ft. 7 in.	yes	Resin soaking in 12.0 % NaCl brine
	1925	1	store resin in 12.0 % NaCl brine		
June 27	2315	1	S/D CW4 feed to RO, level 2 ft.; I/S CW3 to RO, level 15 ft. 5 in.		
June 29	718	1	Regeneration start	yes	Regen.: 12.0% brine, 50 min. for 3300 gal. = 66 gpm
	910	1	Regeneration finished		
	915	1	to RO and CW3, level 2ft., Cl2 I/S		RinC Ca level: 44 at 0 min. Service: 24100 gal., Ca leakage 15
	2030	1	S/D, Regeneration start RO feed from CW3, level 18ft. 10 in.	yes	Regen.: 12.5% brine, 55 min. for 3740 gal. = 68 gpm
	2250	1	to RO, Ca 37		RinC Ca level: 50 at 0 min., 46 at 5, 36 at 10 Service: 18480 gal., Ca leakage 30

Note: Ca TH stated in mg/l as CACO3, Leakages are average

OPERATIONS LOG - 1985 (Continued)

Date	Time	Unit	Operation	Data Sheet	Regeneration and Service Information
July 1	637	1	S/D, Ca 53; CW3 to RO, level 18 ft. 10 in.		
	800	1	Soaking resin in 12.0% NaCl brine		
July 2	1105	2	Obtained resin levels in columns Column C 44 in., D 42.5 in. from bottom of top manifold		
	1610	1	Regeneration start	yes	Regen.: 12.0% brine, 60 min. for 3740 gal. = 62 gpm
	1845	1	to service, Ca 28		RinC Ca level: 56 at 0 min., 28 at 5 Service: 20820 gallons; Ca leakage 21
July 4	920	1	S/D, RO feed from CW3 level 4 ft. 6 in.		
	922	1	Regeneration start	yes	Regen.: 12.0% brine, 56 min. for 3740 gal. = 67 gpm
	1050	1	I/S to RO and CW3 level 3ft. 11in., CA 32		RinC Ca Level: 66 at 0 min., 44 at 5, 32 at 10
	1530	1	to RO only; Cw3 level 12 ft.		Service: 20700 gallons; Ca leakage 30
July 5	730	1	S/D, RO feed from CW3 level 11ft. 10in.		
	731	1	Regeneration start	yes	Regen.: 12.0% brine, 54 min. for 3740 gal. = 69 gpm
	855	1	I/S to RO only, CW3 level 11ft. 4 in.		RinC Ca level: 60 at 0 min., 42 at 5 Service: 19080 gallons; Ca leakage 31
July 6	2020	1	S/D,Ca 56; RO feed from CW3		
	2050	1	Regeneration start	yes	Regen.: 12.0% brine, 55 min. for 3740 gal. = 68 gpm
	2235	1	to RO		RinC Ca level: 108 at 0 min., 44 at 5 Service: 20250 gallons, Ca leakage 26
July 8	1214	1	S/D, RO feed from CW3		
			Regeneration start	yes	Regen.: 12.5% brine, 54 min. for 3740 gal. = 69 gpm
	1355	1	Regeneration finish; CW3 S/D level 10ft. 1in.		RinC Ca level: 56 at 0 min., 42 at 5 Service: 17740 gallons, Ca leakage 31
July 9	2305	1	S/D		
	2335	1	Regeneration start	yes	Regen.: 12.0% brine, 50 min. for 3520 gal. = 70 gpm
July 10	100	1	Regeneration finish to RO; CW3 S/D, level at 9ft. 6in.		RinC Ca level: 70 at 0 min., 51 at 5, 44 at 8 Service: 17600gal., Ca leakage 31
July 11	1030	1	S/D; RO feed from CW3, level 9ft. 6in.		
			Regeneration start	yes	Regen.: 12.0% brine, 55 min. for 3740 gal. = 68 gpm
	1205	1	I/S to RO; CW3 S/D, level 8ft. 11in.		RinC Ca level: 104 at 0 min., 75 at 5, 58 at 10, 37 at 15 Service: 17160 gal., Ca leakage 25
July 12	2015	1	S/D, Ca69; RO from CW3		
	2025	1	Regeneration start	yes	Regen.: 12.0% brine, 56 min. for 3740 gal. = 67 gpm
	2212	1	I/S, Ca 42; CW3 S/D		RinC Ca level: 212 at 0 min, 56 at 5, 42 at 10 Service: 17290 gal., Ca leakage 31
July 14	830	1	S/D; RO feed from CW3, level 8ft., 3in.		
			Regeneration start	yes	Regen.: 51 min. for 3740 gal.= 73 gpm
	1018	1	I/S to RO; CW3 S/D, level 7ft., 7in.		RinC Ca level: 110 at 0 min., 56 at 5

Note: Ca TH stated in mg/l as CACO3, Leakages are average

OPERATIONS LOG - 1985 (Continued)

Date	Time	Unit	Operation	Data Sheet	Regeneration and Service Information
July 15	1755	1	S/D, Ca 50; RO from CW3		
	1808	1	Regeneration start	yes	Regen.: 12.5% brine, 50 min. for 3190 gal.
	2014	1	Regeneration finish		= 64 gpm
			I/S to RO and CW3, level 7ft., 1in.		RinC Ca level: 55 at 0 min., 46 at 5
					Service: 12610 gal., Ca leakage 34
July 16	755	1	S/D for maint., measure resin bed		Bottom of t.manifold to resin: A 38 inches (81.87cf), B 40.5in (77.78cf) (east column)
	1300	1	Regeneration start	yes	Regen.: 12.0% brine, 50 min. for 3740 gal.
	1542	1	Regeneration finish		= 75 gpm
	1547	1	I/S; S/D CW3, level 8ft., 8in.		RinC Ca level: 63 at 0 min., 43 at 2
					Service: 25350 gal., TH leakage 35
July 18	1305	1	S/D, Ca 110; CW3 to RO		
	1310	1	Regeneration start	yes	Regen.: 12.0% brine, 55 min. for 3740 gal.
	1500	1	Regeneration finish		= 68 gpm
	1505	1	I/S to RO; CW3 S/D, level 7ft., 11in.		RinC TH level: 110 at 0 min., 84 at 4
	1710	1	Mix of T6 brine complete, 12.0%		Service: 22140 gal., TH leakage 63
July 19	1502	1	CW3 I/S, 7ft., 11in.		
	1816	1	S/D, TH 613, Ca 60; CW3 13ft., 6in.		
	1819	1	Regeneration start	yes	Regen.: 12.0% brine, 50 min.
	2010	1	Regeneration finish		RinC Ca level: 64 at 0 min., 45 at 5
	2013	1	I/S to RO and CW3, level 12ft., 10in.		Service: 19610 gal.; leakages: Ca 36, TH 63
	2200	1	S/D CW3, level 15ft.		
July 20	700	1	IP7 I/S to unit to CW3		
	850	1	S/D, Ca 60		
July 21	1130	1	Regeneration start	yes	Regen.: 12.0% brine, 64 min. for 3740 gal.
	1325	1	I/S to RO		= 59 gpm
	1515	1	Mix of T6 brine complete, 12.0%		RinC level: 61 at 0 min., 38 at 5
					Service: 20920 gal., leakage: Ca 22, TH 35
July 22	1640	1	IP7 to RO and CW3, level 11ft., 3in.		
	1738	1	IP7 S/D, Ca49; CW3 level 15ft., 9in.		
			CW3 to RO		
	1755	1	Regeneration start	yes	Regen.: 16.5% for 1870 gal. and 12.0% for
	1955	1	Regeneration finish, Ca 43		1870 gal.
			S/D CW3, level 15ft., 1in.		RinC Ca level: 76 at 0 min., 44 at 5
	2005	1	IP7 to RO and CW3		Service: volume and leakages not available
	2115		Mix of T6 brine complete, 12.0%		
	2137	1	S/D CW3, level 22ft.; I/S CW4,		
	2230		level 7 inches, CW3 leaking		
July 23	2	1	S/D, Ca 61		
	15	1	Regeneration start	yes	Regen.: 12.0% brine, 57 min. for 3740 gal.
	250	1	I/S to CW4, Ca31		= 66 gpm
	625	1	S/D, Ca 53; CW3 to RO		RinC Ca level: 100 at 0 min, 64 at 5, 31 at 10
	745		Start drain CW3		Service: volume and leakages not available
	800		RO feed from CW4		
	1205		Salt delivery for T5		
	1327		salt delivery finished		

Note: Ca TH stated in mg/l as CACO3, Leakages are average

OPERATIONS LOG - 1985 (Continued)

Date	Time	Unit	Operation	Data Sheet	Regeneration and Service Information
July 24	1355	2	Backwash from CW1 for 50 min. then filled with 12.0% brine		
July 25	805	2	Regeneration start	yes	Regen.: 50 min. for 3355 gal.= 67 gpm
	922	2	Regeneration finished		RinC Ca level: 350 at 0 min., 201 at 5,
	1005	2	Service to CW4, level 3ft., 4in.		69 at 10, 45 at 15
	1150	2	to RO only; S/D CW4, level 6feet		Service: volume and leakages not available
July 26	815	2	S/D, calibration of flow sensor CW4 to RO		
	830	2	Calibration complete		
	910	2	Prepared T7 brine, 12.0%		
	945	2	I/S; S/D CW4, level 5ft. 9inches		
	1050	2	S/D; RO feed from CW4		
	1320	2	Column B lost resin during rinsing		
	1321	2	I/S, Column A; S/D CW4		
July 27	1043	2	S/D, Ca 58; CW4 to RO, level 4ft. 11in.		
	1158	1	Regeneration start	yes	Regen.: 12.0% brine; 74 min. for 3795 gal.
	1312	1	Flow rate irregularities during regen.		= 51 gpm
	1340	1	Regeneration finished		RinC Ca level: 100 at 0 min., 45 at 5
			I/S to RO and CW4, level 3ft. 10in.		Service: 19070 gal.; leakage: Ca 28, TH 42
	1415		S/D CW4, level 5feet		
July 28	900		Mixing of T6 brine complete, 12.0%		
July 29	1	1	S/D, Ca 52; RO feed from CW4		
	5	1	Regeneration start	yes	Regen.: 12.0% brine; 58 min. for 3740 gal.
	140	1	I/S to RO, Ca 40		= 65 gpm
					RinC Ca level: 62 at 0 min., 40 at 5
					Service: 17770 gal.; leakage: Ca 28, TH 52
July 30	1155	1	S/D, Ca 49; RO feed from CW4, level 4ft. 4inches		
	1420	1	Regeneration complete	yes	Regen.: 12.0% brine; 62 min. for 3850 gal.
	1720	1	I/S to RO		= 62 gpm
	1730		Drained 2.5ft. from CW4, TH 135		RinC Ca level: 60 at 0 min., 50 at 2, 46 at 10
	1930	1	I/S to CW4, filling to 3.5ft.		Service: volume and leakages not available
	2105	1	I/S to RO; CW4 3.5ft.		
July 31	2150	1	S/D, RO feed from Cw4		
	2245	1	Regeneration start	yes	Regen.: 13.0% brine; 57 min. for 3740 gal.
					= 66 gpm
					RinC Ca level: 64 at 0 min., 36 at 5
					Service: 21010 gal.; leakage: Ca27, TH 46
Aug. 1	15	1	Regeneration finished; I/S to RO	yes	see July 31 log
	836	1	I/S to RO and CW4, level 2ft. 8in.		
	910		resin found in CW4		
	930	1	S/D RO, change cartridge filters		
	1035		S/D CW4, level 6ft. 10in.		
	1040	1	I/S to RO		

Note: Ca TH stated in mg/l as CACO3, Leakages are average

OPERATIONS LOG - 1985 (Continued)

Date	Time	Unit	Operation	Data Sheet	Regeneration and Service Information
Aug. 2	530	1	S/D, Ca 55; CW4 to RO, level 6ft. 10in.		
	610		S/D IP3, brine leak		
	1220		Replaced IP3 with IP1		
	1735	1	Regeneration start	yes	Regen.: 12% brine; 57 min. for 3740 gal. = 66 gpm
	1940	1	Regeneration finished, I/S to RO and CW4		RinC Ca level: 140 at 0 min., 100 at 5, 59 at 10, 42 at 15
	2300	1	I/S to CW4, level 3ft. 5in.		Service: 17690 gal.; leakage: Ca 26, TH 46
Aug. 3	5		S/D CW4, level 5ft. 8in.		
	718		S/D RO to repair leak		
	915		I/S RO		
Aug. 4	215	1	S/D, Ca 52; CW4 to RO, level 5ft. 8in.		
	500	1	Regeneration start	yes	Regen.: 11% brine; 72 min. for 4400 gal. = 61 gpm
	710	1	I/S to RO		RinC Ca level: 52 at 0 min., 48 at 5
	825	1	to CW4, level 3ft. 4in.		Service: 20520 gal.; leakage: Ca 28, TH 45
	935		S/D CW4, level 6feet		
Aug. 5	1425	1	S/D; RO feed from CW4		
	1830	1	Regeneration start	yes	Regen.: 12% brine; 12 min. for 3410 gal. = 284 gpm
	2020	1	I/S to RO and CW4, level 3ft. 6in.		RinC Ca level: 104 at 0 min, 62 at 5, 48 at 10
	2312	1	S/D CW4, level 8ft. 10in.		Service: 20470 gal.; leakage: Ca 36, TH 45
Aug. 6	2215	1	S/D, Ca 49; CW4 to RO		
	2225	1	Regeneration start	yes	Regen.: 12% brine; 62 min. for 3740 gal. = 60 gpm
Aug. 7	5		RO S/D, high pH 8.7 from CW4, level 8 feet		RinC Ca level: 100+ at 0 min., 100+ at 5, 59 at 10, 44 at 15
	18	1	Regeneration finish, resin in 12% brine		Service: 27030 gal.; leakage: Ca 36, TH 54
	907	1	I/S to RO, Ca 44		
	2230	1	S/D, Ca 300; CW4 Ca 37, level full		
Aug. 8	105		RO S/D, malfunction acid pump; CW4 level 20ft. 5.5in., pH 8.5		
	220	1	complete filling with 12% brine		
	1020	1	start manual resin cleaning schedule		
	1300	1	complete resin cleaning schedule to step 12		
Aug. 12	800	1	check resin levels		
	830		CW4 to drain		
Aug. 14	930	1	complete resin storage, 12% brine level at 75% full		
	1300		numbers remarked on all IX and evap. pond associated valves		

Note: Ca TH stated in mg/l as CACO3, Leakages are average

ION EXCHANGE UNIT 1
SODIUM CHLORIDE BRINE REGENERATION
JUNE, JULY and AUGUST - 1985

REGENERATION DATA

	INFLUENT BRINE											EFFLUENT BRINE									
												at 20 minutes					at 45 minutes				
Date	Dur.	Vol.	Conc.	Elect. Cond.	Ca	TH	Na	Total Sodium Thruput		Average Flow Rate		Thu-put	Elect. Cond.	Ca.	TH	Na	Thruput	Elect. Cond.	Ca	Total Hardnes	Na
	(min)	(gal.)	(%)	(uS/cm)	(meq/l			(eq/l of resin)	(bv)	(bv/min)	(gpm/ft2)	(bv)	(uS/cm)	(meq/l)			(bv)	(uS/cm)	(meq/l)		
June 2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5	53	3630	12	168100	1.4	7.6	3218.8	9.74	3.03	0.057	1.74	1.14	39800	96.0	260.0	369.7	2.57	157300	138.0	296.0	2492.4
7	54	3740	12	155600	3.6	7.6	2688.1	8.38	3.12	0.058	1.76	1.15	32000	98.0	180.0	247.9	2.60	145200	216.0	380.0	2114.0
8	50	3475	15	NA	NA	NA	NA	NA	2.90	0.058	1.77	1.16	142500	398.0	780.0	900.4	2.61	152000	214.0	360.0	1200.5
9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
12	55	3740	13	160200	3.5	7.6	1731.2	5.40	3.12	0.057	1.73	1.13	142500	398.0	780.0	900.4	2.55	152000	214.0	360.0	1200.5
13	60	3740	13	NA	NA	NA	NA	NA	3.12	0.052	1.59	1.04	NA	NA	NA	NA	2.34	NA	NA	NA	NA
15	50	3025	13	NA	NA	NA	NA	NA	2.53	0.051	1.54	1.01	NA	NA	NA	NA	2.27	NA	NA	NA	NA
16	55	3740	12	NA	NA	NA	NA	NA	3.12	0.057	1.73	1.13	NA	NA	NA	NA	2.55	NA	NA	NA	NA
17	53	3740	12	NA	NA	NA	NA	NA	3.12	0.059	1.80	1.18	NA	NA	NA	NA	2.65	NA	NA	NA	NA
19	54	3740	12.5	161300	2.8	7.6	2905.6	9.06	3.12	0.058	1.76	1.15	85000	376.0	740.0	522.0	2.60	155600	166.0	252.0	3049.2
21	54	3740	12.5	156200	2.3	6.4	3384.1	10.55	3.12	0.058	1.76	1.15	44500	148.0	296.0	256.6	2.60	147600	170.0	336.0	2166.2
22	50	3520	12	NA	NA	NA	NA	NA	2.94	0.059	1.79	1.17	NA	NA	NA	NA	2.64	NA	NA	NA	NA
24	57	3740	12	156600	1.54	6.4	2818.6	8.79	3.12	0.055	1.67	1.09	34500	106.0	188.0	252.3	2.46	147300	154.0	268.0	2270.6
25	55	3740	12	153400	3.74	6.8	2696.8	8.41	3.12	0.057	1.73	1.13	47800	142.0	368.0	291.4	2.55	146600	226.0	348.0	2470.6
29	50	3300	12	153000	3	6.0	3323.2	9.14	2.76	0.055	1.68	1.10	31000	110.0	248.0	265.3	2.48	146400	154.0	308.0	2396.7
29	55	3740	12.5	NA	NA	NA	NA	NA	3.12	0.057	1.73	1.13	NA	NA	NA	NA	2.55	NA	NA	NA	NA
July 2	60	3740	12	NA	NA	NA	NA	NA	3.12	0.052	1.59	1.04	NA	NA	NA	NA	2.34	NA	NA	NA	NA
4	56	3740	12	149000	3.3	6.2	2013.9	6.28	3.12	0.056	1.70	1.11	60100	174.0	372.0	395.8	2.50	140400	190.0	346.0	1853.0
5	54	3740	12	157300	3.4	6.6	2148.8	6.70	3.12	0.058	1.76	1.15	43400	144.0	292.0	247.9	2.60	149200	200.0	364.0	1935.6
6	55	3740	NA	NA	NA	NA	NA	NA	3.12	0.057	1.73	1.13	NA	NA	NA	NA	2.55	NA	NA	NA	NA
8	54	3740	12.5	147400	4	6.8	2070.5	6.46	3.12	0.058	1.76	1.15	58600	204.0	444.0	321.9	2.60	140000	190.0	332.0	1831.2
9	50	3520	12	155300	3.4	13.6	2557.6	7.51	2.94	0.059	1.79	1.17	43500	146.0	322.0	262.7	2.64	148200	166.0	256.0	1546.3
11	55	3740	12	NA	NA	NA	NA	NA	3.12	0.057	1.73	1.13	NA	NA	NA	NA	2.55	NA	NA	NA	NA
12	56	3740	12	148200	3.8	12.8	2061.8	6.43	3.12	0.056	1.70	1.11	114800	390.0	866.0	769.9	2.50	141400	120.0	244.0	1833.4
14	51	3740	NA	NA	NA	NA	NA	NA	3.12	0.061	1.87	1.22	NA	NA	NA	NA	2.75	NA	NA	NA	NA
15	50	3190	12.5	159200	4.6	9.6	2616.4	6.96	2.66	0.053	1.62	1.06	48000	162.0	346.0	236.6	2.39	150000	154.0	278.0	2420.6
16	50	3740	12	NA	NA	NA	NA	NA	3.12	0.062	1.90	1.25	NA	NA	NA	NA	2.81	NA	NA	NA	NA
18	55	3740	12	NA	NA	NA	NA	NA	3.12	0.057	1.73	1.13	NA	NA	NA	NA	2.55	NA	NA	NA	NA

ION EXCHANGE UNIT 1
SODIUM CHLORIDE BRINE REGENERATION
JUNE, JULY and AUGUST - 1985 (Continued)

REGENERATION DATA

	INFLUENT BRINE											EFFLUENT BRINE									
												at 20 minutes					at 45 minutes				
Date	Dur.	Vol.	Conc.	Elect. Cond.	Ca	TH	Na	Total Sodium Thruput		Average Flow Rate		Thu-put	Elect. Cond.	Ca.	TH	Na	Thruput	Elect. Cond.	Ca	Total Hardnes	Na
	(min)	(gal.)	(%)	(uS/cm)	(meq/l			(eq/l of resin)	(bv)	(bv/min)	(gpm/ft2)	(bv)	(uS/cm)	(meq/l)			(bv)	(uS/cm)	(meq/l)		
July 19	50	NA	12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
21	64	3740	12	136600	4.8	9.0	2087.9	6.51	3.12	0.049	1.49	0.97	111900	392.0	76.8	185.1	2.19	130300	162.0	27.0	1663.8
22	NA	3740	mixed	179500	4.4	8.0	3545.0	11.05	3.12	NA	NA	NA	61400	236.0	504.0	321.9	NA	168700	370.0	660.0	2577.2
23	57	3740	12	NA	NA	NA	NA	NA	3.12	0.055	1.67	1.09	NA	NA	NA	NA	2.46	NA	NA	NA	NA
27	74	3740	12	131000	4.2	7.6	2218.4	6.92	3.12	0.042	1.29	0.84	68500	306.0	634.0	456.7	1.90	126800	216.0	310.0	1826.9
29	58	3740	12	127600	6	7.6	2087.9	6.51	3.12	0.054	1.64	1.07	33300	80.0	180.0	239.2	2.42	123700	196.0	298.0	1631.1
30	62	3850	12	123300	5	7.8	1957.4	6.28	3.22	0.052	1.58	1.03	65900	312.0	722.0	391.5	2.33	121500	188.0	358.0	1696.4
31	57	3740	13	160200	7	8.6	2218.4	6.92	3.12	0.055	1.67	1.09	22000	64.0	430.0	1761.6	2.46	149000	208.0	430.0	1761.6
Aug. 2	57	3740	12	NA	NA	NA	NA	NA	3.12	0.055	1.67	1.09	NA	NA	NA	NA	2.46	NA	NA	NA	NA
4	72	4400	11	NA	NA	NA	NA	NA	3.67	0.051	1.56	1.02	NA	NA	NA	NA	2.29	NA	NA	NA	NA
5	12	3410	12	168100	1.4	7.6	3218.8	9.15	2.85	0.237	7.24	4.74	NA	NA	NA	NA	10.66	NA	NA	NA	NA
6	62	3740	12	153000	13.4	17.6	2218.4	6.92	3.12	0.050	1.54	1.01	132100	471.2	840.0	1239.7	2.26	152600	52.8	85.1	2218.4

ION EXCHANGE UNIT 1 SERVICE DATA
SODIUM CHLORIDE BRINE REGENERATION
JUNE, JULY and AUGUST - 1985

	INFLUENT PROCESS WATER						EFLUENT PROCESS WATER					
							Aveage Leakage		Softened Water		Resin Capacity	
Date	Ca	Total Hardness	Sodium	Elect. Cond.	Turbidity	pH	Ca	Total	Produced		Ca	Total
	(meq/l)			(uS/cm)	N.T.U.		(meq/l)		(gallons)	(bed vol.)	(eq/l of resin)	
June 2	NA	50.4	NA	10800	NA	NA	NA	NA	NA	NA	NA	NA
3	NA	50.4	NA	10900	NA	NA	NA	NA	NA	NA	NA	NA
5	21.2	52.0	104.3	10700	.1	7.3	0.6	NA	20580	17.19	0.35	NA
7	21.2	51.6	95.7	11400	.4	7.3	0.6	NA	20510	17.13	0.35	NA
9	NA	51.6	NA	11400	NA	NA	0.6	NA	4500	3.76	NA	NA
9	NA	51.6	NA	11400	NA	NA	NA	NA	19300	16.12	NA	NA
11	NA	53.2	NA	11000	NA	NA	0.5	NA	11070	9.25	NA	NA
12	NA	52.8	NA	11100	NA	NA	0.5	NA	NA	NA	NA	NA
13	NA	52.4	NA	11000	NA	NA	0.6	NA	18750	15.66	NA	NA
15	NA	52.8	NA	11100	NA	NA	NA	NA	14040	11.73	NA	NA
16	NA	53.2	NA	11700	NA	NA	0.6	NA	12910	10.78	NA	NA
17	NA	52.8	NA	11300	NA	NA	0.5	NA	17930	14.97	NA	NA
19	22.0	54.8	104.3	11800	.1	7.5	0.5	NA	21950	18.33	0.39	NA
21	26.0	52.4	97.8	11300	.1	7.5	0.6	NA	17800	14.87	0.38	NA
22	NA	52.4	NA	11000	NA	NA	0.6	NA	18010	15.04	NA	NA
24	27.4	51.2	104.3	11300	.1	7.3	0.5	NA	7500	6.26	0.17	NA
25	29.0	52.0	100.0	11100	.2	7.3	0.6	NA	18640	15.57	0.44	NA
29	24.0	50.8	117.4	11100	.1	7.3	0.3	NA	24100	20.13	0.48	NA
29	NA	52.0	NA	10600	NA	NA	0.6	NA	18480	15.43	NA	NA
July 2	NA	43.2	NA	10700	NA	NA	0.4	NA	20820	17.39	NA	NA
4	24.0	50.0	91.3	11800	<.1	7.6	0.6	NA	20700	17.29	0.40	NA
5	22.0	48.0	87.0	12400	<.1	7.5	0.6	NA	19080	15.93	0.34	NA
6	NA	50.8	NA	10700	NA	NA	0.5	NA	17740	14.82	NA	NA
8	27.2	48.6	91.3	11500	NA	NA	0.6	NA	17740	14.82	0.39	NA
9	27.6	51.2	85.4	11100	NA	NA	0.6	NA	19440	16.24	0.44	NA
11	NA	52.4	NA	12500	NA	NA	0.5	NA	17160	14.33	NA	NA
12	27.2	51.2	102.2	11400	NA	NA	0.6	NA	17291	14.44	0.38	NA
14	NA	49.2	NA	11600	NA	NA	0.6	NA	16110	13.45	NA	NA
15	28.0	50.8	97.6	11500	NA	NA	0.6	NA	12614	10.53	0.29	NA
16	NA	55.4	NA	11600	NA	NA	NA	0.7	25350	21.17	NA	1.16
18	NA	50.6	NA	11800	NA	NA	NA	1.3	22140	18.49	NA	0.91
19	NA	50.0	NA	11500	NA	NA	0.7	1.3	19610	16.38	NA	0.80
21	26.0	50.4	140.0	10800	<.1	7.3	0.4	0.7	20922	17.47	0.45	0.87
22	28.0	49.6	88.3	10800	<.1	7.6	NA	NA	NA	NA	NA	NA
23	NA	56.8	NA	10700	NA	NA	NA	NA	NA	NA	NA	NA
27	26.0	53.2	93.5	10300	<.1	7.6	0.6	0.8	19070	15.93	0.41	0.83
29	26.0	50.0	100.0	11400	<.1	7.8	0.6	1.0	17770	14.84	0.38	0.73
30	27.2	50.4	84.8	10900	<.1	7.2	NA	NA	NA	NA	NA	NA
31	26.8	52.4	87.0	10500	<.1	7.2	0.5	0.9	21010	17.55	0.46	0.90
Aug. 2	NA	50.0	NA	10800	NA	NA	0.5	0.9	17690	14.77	NA	0.73
4	NA	56.0	NA	10900	NA	NA	0.6	0.9	20520	17.14	NA	0.94
5	NA	NA	NA	10700	NA	NA	0.7	0.9	20470	17.10	NA	NA
6	29.2	51.2	89.1	10700	<.1	7.2	0.7	1.1	27030	22.57	0.64	1.13

ION EXCHANGE UNIT 2
SODIUM CHLORIDE BRINE REGENERATION
MAY, JUNE and JULY - 1985

REGENERATION and SERVICE DATA

REGENERATION DATA:

			INFLUENT BRINE					Total Sodium Thruput		Average Flow Rate	
Date	Dur.	Volume	Conc.	Elect. Cond.	Ca	Total Hardness	Sodium	(eq/l of resin)	(bv)	(bv/min)	(gpm/ft2)
	(min)	(gal)	(%)	(uS/cm)	(meq/l)						
May 31	50	3520	12	147300	9	17.2	2479.3	7.276	2.940	0.059	1.79
June 5	53	3630	12	149900	6	12.0	2622.9	7.938	3.032	0.057	1.74
7	NA	NA	NA	190200	22	30.4	3627.7	NA	NA	NA	NA
10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11	59	3740	14	164200	3	8.8	1722.5	5.371	3.123	0.053	1.61
15	50	3025	13	NA	NA	NA	NA	NA	NA	NA	NA
15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
July 25	50	3355	NA	152900	6	9.2	2348.8	6.570	2.802	0.056	1.71

	EFFLUENT BRINE									
	at 20 minutes									
Date	Thruput	Elect. Cond.	Calcium	Total Hardness	Sodium	Thruput	Elect. Cond.	Calcium	Total Hardness	Sodium
	(bv)	(uS/cm)	(meq/l)			(bv)	(uS/cm)	(meq/l)		
May 31	1.17	58100	148.0	380.0	395.8	2.64	132500	130.0	268.0	1872.6
June 5	1.14	144300	354.0	368.0	2662.0	2.57	147900	116.0	168.0	3027.4
7	NA	150200	100.0	156.0	2335.8	NA	166300	100.0	160.0	2866.5
10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11	1.06	140600	380.0	670.0	935.2	2.38	151500	192.0	340.0	1496.3
15	1.01	NA	NA	NA	NA	2.27	NA	NA	NA	NA
15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
July 25	1.12	139900	106.0	224.0	1826.9	2.52	147300	70.0	122.0	2022.6

SERVICE DATA:

	INFLUENT PROCESS WATER						EFFLUENT PROCESS WATER					
							Average Leakage		Softered Water Produced		Resin Capacity	
Date	Ca	Total Hardnes	Sodium	Elect. Cond.	Turbidit	pH	Calcium	Total			Ca	Total
	(meq/l)			(uS/cm)	N.T.U.		(meq/l)		(gal)	(bv)	(eq/l of resin)	
May 31	21.2	45.2	101.5	11100	.7	NA	NA	NA	NA	NA	NA	NA
June 5	21.0	51.2	108.7	11700	.1	7.5	NA	NA	NA	NA	NA	NA
7	21.4	52.0	100.0	11400	.1	7.5	NA	NA	NA	NA	NA	NA
10	NA	53.6	NA	10900	NA	NA	NA	NA	NA	NA	NA	NA
10	NA	53.6	NA	10900	NA	NA	NA	NA	NA	NA	NA	NA
11	NA	53.2	NA	11000	NA	NA	NA	NA	NA	NA	NA	NA
15	NA	52.8	NA	11100	NA	NA	NA	NA	NA	NA	NA	NA
15	NA	52.8	NA	11100	NA	NA	NA	NA	NA	NA	NA	NA
July 25	28.0	50.8	91.3	10400	.1	7.5	NA	NA	NA	NA	NA	NA

OPERATION PLAN FOR ION-EXCHANGE SYSTEM UNIT 1 AT LOS BANOS DEMONSTRATION DESALTING FACILITY

This is the operation plan for ion-exchange system unit 1 for the time period through June 16. The primary purpose of the plan is to schedule operations in order to deliver "softened" water to the Hydranautics reverse-osmosis unit.

IX unit 1 is to be operated according to the instructions as shown on the operation schedule. Instructions concerning regeneration and sampling and other instructions relevant to operation of the system are listed below.

Calcium Leakage

The level of calcium in the IX process water effluent that is to be desalted is to be no greater than 50 milligrams per liter as $CaCO_3$. Specific instructions to verify calcium leakage throughout the cycle are as follows:

1. Rinse C to service. Verify calcium leakage (sample tap SX1E) during event in 5-minute intervals. End point of rinse C is when leakage is less than 50 mg/L. Record leakages and times on data sheet.

2. End of service. Verify calcium leakages (sample tap SX1E) on hourly basis starting 10 hours before scheduled regeneration. Regenerate early if calcium leakage is greater than 50 mg/L. Record leakages and times on data sheet.

Regeneration

Regeneration calls for using 3,750 gallons of 12-percent brine (3,750 gallons equals 2 feet 10 inches of tank depth for tanks 6 and 7). If, at the end of 50 minutes, less than 2 feet 10 inches of brine was used, extend regeneration duration to encompass the entire 2 feet 10 inches. If less than 12-percent brine is used for regeneration, extend regeneration duration an additional 3.5 inches for every percent reduction of brine concentration from 12 percent (for 10- and 11-percent brines, regeneration volume is to be 3 feet 5 inches and 3 feet 1.5 inches, respectively). Record all pertinent information on data sheet.

The schedule for regeneration is dependent upon flowrate at which the Hydranautics RO unit is operating. The volume of process water "softened" by the IX system is expected to be 27,600 gallons. Regeneration is to be scheduled accordingly. Verification of calcium leakage is to be performed as previously discussed.

IX unit 2 is to be in service or a supply of "softened" process water is to be stored in CW4 in order to keep the Hydranautics RO unit in operation while IX unit 1 is being regenerated. The process water stored in CW4 may require dechlorination before desalting with the RO unit. Dechlorination is required when the free chlorine residual is 1.0 mg/L or higher.

Sampling

Laboratory Analysis

One-pint samples are to be taken at various times in the cycle. The sample bottles are to be marked and taken to the laboratory for analysis. A laboratory analysis sheet shall accompany the samples.

The schedule for sample times, analyses performed, and other pertinent information are listed below.

Sample 1. IX influent (SW1E) -- calcium, total hardness, electrical conductivity, sodium, turbidity, and pH.

Sample 2. Fresh brine after mixing (STE6) -- sodium, electrical conductivity, calcium, and total hardness.

Sample 3. Used brine 20 minutes into regeneration (SX1B) -- sodium, electrical conductivity, calcium, and total hardness.

Sample 4. Used brine 45 minutes into regeneration (SX1B) -- sodium, electrical conductivity, calcium, and total hardness.

Sample 5. Service 0 (SX1E) -- calcium, total hardness, electrical conductivity, sodium, turbidity, and pH.

Other Analyses

Calcium. Samples are to be collected during the rinse and service events and immediately analyzed for calcium. This section was previously discussed under the heading calcium leakage.

Salinity. A sample is to be taken from STE6 after mixing but before regeneration and is to be analyzed for salt content using the hygrometer. The volume of brine to be used for regeneration depends upon the salinity and is to be adjusted if necessary. This procedure is as previously discussed in the regeneration section.

ION-EXCHANGE OPERATIONS SCHEDULE -- UNIT 1
MANUAL OPERATION
SODIUM CHLORIDE BRINE REGENERATION

Service flow by gravity.
Regeneration flow at 75 gpm with 12% brine.

Used brine to IX sump.
Rinses A and B to IX sump.
Rinse C to RWPS.
Service to RO.

Number	Event Description	Duration (minutes)	Unit 1	Process Flow			Comment or Explanation
				Unit	From	To	
1	Recirculation of sodium chloride brine	20	IP 3 IV 16, 39m, 40m	1	T6	T6	Recirculation to be performed during service just before regeneration.
2	Drain	3	IV 6,10,22	1	Unit 1	RWPS	Verify event duration (see note below).
3	Sodium chloride regeneration	50	IP 3 IV 16,14,7,9,21	1	T6	IX sump	See regeneration instructions.
4	Drain	3	IV 6,10,21	1	Unit 1	IX sump	Verify event duration (see note below).
5	Rinse A	5	IP 7 IV 1,7,10,21	1	CW1	IX sump	
6	Rinse B	10	IP 7 IV 2,7,10,21	1	CW1	IX sump	
7	Rinse C	*	IP 7 IV 2,7,10,22	1	CW1	RWPS	Verify calcium leakage during event from sample tap SX1E.
8	Service	**	Gravity IV 1,7,11	1	CW1	RO	Verify calcium leakage throughout event from unit 1 (SX1E).
9	Set up for regeneration		IP 4 IV 118	1	T5	T6	To be performed during service event.

*Duration to be determined in field. Event ends when calcium leakage is less than 50 mg/L as $CaCO_3$.

**Total service volume is expected to be about 27,600 gallons.

Note: Level of fluid in columns to be 3/4 full at end of event.

Abbreviations:
m = manual value
CW = clearwell
IP = ion-exchange pump
IV = ion-exchange valve
IX = ion exchange
RO = reverse osmosis (Hydranautics)
T = brine tank
RWPS = return water pump station

OPERATION PLAN FOR ION-EXCHANGE SYSTEM UNIT 2 AT LOS BANOS DEMONSTRATION DESALTING FACILITY

This is the operation plan for ion-exchange system unit 2 for the time period through June 16. The objectives of the plan are to determine the durations required for rinsing (rinse C) and for service.

IX unit 2 is to be operated according to the instructions as shown on the operation schedule. Instructions concerning regeneration and sampling and other instructions relevant to operation of the system are listed below.

Duration of Rinse C

In order to determine the duration of rinse C, samples are to be taken during the event in 5-minute intervals from sample tap SX2E and immediately analyzed for calcium hardness. End point of rinse C occurs when calcium hardness is less than 50 milligrams per liter as $CaCO_3$. Record calcium levels and times on data sheet.

Duration of Service

The duration of the service event is expected to be 250 minutes at a flowrate of 110 gallons per minute. Samples are to be taken from SX2E and analyzed for calcium hardness at 15-minute intervals starting at 160 minutes into the event. End of service occurs at duration 250 minutes or when calcium hardness is greater than 100 mg/L as $CaCO_3$. Record all calcium levels and times on data sheet.

Schedule of Operations

The schedule of operations for IX unit 2 is as follows:

Tuesday, June 11
Thursday, June 13
Saturday, June 15

If possible, regeneration of unit 1 should coincide when unit 2 is in service in order supply "soft" water to the Hydranautics reverse-osmosis unit. During this time unit 2 is to be softening process water by gravity. If circumstances do not permit this, an adequate supply of water softened by unit 2 is to be available in CW4 in order to feed the RO unit. All water stored in CW4 is to be chlorinated.

Regeneration

Regeneration calls for using 3,750 gallons of 12-percent brine (3,750 gallons equals 2 feet 10 inches of tank depth for tanks 6 and 7). If, at the end of 50 minutes, less than 2 feet 10 inches of brine was used, extend regeneration duration to encompass the entire 2 feet 10 inches. If less than 12-percent brine is used for regeneration, extend regeneration duration

an additional 3.5 inches for every percent reduction of brine concentration from 12 percent (for 10- and 11-percent brines, regeneration volume is to be 3 feet 5 inches and 3 feet 1.5 inches, respectively). Record all pertinent information on data sheet.

Sampling

Laboratory Analysis

One-pint samples are to be taken at various times in the cycle. The sample bottles are to be marked and taken to the laboratory for analysis. A laboratory analysis sheet shall accompany the samples.

The schedule for sample times, analyses performed, and other pertinent information are listed below.

Sample 1. IX influent (SW2E) -- calcium, total hardness, electrical conductivity, sodium, turbidity, and pH.

Sample 2. Fresh brine after mixing (STE7) -- sodium, electrical conductivity, calcium, and total hardness.

Sample 3. Used brine 20 minutes into regeneration (SX2B) -- sodium, electrical conductivity, calcium, and total hardness.

Sample 4. Used brine 45 minutes into regeneration (SX2B) -- sodium, electrical conductivity, calcium, and total hardness.

Sample 5. Service 0 (SX2E) -- calcium, total hardness, electrical conductivity, sodium, turbidity, and pH.

Other Analyses

Calcium. Samples are to be collected during the rinse and service events and immediately analyzed for calcium. This section was previously discussed.

Salinity. A sample is to be taken from STE7 after mixing but before regeneration and is to be analyzed for salt content using the hygrometer. The volume of brine to be used for regeneration depends upon the salinity and is to be adjusted if necessary. This procedure is as previously discussed in the regeneration section.

ION-EXCHANGE OPERATIONS SCHEDULE -- UNIT 2
MANUAL OPERATION
SODIUM CHLORIDE BRINE REGENERATION

Service flow at 110 gpm.
Regeneration flow at 75 gpm with 12% brine.

Used brine to IX sump.
Rinses A and B to IX sump.
Rinse C to RWPS.
Service to RWPS.

Number	Event Description	Duration (minutes)	Unit 2	Process Flow Unit	Process Flow From	Process Flow To	Comment or Explanation
1	Recirculation of sodium chloride brine	20	IP 2 IV 116, 139m, 140m	2	T7	T7	Recirculation to be performed during service just before regeneration.
2	Drain	3	IV 106,110,121	2	Unit 2	IX sump	Verify event duration (see note below).
3	Sodium chloride regeneration	50	IP 2 IV 116,114,107,109,121	2	T7	IX sump	
4	Drain	3	IV 106,110,121	2	Unit 2	IX sump	Verify event duration (see note below).
5	Rinse A	5	IP 8 IV 101,110,107,121	2	CW1	IX sump	
6	Rinse B	10	IP 8 IV 2,7,10,21	2	CW1	RWPS	
7	Rinse C	*	IP 8 IV 2,7,10,22	2	CW1	RWPS	Verify calcium leakage at end of event from unit 2 (SX1E).
8	Service	**	IP 8 IV 101,107,111 SOV 6	2	CW1	RWPS	Verify calcium leakage throughout event from unit 2 (SX1E).
9	Set up for regeneration		IP 4 IV 117	2	T5	T7	To be performed during service event.
10	Storage	15	IP 2 IV 116,114,107,109,122	2	T7	RWPS	

*Duration to be determined in field. Event ends when calcium leakage is less than 50 mg/L as $CaCO_3$.

**Total service volume is expected to be about 27,600 gallons. Event ends when calcium leakage is greater than 100 mg/L as $CaCO_3$ or 250 minutes.

Note: Level of fluid in columns to be 3/4 full at end of event.

Abbreviations:
m = manual value
CW = clearwell
IP = ion-exchange pump
IV = ion-exchange valve
IX = ion exchange
T = brine tank
RWPS = return water pump station

MAIN UNIT CHEM-ANALYSIS DATA SHEET
ION-EXCHANGE SYSTEM

Water Type Clarifier

MANUAL OPERATION

IX Unit _____

Date ___/___/___

LAB NUMBER	EVENT TIME	TURB-IDITY	E.C. us/cm	pH	TOTAL HARDNESS (ppm as $CaCO_3$)	SODIUM (ppm)	CALCIUM (ppm as $CaCO_3$)	CHLORIDE (ppm)	SULPHATE (ppm)	CHLORINE FREE (ppm)
	Sample 1 IX infl.							X	X	X
	Sample 2 fr. brine	X		X				X	X	X
	Sample 3 u. brine20	X		X				X	X	X
	Sample 4 u. brine45	X		X				X	X	X
	Sample 5 service 0							X	X	X

SODIUM CHLORIDE REGENERATION DATA SHEET
ION-EXCHANGE SYSTEM
CLARIFIER WATER

Unit 1 Date_____

Event Description	Begin Time	End Time	Other
Mixing			_____-percent brine after mixing.
Drain			Level in IX columns _____ full.
Regeneration			Flow reading: _____ Level in T6: _____ begin, _____ end
Drain			Level in IX columns _____ full.
Rinse A			Flow reading: _____
Rinse B			Flow reading: _____
Rinse C			Flow reading: _____ Calcium at: _____ 0 minutes, _____ 5 minutes _____ 10 minutes, _____ 15 minutes _____ 20 minutes
Service			Calcium at hours before scheduled regeneration: _____10 hours, _____ 9 hours, _____ 8 hours, _____ 7 hours, _____ 6 hours, _____ 5 hours, _____ 4 hours, _____ 3 hours, _____ 2 hour _____ 1 hour _____ 5 minutes before regeneration

Remarks:

SODIUM CHLORIDE REGENERATION DATA SHEET
ION-EXCHANGE SYSTEM
CLARIFIER WATER

Unit 2 Date_____

Event Description	Begin Time	End Time	Other
Mixing			_____-percent brine after mixing.
Drain			Level in IX columns _____ full.
Regeneration			Flow reading: _____ Level in T6: _____ begin, _____ end
Drain			Level in IX columns _____ full.
Rinse A			Flow reading: _____
Rinse B			Flow reading: _____
Rinse C			Flow reading: _____ Calcium at: _____ 0 minutes, _____ 5 minutes _____ 10 minutes, _____ 15 minutes _____ 20 minutes
Service			Flow reading: _____ Calcium at hours before scheduled regeneration: _____ 160 minutes, _____ 175 minutes _____ 190 minutes, _____ 205 minutes _____ 220 minutes, _____ 235 minutes _____ 250 minutes

Remarks:

APPENDIX E

MAIN UNIT PERIOD 2 OPERATIONS

Ion-Exchange System
January and February 1986

Operation Log
Operation Parameters and Results

OPERATION LOG - 1986

Date	Unit	Time	Action/Comments
Jan. 1	1,2	MN Cond.	off
2	1,2	MN Cond.	off
		13:00	RO2 I/S
		15:19	RO3 I/S
		15:35	Transfer brine from T3 to T4
	1	16:05	I/S @ event1 by computer. IX2 will follow
		20:10	Problems experienced with IX computer
3	1	10:15	flushed with process water
		11:31	RO2 & 3 I/S
	2	12:30	I/S to CW5 by computer operation
		16:00	crossover brine pipe to IV27 broke
		16:20	IV23 stuck (ball Valve). Switched with IV24
	1,2	17:00	I/S - auto mode
		17:40	IP6 started manually when failed to operate IX1 event 10
	1,2	18:53	S/D to reprogram IV117 to IV17 event11
	1,2	19:12	I/S
4	1,2	MN Cond.	I/S to CW5, RO2, CW6, RO3, T1
		4:30	reprogrammed computer
	1,2	16:35	S/D, IP6 discharge line to T4 broke
		16:45	RO2 & 3 S/D
5	1,2	MN Cond.	off
6		9:45	IP9's coupling replaced
		11:50	Transferred brine from T2 & 3 to T4
		11:21	RO2 & 3 I/S
	1,2	14:06	I/S auto mode, IX2 @ event8
		17:05	EDR reject to T1
	2	17:45	S/D, IV123 (ball) would not open causing relief valve to open
		21:15	Installed modified operations program from new tape - AUTO START IX OP.S
		22:30	RO2, 3 and EDR S/D per instructions
7	1,2	NM Cond	off
		10:20	repair completed on IX1 relief valve piping
8	1,2	MN Cond.	off
		15:00	repair completed on line from T2/3 to T4
9	1,2	MN Cond	off. Worked on valves IV4, 17 and 22
10	1,2	MN Cond	off
	1,2	10:21	I/S auto mode - Regeneration
		11:45	RO2 & 3 I/S
		12:15	EDR I/S
		12:55	EDR S/D - abnormalities in operation
		13:23	EDR I/S
	1	14:30	TH @ 110 and Ca @ 44 as CaCO3
11	1,2	MN Cond	I/S to CW5, RO2 ... EDR, T1
	2	7:22	S/D in event8 - CW5 overflow
		9:27	Restarted computer after turning off to corredt some error
		10:54	IP1 S/D, IV17 remained closed during event 11 of IX1
	1	12:45	S/D to fill T6 with brine

Date	Unit	Time	Action/Comments
Jan. 11	2	21:30	S/D, CW5 @ 20 ft, IX2 regenerated
	2	22:00	I/S, CW5 @ 16 ft. 5 in.
12	1,2	MN Cond	I/S to CW5, RO2 ... EDR, T1
	1,2	4:23	S/D, CW5 @ 23 ft.
	1	7:04	I/S @ regeneration, CW5 @ 13 ft.
	1	11:36	S/D to refill T6 from T1 and T4 from T2/3
	1	12:37	I/S @ event1
		14:00	Changed event10's duration to 40 min. from 24. T4 almost empty after 2 regenerations
	1	14:31	S/D and ready for event8 - service
	2	14:46	S/D
	1,2	17:00	I/S, IX1 @ event8 - CW5 @ 10ft; IX2 @ event1
		18:45	Trouble calls on IP6 (tripped twice), IV17 sticking intermittently and tank level gauges sticking
	1	20:10	S/D, did not go through to event12, drain
	1	22:05	I/S @ event1
13	1,2	MN Cond	I/S to CW5, RO2 ... EDR, T1
		3:00	Brine transfer from T2/3 to T4 by hand
	1	7:00	S/D, ready for event8 - service
		7:30	RO2 & 3 S/D to repair leaky pipes from clearwells
		8:04	EDR S/D
		10:10	Brine transfer from T2 to T4 by hand
14	1,2	MN Cond	off
	1,2	8:30	Dry run of IX system
	1,2	11:10	S/D dry run, transferred brine from s.solar pond to T2 & 3
15	1,2	MN Cond	off
		12:20	RO2 & 3 I/S
		14:40	RO3 S/D, HP relief valve released - 880 psi
		15:00	RO2 S/D, low suction head
	1	16:03	I/S regeneration - auto
	1	20:25	S/D, CW5 @ 23 ft.
16	1,2	MN Cond	off
17	1,2	MN Cond	off
		10:35	IV1 valve maintenance
18	1,2	MN Cond	off
		14:40	IP6 cycling in auto mode, OK in hand mode
19	1,2	MN Cond	off
20	1,2	MN Cond	off
21	1,2	MN Cond	off
		15:50	new RO3 relief valve released and would not reset
22	1,2	MN Cond	off
23	1,2	MN Cond	off
		14:30	IV17 & 18 repair
24	1,2	MN Cond	off
25	1,2	MN Cond	off
26	1,2	MN Cond	off

OPERATION LOG - 1986

Date	Unit	Time	Action/Comments
Jan. 27		10:08	IV18 limit switch adjustment
28	1,2	MN Cond	off, work on RO3 pinch valve regulator
29	1,2	MN Cond	off
		7:45	IV10 & 13 maintenance
		12:10	T2/3 pump cutoff switch maintenance
30	1,2	MN Cond	off
		7:30	RO3 I/S
		10:37	RO2 I/S
	1,2	11:18	I/S - auto; acid pump whenever IX unit is not in service
		19:05	Refilled T4 from T2 - manual
		20:45	Refilled T7 from T1 - manual
31	1,2	MN Cond.	I/S to CW5, RO2 ... EDR, T1
Feb. 1	1,2	MN Cond.	I/S to CW5, RO2 ... EDR, T1
	2	8:33	S/D, acid pump off, CW5 @ 17 ft. 11 in.
2	1	9:56	I/S, acid pump on, CW5 @ 12 ft. 8 in.
	1	13:06	S/D, acid pump off, CW5 @ 16 ft.
	2	14:02	I/S, acid pump on, CW5 @ 12 ft. 4 in.
		15:15	Refilled T6 from T1 manually
2	1,2	MN Cond.	I/S to CW5, RO2 ... EDR, T1
3		18:58	EDR S/D, fire
4		19:19	RO3 S/D
		19:57	RO2 S/D
	1,2	21:18	S/D
3	1,2	MN Cond.	S/D
4		MN Cond.	S/D
5		18:55	RO2, 3 and EDR I/S
	1,2	19:35	I/S IX2 @ event 1. Computer failed to operate IP5 on both units
		20:15	IX2 @ event8, CW5 @ 12ft. 8 in.
5	1,2	MN Cond.	I/S to CW5, RO2 ... EDR, T1
		7:00	EDR tripped and placed back into service
		16:25	EDR tripped. Would not switch to anode mode
		17:00	RO2 & 3 S/D
6	1,2	17:52	S/D
		18:28	EDR I/S
		19:30	RO2 & 3 I/S
	1,2	21:30	I/S, IX1 @ event8, IX2 @ event1, CW5 @ 5ft. 11 in.
6	1,2	MN Cond.	I/S to CW5, RO2 ... EDR, T1
7		7:36	manually refilled T6 from T1
	1	14:50	S/D, IV12 & 14 maintenance
		14:55	EDR S/D to install new volt/amp motor
	1	15:10	I/S @ event1
7	1,2	MN Cond.	I/S to CW5, RO2 ... EDR, T1
		5:30	IX computer lost power when breaker 7 tripped. Breaker reset and IX system I/S
	2	6:54	S/D during event8 and placed in regen., CW5 @ 23 ft.(full)
	1,2	11:20	Placed in manual mode to reprogram computer

OPERATION LOG - 1986

Date	Unit	Time	Action/Comments
Feb. 7		12:05	Refilled T6 & 7 from T1 and T4 from T2 & 3
			Maintenance on IP1 suction line - repair leak
		15:40	RO2 S/D, CW5 low due to trouble shooting of IX oper's program
		18:35	RO3 S/D, low level in CW6
	1,2	22:06	I/S - auto
		23:30	RO2 I/S
8	1,2	MN Cond.	I/S to CW5, RO2 to CW6
		1:17	RO3 I/S
		2:00	EDR I/S to T1
		6:00	EDR S/D, valves 4 and 5 not operating
		10:49	EDR test run
9	1,2	MN Cond.	I/S to CW5, RO2 ... EDR, T1
10	1.2	MN Cond.	I/S to CW5, RO2 ... EDR, T1
		8:15	maintenance on IV2 - repair leakage
11	1,2	MN Cond.	I/S to CW5, RO2 ... EDR, T1
14		12:30	resin discovered on bottom of RWPS
		15:05	resin discovered in cartridge filters
12	1,2	MN Cond.	I/S to CW5, RO2 ... EDR, T1
13	1,2	MN Cond.	I/S to CW5, RO2 ... EDR, T1
14	1,2	MN Cond.	I/S to CW5, RO2 ... EDR, T1
		10:35	adjustment of T2's level switch
15	1,2	MN Cond.	I/S to CW5, RO2 ... EDR, T1
		5:15	IP6 failed to operate in both auto and hand mode. T4 @ 2ft. 6in.
16		6:35	Refilled T4 by hand mode
		9:45	maintenance on IV17
17		9:57	S/D computer, both units in event8 at same time.
		11:08	I/S computer
16	1,2	MN Cond.	I/S to CW5, RO2 ... EDR, T1
	1,2	23:17	S/D with EDR, resin accumulation in cartridge filter
17	1,2	MN Cond.	S/D, RO2 to CW6 to RO3 to CW8
		1:09	RO3 S/D
		2:08	RO2 S/D by tripping low pressure switch
		8:30	Resin found to be coming out of IX1b and IX2a lower manifolds

IX system was S/D for the rest of the month for repair
of manifolds and other modifications

Sodium Throughput during regeneration for operating conditions
Month: January and February, 1986

REGENERATION

Date	Flow		Duration		Sodium		Sodium Throughput		
	Recycle Brine	Fresh Brine	Recycle Brine	Fr. Brine	Recycle Brine	Fresh Brine	Recycle Brine	Fresh Brine	Total
	(gpm)		(minutes)		(meq/l)		(eq/l of resin)		
Jan. 1	IX System OFF				NA	NA	NA	NA	NA
2	IX System OFF				NA	NA	NA	NA	NA
3	200	150	41	9	NA	NA	NA	NA	NA
4	200	150	41	9	NA	NA	NA	NA	NA
5	IX System OFF				NA	NA	NA	NA	NA
6	200	150	41	9	NA	NA	NA	NA	NA
7, 8, 9	IX System OFF				NA	NA	NA	NA	NA
10	200	150	41	9	NA	NA	NA	NA	NA
11	200	150	41	9	NA	NA	NA	NA	NA
12	200	150	41	9	NA	NA	NA	NA	NA
13, 14	IX System OFF				NA	NA	NA	NA	NA
15	200	150	41	9	NA	NA	NA	NA	NA
16	IX System OFF				NA	NA	NA	NA	NA
17	IX System OFF				NA	NA	NA	NA	NA
18	IX System OFF				NA	NA	NA	NA	NA
19	IX System OFF				NA	NA	NA	NA	NA
20	IX System OFF				NA	NA	NA	NA	NA
21	IX System OFF				NA	NA	NA	NA	NA
22	IX System OFF				NA	NA	NA	NA	NA
23	IX System OFF				NA	NA	NA	NA	NA
24	IX System OFF				NA	NA	NA	NA	NA
25	IX System OFF				NA	NA	NA	NA	NA
26	IX System OFF				NA	NA	NA	NA	NA
27	IX System OFF				NA	NA	NA	NA	NA
28	IX System OFF				NA	NA	NA	NA	NA
29	IX System OFF				NA	NA	NA	NA	NA
30	IX System OFF				NA	NA	NA	NA	NA
31	200	150	41	9	NA	NA	NA	NA	NA
Feb. 1	200	150	41	9	NA	NA	NA	NA	NA
2	200	150	41	9	NA	NA	NA	NA	NA
3, 4	IX System OFF				NA	NA	NA	NA	NA
5	200	150	52	8	1500.0	NA	11.60	NA	NA
6	200	150	52	8	1760.9	1652.2	13.61	1.47	15.09
7	200	150	52	8	3913.0	1913.0	30.25	1.71	31.96
8	200	150	52	8	1521.7	1934.8	11.76	1.73	13.49
9	200	150	52	8	1673.9	2173.9	12.94	1.94	14.88
10	200	150	53	7	1043.5	1478.3	8.22	1.15	9.38
11	200	150	53	7	NA	NA	NA	NA	NA
12	200	150	53	7	934.8	456.5	7.37	0.36	7.72
13	200	150	53	7	1065.2	1413.0	8.39	1.10	9.50
14	200	150	53	7	826.1	1326.1	6.51	1.03	7.54
15	200	150	53	7	978.3	1869.6	7.71	1.46	9.17

Total hardness removed during Service Event for operation conditions

Month: January and February, 1986 SERVICE
Bed Volume: 5092 liters

			Total Hardness		Calcium	Influent	T.Hardness
	Flow	Duration	Influent	Effluent	Effluent	Na:TH	Removed
Date	(gpm)	(minutes)	(meq/l)			(ratio)	(eq/l of resin)
Jan. 1		IX System OFF					
2		IX System OFF					
3	110	190	55.5	NA	NA	1.2	NA
4	110	190	50.3	NA	NA	1.3	NA
5		IX System OFF					
6	110	190	50.8	7.6	2.2	1.4	0.67
7, 8, 9		IX System OFF					
10	110	190	49.4	3.5	1.3	1.6	0.71
11	110	190	NA	9.2	2.4	NA	NA
12	110	190	47.8	4.8	1.0	1.5	0.67
13, 14		IX System OFF					
15	110	190	46.1	2.8	1.0	1.5	0.67
16		IX System OFF					
17		IX System OFF					
18		IX System OFF					
19		IX System OFF					
20		IX System OFF					
21		IX System OFF					
22		IX System OFF					
23		IX System OFF					
24		IX System OFF					
25		IX System OFF					
26		IX System OFF					
27		IX System OFF					
28		IX System OFF					
29		IX System OFF					
30		IX System OFF					
31	110	190	NA	3.3	1.6	NA	NA
Feb. 1	110	190	50.1	3.2	1.4	NA	0.73
2	110	190	49.8	3.3	1.6	NA	0.72
3, 4		IX System OFF					
5	110	190	49.8	11.6	2.2	1.9	0.59
6	110	190	50.8	10.3	1.6	1.8	0.63
7	110	190	50.3	10.1	2.0	1.9	0.62
8	110	190	51.2	11.1	2.4	2.1	0.62
9	110	190	51.9	12.5	2.6	2.2	0.61
10	110	190	49.4	15.5	2.8	1.9	0.53
11	110	190	NA	NA	NA	NA	NA
12	110	190	47.8	15.0	2.3	1.6	0.51
13	110	190	48.7	12.5	1.8	1.6	0.56
14	110	190	48.4	11.4	1.7	1.6	0.57
15	110	190	46.1	13.2	1.7	1.8	0.51

CLEARWELL 2 - SAMPLE TAP SW2D ION EXCHANGE INFLUENT

Date	Time	TH	Ca	Cl2-F	SiO2	Turb	EC	pH	Cl	Na	SO4
1986		(meq/l)		(mg/l)		(NTU)	(uS/cm)		(meq/l)		
Jan 1	7:30	41.2	23.1	NA	12	0.1	8600	7.4	36.6	58.7	NA
2	7:30	41.8	23.2	0.6	12	0.1	8500	7.2	36.6	62.6	NA
3	7:30	42.8	22.7	0.5	13	0.4	8100	7.5	36.6	65.2	NA
4	7:30	43.1	22.9	NA	9	0.1	8800	7.7	NA	66.5	NA
5	7:30	44.0	23.5	NA	10	0.1	8700	7.5	NA	67.8	NA
6	7:30	43.3	23.6	NA	10	0.1	8500	7.5	NA	69.1	NA
7	7:30	43.3	23.6	0.2	10	0.1	8800	7.5	33.8	69.1	NA
8	7:30	44.4	23.5	0.5	7	0.1	8850	7.5	36.6	64.1	66.7
9	7:30	44.4	23.2	0.5	10	0.1	9100	7.5	NA	NA	NA
10	7:30	43.9	23.8	0.5	8	0.1	9200	7.3	36.6	77.2	70.8
11	7:30	44.9	23.3	NA	10	0.2	9200	7.5	NA	73.9	NA
12	7:30	45.7	23.3	NA	10	0.1	9400	7	NA	71.7	NA
13	7:30	45.9	24.2	0.7	9	0.1	9600	7	36.6	70.7	83.3
14	7:30	46.3	24.0	0.7	9	0.3	9500	7.4	NA	70.7	NA
15	7:30	43.4	24.5	0.3	10	0.1	9400	7.1	39.4	69.6	67.7
16	7:30	46.5	24.3	1.0	10	0.1	9800	7.5	NA	68.5	NA
17	7:30	45.5	23.5	1.0	11	0.1	9600	7.4	39.4	71.7	81.3
18	7:30	45.7	23.6	NA	12	0.1	9700	7.7	NA	66.3	NA
19	7:30	45.8	23.4	NA	11	0.1	9600	7.7	NA	68.5	NA
20	7:30	45.6	23.4	NA	12	0.1	10000	7.5	45.1	72.8	75.0
21	7:30	47.5	23.3	NA	13	0.1	9800	7.6	NA	70.7	NA
22	7:30	46.6	23.4	0.8	13	0.1	10000	7.5	39.4	76.1	78.1
23	7:30	46.2	23.3	0.7	13	0.1	10100	7.7	NA	78.3	NA
24	7:30	47.9	24.3	1.2	12	0.1	10100	7.2	39.4	77.2	78.1
25	7:30	52.7	24.1	NA	13	0.1	10600	7.4	NA	83.7	NA
26	7:30	48.8	23.3	NA	15	0.1	10400	7.4	NA	84.8	NA
27	7:30	49.3	24.1	1.3	8	0.1	10700	7.2	45.1	85.9	93.8
28	7:30	50.8	25.3	0.6	15	0.1	10800	7.5	NA	85.9	NA
29	7:30	49.6	24.1	0.5	12	0.1	10700	7.4	39.4	80.4	72.9
30	7:30	49.2	24.3	0.7	11	0.1	10800	7.5	NA	85.9	NA
31	7:30	46.0	24.2	0.5	9	0.1	10700	7.7	42.3	90.2	70.8
Feb 1	7:30	50.1	25.0	NA	8	0.1	10900	7.3	NA	NA	NA
2	7:30	49.8	24.3	NA	6	0.1	11300	7.6	NA	NA	NA
3	7:30	55.5	25.2	0.8	7	0.1	11200	7.2	45.1	87.0	78.1
4	7:30	50.3	24.4	0.8	7	0.1	11000	7.5	NA	92.4	NA
5	7:30	49.8	24.6	0.7	6	0.1	11800	7	45.1	93.5	81.3
6	7:30	50.8	26.2	1.5	5	0.1	11400	7.5	NA	92.4	NA
7	7:30	50.3	24.1	1.7	5	0.1	11200	7.4	45.1	93.5	83.3
8	7:30	51.2	24.7	NA	6	0.1	11100	7.6	NA	107.6	NA
9	7:30	51.9	25.4	NA	7	0.1	11000	7.6	NA	116.3	NA
10	7:30	49.4	24.8	2.7	7	0.3	11200	7.4	42.3	95.7	72.9
11	7:30	NA	NA	0.6	7	0.8	10700	7.4	NA	NA	NA
12	7:30	47.8	24.6	NA	6	0.1	10900	7.5	NA	77.2	NA
13	7:30	48.7	25.5	1.8	7	0.2	10700	7.5	39.4	76.1	83.3
14	7:30	48.4	24.2	1.9	6	0.1	10200	7.5	NA	76.1	NA
15	7:30	46.1	24.0	NA	12	0.1	9700	7.4	NA	84.8	NA
Num.of Anal.		45	45	28	46	46	46	46	20	42	16
Mean		47.2	24.0	0.9	9.6	0.1	10042	7.4	40.0	78.5	77.4
StandardDev.		3.2	0.8	0.6	2.7	0.1	943	0.2	3.6	12.2	7.0
Lower95%C.L.		46.2	8.8	0.0	8	0	9764	7	38.4	74.7	73.8
Upper95%C.L.		48.1	24.3	1.1	10.4	0.2	10321	7.5	41.6	82.3	80.9

CLEARWELL 5 - SAMPLE TAP SW5D ION EXCHANGE EFFLUENT

Date	Time	TH	Ca	Cl2-F	SiO2	Turb	EC	pH	Cl	Na	SO4
1986		(meq/l)		(mg/l)		(NTU)	(uS/cm)		(meq/l)		
Jan 1	7:30	2.3	3.1	NA	NA	NA	10000	NA	36.6	104.3	78.1
2	7:30	7.6	2.2	NA	NA	NA	8200	NA	31.0	100.0	114.6
3	7:30	3.5	1.2	0.1	9	0.1	10000	5.7	36.6	97.8	72.9
4	7:30	3.3	1.4	0.1	10	0.1	9300	5.7	NA	117.4	NA
5	7:30	3.5	1.3	0.1	10	0.1	9600	5.5	36.6	104.3	85.4
6	7:30	9.2	2.4	NA	11	0.1	9900	6.5	NA	102.2	NA
7	7:30	4.8	1.5	NA	10	0.1	10000	5.4	NA	108.7	NA
8	7:30	2.7	1.2	0.1	9	0.1	10600	5.4	36.6	NA	78.1
9	7:30	2.9	1.1	0.3	11	0.1	10500	5.8	NA	108.7	NA
10	7:30	2.8	1.0	0.1	8	0.1	10300	5.3	36.6	108.7	81.3
11	7:30	3.2	0.9	0.2	9	0.1	11000	6.9	NA	106.5	NA
12	7:30	3.2	0.9	0.1	10	0.1	10600	6.7	39.4	115.2	78.1
13	7:30	3.1	2.1	NA	9	0.1	10700	7.1	NA	104.3	NA
14	7:30	3.1	0.9	NA	9	0.1	10600	7	NA	106.5	NA
15	7:30	3.1	0.9	NA	10	0.1	10700	7	39.4	113.0	72.9
16	7:30	3.3	0.8	NA	10	0.1	10700	6.8	NA	104.3	NA
17	7:30	3.2	0.9	0.1	10	0.1	10600	6.9	39.4	110.9	72.9
18	7:30	3.2	0.9	0.1	9	0.6	10600	7.1	NA	115.2	NA
19	7:30	3.1	0.8	0.1	10	0.1	10600	6.4	39.4	115.2	78.1
20	7:30	3.2	0.8	NA	10	0.1	10700	6.8	NA	119.6	NA
21	7:30	3.1	0.8	NA	9	0.1	10700	6.8	NA	123.9	NA
22	7:30	3.3	0.9	0.1	11	0.1	10700	6.5	39.4	123.9	65.6
23	7:30	3.2	0.8	0.1	9	0.1	10900	7	NA	123.9	NA
24	7:30	3.3	0.9	0.1	9	0.1	10900	6.8	36.6	115.2	67.7
25	7:30	3.2	0.9	0.1	18	0.1	10700	6.9	NA	123.9	NA
26	7:30	6.2	1.6	0.1	10	0.1	11600	5.9	42.3	147.8	70.8
27	7:30	7.8	1.4	0.4	8	0.1	11750	5.5	NA	NA	NA
28	7:30	9.2	1.6	NA	7	0.2	12200	6	NA	NA	NA
29	7:30	10.3	1.8	NA	7	0.1	12000	5.4	45.1	130.4	75.0
30	7:30	10.1	1.8	0.3	7	0.1	11750	6.1	NA	150.0	NA
31	7:30	11.6	2.2	0.1	6	0.1	12500	5.1	39.4	141.3	83.3
Feb 1	7:30	10.3	1.6	0.5	5	0.1	12000	5.7	NA	141.3	NA
2	7:30	10.1	2.0	0.5	5	0.1	11900	5.6	42.3	123.9	85.4
3	7:30	11.1	2.4	0.7	NA	0.1	12100	6.3	NA	158.7	NA
4	7:30	12.5	2.6	NA	NA	0.1	11900	6.5	NA	171.7	NA
5	7:30	15.5	2.8	NA	NA	0.1	11800	5.8	42.3	121.7	88.5
6	7:30	NA	NA	1.3	NA	0.1	11300	5.8	NA	NA	NA
7	7:30	15.0	2.3	0.1	NA	0.1	11500	6.1	NA	108.7	NA
8	7:30	12.5	1.8	NA	NA	0.2	11600	5.7	39.4	113.0	135.4
9	7:30	11.4	1.7	1.0	NA	0.1	10900	6.1	NA	108.7	NA
10	7:30	13.2	1.7	1.0	NA	0.1	10400	5.9	NA	106.5	NA
Num.of Anal.		40	40	25	31	39	41	39	18	37	18
Mean		6.4	1.5	0.3	9.2	0.1	10888	6.2	38.8	118.9	82.5
StandardDev.		4.1	0.7	0.3	2.3	0.1	875	0.6	3.2	17.1	17.0
Lower95%C.L.		5.1	1.3	0.0	8.0	0.0	10614	5.0	37.3	113.1	74.4
Upper95%C.L.		7.8	1.7	0.4	10.0	0.1	11161	6.4	40.3	124.6	90.5

ION EXCHANGE FRESH BRINE
BRINE TANK 1 - SAMPLE TAP ST1D

Date	Time	Na	TH	Ca	EC	Temp.	TDS	SO4	Cl
1986		(meq/l)			(uS/cm)	(C)	(mg/l)	(meq/l)	
Feb. 6	7:30	1652.2	120.8	25.3	100500	NA	NA	1.1	774.4
7	7:30	1913.0	132.2	22.6	72300	NA	NA	1.5	703.9
8	7:30	1934.8	147.6	24.9	75300	NA	NA	NA	NA
9	7:30	2173.9	142.0	25.7	77400	NA	NA	NA	NA
10	7:30	1478.3	183.6	33.4	73000	NA	NA	0.9	732.1
11	7:30	NA	NA	NA	76000	NA	NA	NA	NA
12	7:30	456.5	191.2	30.8	90800	NA	NA	NA	NA
13	7:30	1413.0	219.8	29.9	89400	NA	NA	1.4	591.5
14	7:30	1326.1	204.0	31.4	90500	NA	NA	NA	NA
15	7:30	1869.6	NA	NA	82100	NA	NA	NA	NA
Num.of Anal.		9	8	8	10	NA	NA	4	4
Mean		1579.7	167.7	28.0	82730	NA	NA	1.2	700.5
StandardDev.		505.4	36.6	3.9	9537	NA	NA	0.3	78.2
Lower95%C.L.		1242.7	141.8	25.3	32767	NA	NA	0.9	622.3
Upper95%C.L.		1916.7	193.5	30.7	88761	NA	NA	1.5	778.7

ION EXCHANGE RECYCLED BRINE
BRINE TANK 4 - SAMPLE TAP ST4D

Date	Time	Na	TH	Ca	EC	Temp.	TDS	SO4	Cl
1986		(meq/l)			(uS/cm)	(C)	(mg/l)	(meq/l)	
Feb. 5	7:30	1500.0	349.2	64.4	99800	NA	NA	229.2	1548.7
6	7:30	1760.9	342.6	63.1	98800	NA	NA	229.2	1267.2
7	7:30	3913.0	331.6	55.6	65600	NA	NA	291.7	1123.5
8	7:30	1521.7	344.4	49.5	77400	NA	NA	NA	NA
9	7:30	1673.9	341.8	53.6	77200	NA	NA	NA	NA
10	7:30	1043.5	360.0	52.6	73400	NA	NA	312.5	1174.4
11	7:30	NA	NA	NA	72100	NA	NA	NA	NA
12	7:30	934.8	354.4	41.8	86500	NA	NA	NA	NA
13	7:30	1065.2	384.6	43.2	81800	NA	NA	270.8	1042.3
14	7:30	826.1	372.2	41.8	80600	NA	NA	NA	NA
15	7:30	978.3	NA	NA	80000	NA	NA	NA	NA
Num.of Anal.		10	9	9	11	0	0	5	5
Mean		1521.7	353.4	51.7	81200	NA	NA	266.7	1231.2
StandardDev.		904.3	16.6	8.6	10505	NA	NA	37.3	195.4
Lower95%C.L.		949.8	342.4	46.0	32767	NA	NA	233.3	923.0
Upper95%C.L.		2093.7	364.5	57.5	87534	NA	NA	300.0	1405.9

APPENDIX F

MAIN UNIT PERIOD 3 OPERATIONS

Ion-Exchange System
May and June 1986

Operation Log
Operation Parameters and Results
Test Plan

OPERATION LOG - 1986

Date	Unit	Time	Action/Comments
May 1	off	12:15	Filled T2 & 3 to 12 feet with brine from south solar pond
		17:00	Start repair of CWs 3 & 4 suction lines
2	1	12:15	Started in auto mode
	1	13:41	S/D to correct program and install printer.
		14:30	Work on IV 123 (ball valve) - stuck.
5		7:30	Replaced IV 123 with 27
		9:05	Equalize Tanks T2 & 3
	1,2	12:07	I/S in computer operation
		15:30	Started tran. pump to CW5 from CWs3 & 4 and acid pump
		15:40	S/D acid and transfer pumps - acid recir. valve would not close
		16:40	I/S acid and transfer pumps
		18:48	RO2 I/S, CW5 @ 10 ft. 5 in.
	1	19:17	IV 23 did not open - event 2
	1	19:30	Opened IV 23 manually
	1	23:59	S/D, IV 23 failed to open for events 2 and 6
6	1,2	MN Cond.	2 I/S, 1 S/D
		00:10	RO3 I/S, CW6 @ 12ft. 6 in.
		00:20	EDR failed to start
	2	3:04	S/D because of valve problems and EDR S/D
		3:10	ROs2 & 3 S/D
	2	10:55	IV 102 repaired
		14:35	ROs2 & 3 I/S
	2	15:25	I/S
	1	20:30	I/S
		22:00	CW4 bottom appears to be leaking
	1	23:30	S/D
7	2	00:05	I/S to CWs3 & 4
	2	3:05	S/D
	1	3:39	I/S to CWs3 & 4
		7:00	S/D inflow to CW4 - leaking bottom
		7:40	EDR I/S
		8:25	EDR S/D - no amp on stages 3 and 4
	1,2	8:27	S/D - CW3 full
		10:15	EDR I/S
	1,2	11:00	I/S, 2 in event 8 and 1 in event 1
		12:18	EDR S/D, no voltage in stages 2, 3 and 4
		12:45	EDR I/S
8	1	MN Cond.	I/S to CW3
	2	6:41	S/D regen out of water
	1	6:50	Service run complete and S/D
		7:00	IP6 would not run
		7:30	IP6 I/S - level probe apparently dirty
	2	8:19	I/S - regeneration
	2	9:35	Regen. complete and in service, CW3 @ 10 ft. 6 in.
9	1,2	MN Cond.	I/S to CW3
		14:00	Programmed brine transfer from T2/3 to T4 into operations program
10	1,2	MN Cond.	I/S to CW3, CW5, RO2 .... EDR, T1

OPERATION LOG - 1986

Date	Unit	Time	Action/Comments
May 10		2:39	IP6 failed to run, event10, T2 to T4 (3ft) during service. Reset breaker
	2	2:42	S/D to transfer brine to T4
	2	3:32	I/S regeneration by computer
		7:55	EDR S/D transfer pump to T1 down
		15:30	EDR I/S
		19:15	EDR transfer pump replaced
11	1,2	MN Cond.	I/S to CW3, CW5, RO2 .... EDR, T1
		00:36	Abnormalities in EDR unit - see Plant Logs
		7:30	EDR S/D , plugged brine line and rotometer
		8:45	Event10 duration changed to 30 min. from 35
		9:20	EDR I/S
12	1,2	MN Cond.	I/S to CW3, CW5, RO2 .... EDR, T1
	1,2	11:27	S/D for RO2 & 3 volumetric tests
		12:00	EDR S/D
	1	16:19	I/S @ event 8
13	1,2	MN Cond.	I/S to CW3, CW5, RO2 .... EDR, T1
		1:00	no brine flow into EDR brine tank
		2:40	EDR S/D
		6:15	T1 level at 1 ft. 9 in.
		10:15	Start repair of CW4
		10:35	EDR I/S
14	1,2	MN Cond.	I/S to CW3, CW5, RO2 .... EDR, T1
		13:30	EDR S/D
15	1,2	MN Cond.	I/S to CW3, CW5, RO2 .... EDR, T1
		8:55	Transferred brine from T2 & 3 to T4
	1,2	14:14	S/D for maintenance on IV11 - leakage through valve
	1,2	15:56	I/S, 2 in service, 1 start regeneration
16	1,2	MN Cond.	I/S to CW3, CW5, RO2 .... EDR, T1
	1,2	00:01	S/D to transfer brine from T2/3 to T4 - programmed option did not work
	1,2	00:28	I/S, 1 @ event1, 2 @ event 8
		03:30	Event12 duration changed to 20 min from 30 -> CW3 @ 2ft. 6in.
		15:08	S/D RO2 & 3 in order to start VCE
		17:00	RO3 I/S
		19:10	RO2 I/S
17	1,2	MN Cond.	I/S to CW3, CW5, RO2 .... EDR, T1
		00:05	EDR S/D, plugged line again. T1 @ 7 ft. 2in.
18	1,2	MN Cond.	I/S to CW3, CW5, RO2 .... EDR, T1
		00:45	EDR S/D - transfer pump. T1 @ 2 ft. 4 in.
	1,2	7:04	S/D, T1 empty
		11:00	EDR I/S
		12:16	RO2 low pressure switch tripped, CW5 @ 12ft. 5in.
	2	15:12	I/S to CW3
		16:16	RO3 low pressure switch tripped, CW6 @ 7ft. 9in.
	1	16:55	I/S regeneration
		18:32	RO2 I/S
		19:17	RO3 I/S
19	2	MN Cond.	I/S to CW3, CW5, RO2 .... EDR, T1

OPERATION LOG - 1986

Date	Unit	Time	Action/Comments
May 19		13:00	started filling T1 from s.solar pond
		14:20	T1 @ 2 ft. 6in.
	1	16:51	I/S
		19:00	Stopped filling T1 - 14 ft. 3 in.
		19:51	IX1 S/D - normal, but IX2 failed to go into service. Stopped and restarted computer - IX2 I/S IX1 regeneration
20	1,2	MN Cond.	I/S to CW3, CW5, RO2 .... EDR, T1
		8:15	EDR S/D for maintenance
		16:10	T1 (11 ft. 6 in.) refill from s.solar pond
		17:15	T1 @ 15 ft.
21	1,2	MN Cond.	I/S to CW3, CW5, RO2....RO3, EDR acid clean
		11:00	CW4 repairs finished - requires a few days for curing.
		13:30	EDR S/D - electrode hose came off
		13:50	EDR I/S
	1	17:28	S/D IV4 stuck
	1	19:00	I/S
22	1,2	MN Cond.	I/S to CW3, CW5, RO2 .... EDR, T1. T1 level at 10ft. 4in.
23	1,2	MN Cond.	I/S to CW3, CW5, RO2 .... EDR, T1
		7:30	EDR S/D - problems with center electrode on stack 1.
		12:00	start refilling T1 from s.solar pond
		14:10	finished refilling T1 (14 ft. 10 in.)
24	1,2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. EDR S/D
		15:18	start refilling T1 from s.solar pond
		17:00	finished refilling T1 (14 ft. 11 in.)
	1	18:10	110 gpm flow regulator causing line vibration.
25	1,2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. EDR S/D
		12:30	Note: whenever power goes off and on IX computer resets event durations to default times.
		19:20	start refilling T1 (8 ft 3 in) from south solar pond.
		20:25	finished refilling T1 (12 ft. 6 in.)
26	1,2	MN Cond.	I/S to CW3, CW5, RO2...CW6. EDR S/D
		15:35	start refilling T1 (6 ft 5 in) from south solar pond.
		16:40	finished refilling T1 (10 ft. 2 in.)
27	1,2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. EDR S/D
	1	9:56	S/D, replaced 110 gpm f.controller with 100 gpm one.
		11:13	Power failure
28	2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. IX1, EDR. VCE S/D.
		11:00	start refilling T1 from s.solar pond
29	2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. IX1, EDR. VCE S/D.
	2	11:38	auto S/D by computer to make program modification.
	2	18:26	I/S to CW3
30	2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. IX1, EDR. VCE S/D.
		10:30	finished refilling T1 (5'8" to 10'2")
31	2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. IX1, EDR. VCE S/D.
		8:15	start refilling T1 (8 ft) from s.solar pond
		11:45	finished refilling T1 (full)
June 1	2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. IX1, EDR. VCE S/D.

OPERATION LOG - 1986

Date	Unit	Time	Action/Comments
June 2	2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. IX1, EDR. VCE S/D.
		8:20	refilled T1 from s.solar pond
		14:25	RO2 & 3 S/D
	2	15:15	S/D after event3. Ready for event4
		17:50	RO2 & 3 I/S
	2	18:55	I/S event4
3	2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. IX1, EDR S/D
		8:40	refilled T1 from s.solar pond
		11:30	parity chip added to IX computer to facilitate printer.
		12:50	IX printer working
4	2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. IX1, EDR S/D
	2	00:45	I/S @ 110 gpm
	1	00:47	I/S by hand oper. - regen.
	2	10:00	I/S @ 230 gpm to CW3. Single unit operation until further notice.
		11:30	refilled T1 from s.solar pond
5	2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. IX1, EDR S/D
		10:30	start refilling T1 (5 ft 5 in) from south solar pond.
		13:30	finished refilling T1 (13 ft 2 in)
6	2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. IX1, EDR S/D
		10:30	start refilling T1 (7 ft 6 in) from south solar pond.
7	2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. IX1, EDR S/D
		9:30	changed event12 to 60 min. from 50
		12:30	changed event12 to 80 min. from 60
8	2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. IX1, EDR S/D
		10:00	changed event12 to 90 min. from 80
		13:35	Installation of Ec probe in IX2's effluent line.
9	2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. IX1, EDR and RO3-blockB S/D.
		11:00	brine transfer to T1 from s.solar pond
10	2	MN Cond.	I/S to CW3, CW5, RO2 ...CW6. IX1, EDR and RO3-blockB S/D.
		9:15	Changed durations for events1 & 2 to 13 and 39.
		13:30	S/D RO2 & 3
	2	14:03	S/D after event3. Ready for event4

IX System was S/D for rest of month

ION EXCHANGE OPERATION PARAMETERS
Month: May and June, 1986

Date	Service Flow (gpm)	Service Duration (min)	Resin Volume (liters)	Recycle Brine Flow (gpm)	Recycle Brine Duration (min)	Fresh Brine Flow (gpm)	Fresh Brine Duration (min)
May 1			IX System OFF				
2	110	180	4840	200	42	150	8
3	110	180	4840	200	42	150	8
4	110	180	4840	200	42	150	8
5	110	180	4840	200	42	150	8
6	110	180	4840	200	42	150	8
7	110	180	4840	200	42	150	8
8	110	180	4840	200	52	150	8
9	110	180	4840	200	52	150	8
10	110	180	4840	200	52	150	8
11	110	180	4840	200	52	150	8
12	110	180	4840	200	35	150	15
13	110	180	4840	200	35	150	15
14	110	180	4840	200	35	150	15
15	110	180	4840	200	35	150	15
16	110	180	4840	200	52	150	8
17	110	180	4840	200	52	150	8
18	110	180	4840	200	52	150	8
19	110	180	4840	200	52	150	8
20	110	180	4840	200	52	150	8
21	110	180	4840	200	52	150	8
22	110	180	4840	200	52	150	8
23	110	180	4840	200	52	150	8
24	110	180	4840	200	52	150	8
25	110	180	4840	200	52	150	8
26	110	180	4840	200	52	150	8
27	230	90	4840	200	52	150	8
28	230	90	4840	200	52	150	8
29	230	90	4840	200	52	150	8
30	230	90	4840	200	52	150	8
31	230	90	4840	200	52	150	8
Jun 1	230	90	4840	200	52	150	8
2	230	90	4840	200	52	150	8
3	230	90	4840	200	52	150	8
4	230	90	4840	200	52	150	8
5	230	90	4840	200	52	150	8
6	230	90	4840	200	52	150	8
7	230	90	4840	200	52	150	8
8	230	90	4840	200	52	150	8
9	230	90	4840	200	52	150	8
10	230	90	4840	200	52	150	8

OPERATION RESULTS

Comparison of Total Hardness and Sodium in Regenerant Brines
Month: May and June, 1986

	Recycle Brine			Fresh Brine		
	TH	Na	Ratio	TH	Na	Ratio
Date	(meq/l)	(meq/l)	Na:TH	(meq/l)	(meq/l)	Na:TH
May 1		IX System OFF				
2	300.0	2000.0	6.7	220.0	2173.9	9.9
3	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA	NA
5	NA	NA	NA	NA	NA	NA
6	NA	NA	NA	NA	NA	NA
7	260.0	134.8	0.5	220.0	1217.4	5.5
8	280.0	1391.3	5.0	220.0	2260.9	10.3
9	280.0	1173.9	4.2	220.0	2347.8	10.7
10	260.0	1173.9	4.5	280.0	2434.8	8.7
11	260.0	1130.4	4.3	300.0	2565.2	8.6
12	252.0	1043.5	4.1	310.0	2782.6	9.0
13	255.0	956.5	3.8	303.4	2304.3	7.6
14	249.2	826.1	3.3	301.0	2087.0	6.9
15	248.0	782.6	3.2	288.0	1869.6	6.5
16	246.0	652.2	2.7	294.0	1652.2	5.6
17	244.0	739.1	3.0	302.0	1782.6	5.9
18	238.0	739.1	3.1	274.0	1695.7	6.2
19	244.0	652.2	2.7	280.0	1043.5	3.7
20	NA	652.2	NA	NA	2173.9	NA
21	260.0	521.7	2.0	220.0	1608.7	7.3
22	NA	NA	NA	NA	NA	NA
23	280.0	565.2	2.0	200.0	1130.4	5.7
24	52.8	608.7	11.5	39.6	1521.7	38.4
25	260.0	608.7	2.3	198.4	1652.2	8.3
26	260.0	521.7	2.0	200.0	1565.2	7.8
27	260.0	652.2	2.5	200.0	1521.7	7.6
28	50.8	608.7	12.0	36.0	1565.2	43.5
29	260.0	608.7	2.3	200.0	1521.7	7.6
30	280.0	652.2	2.3	199.6	1565.2	7.8
31	300.0	652.2	2.2	200.0	1608.7	8.0
June 1	300.0	652.2	2.2	200.0	1565.2	7.8
2	300.0	652.2	2.2	200.0	1565.2	7.8
3	320.0	695.7	2.2	200.0	1434.8	7.2
4	340.0	739.1	2.2	200.0	1521.7	7.6
5	300.0	652.2	2.2	200.0	1565.2	7.8
6	320.0	695.7	2.2	200.0	1521.7	7.6
7	340.0	739.1	2.2	200.0	1521.7	7.6
8	320.0	695.7	2.2	220.0	1565.2	7.1
9	340.0	739.1	2.2	200.0	1521.7	7.6
10	340.0	739.1	2.2	200.0	1521.7	7.6

CLEARWELL 2 - SAMPLE TAP SW2D ION EXCHANGE INFLUENT

Date	Time	TH	Ca	Cl2-F	SiO2	Turb	EC	pH	Cl	Na	SO4	TOC
1986		(meq/l)		(mg/l)		(NTU)	(uS/cm)		(meq/l)			(mg/l)
May 1	7:30	49.2	23.1	0.5	5.0	0.1	10900	7.7	43.4	87.0	84.4	NA
6	7:30	NA	NA	NA	NA	NA	NA	NA	43.6	89.1	93.8	NA
7	7:30	NA	NA	NA	NA	NA	NA	NA	NA	91.3	NA	21
8	7:30	50.0	26.7	0.2	5.0	0.1	11200	7.8	45.1	91.3	83.3	NA
9	7:30	40.8	27.2	0.1	5.0	0.1	11500	7.8	NA	93.5	NA	18
10	7:30	50.2	27.5	0.1	5.0	0.2	11600	7.6	NA	95.7	NA	NA
11	7:30	49.8	26.5	0.1	5.0	0.1	11700	7.6	NA	100.0	NA	NA
12	7:30	50.8	27.0	0.3	5.0	0.2	11500	7.4	NA	102.2	NA	NA
13	7:30	50.0	27.1	0.2	5.0	0.1	11400	7.3	46.5	97.8	89.6	NA
14	7:30	50.1	27.7	0.2	5.0	0.1	11400	5.7	NA	93.5	NA	10
15	7:30	51.2	27.3	NA	5.0	0.1	11400	7.6	46.5	95.7	91.7	NA
16	7:30	50.3	29.3	0.1	5.0	0.1	11900	7.9	NA	82.6	NA	10
17	7:30	51.2	27.7	NA	5.0	0.1	11900	7.7	NA	87.0	NA	NA
18	7:30	52.6	28.0	0.1	5.0	0.1	11900	7.9	NA	NA	NA	NA
19	7:30	51.4	27.2	0.1	5.0	0.1	11900	7.7	NA	73.9	NA	NA
20	7:30	NA	NA	0.1	5.0	0.1	12200	7.9	47.3	73.9	83.3	NA
21	7:30	50.6	27.5	0.1	5.0	0.1	12100	7.6	NA	100.0	NA	10
22	7:30	52.3	27.1	0.1	5.0	0.1	12000	7.6	54.1	106.5	93.8	NA
23	7:30	51.6	26.5	0.1	5.0	0.1	12400	7.9	NA	100.0	NA	10
24	7:30	50.4	26.5	NA	5.0	0.1	12500	7.5	NA	104.3	NA	NA
25	7:30	47.2	23.6	0.1	5.0	0.1	13200	7.7	NA	119.6	NA	NA
26	7:30	47.6	24.4	0.1	5.0	0.1	13300	7.7	NA	117.4	NA	10
27	7:30	47.6	23.7	0.1	5.0	0.1	13800	7.54	67.6	106.5	85.4	NA
28	7:30	46.6	22.5	0.1	5.0	0.1	13200	7.6	NA	113.0	NA	NA
29	7:30	45.8	21.5	0.1	5.0	0.1	13500	7.6	80.3	110.9	93.8	NA
30	7:30	46.2	22.5	0.1	5.0	0.1	13500	7.8	NA	113.0	NA	10
31	7:30	48.8	21.0	NA	5.0	0.1	13800	7.5	NA	115.2	NA	NA
June 1	7:30	51.4	22.5	0.1	5.0	0.1	14400	7.5	NA	137.4	NA	NA
2	7:30	52.0	23.5	0.1	5.0	0.1	14700	7.4	NA	135.2	NA	10
3	7:30	55.2	20.5	0.1	5.0	0.3	14900	6.6	74.6	135.2	95.8	NA
4	7:30	46.6	19.5	0.1	5.0	0.3	15200	6.8	NA	135.2	NA	10
5	7:30	48.8	21.0	0.1	5.0	0.2	14900	7.1	78.9	144.3	102.1	NA
6	7:30	51.0	23.0	NA	5.0	2.1	15000	6.5	NA	144.3	NA	10
7	7:30	47.2	22.5	NA	5.0	1.6	15500	7.8	NA	148.7	NA	NA
8	7:30	48.6	22.5	0.1	5.0	1.6	15400	7.7	NA	146.5	NA	NA
9	7:30	53.8	20.5	0.1	5.0	0.2	15100	7.8	NA	139.6	NA	10
10	7:30	51.6	35.0	0.1	5.0	0.8	14500	8	70.4	128.7	95.8	NA
Num.of Anal.		34	34	29	35	35	35	35	12	36	12	12
Mean		49.7	25.1	0.1	5.0	0.3	13009	7.5	58.2	109.9	924.4	11.6
StandardDev.		2.7	3.3	0.1	0.0	0.5	1464	0.5	14.9	21.6	5.9	3.8
Lower95%C.L		48.7	24.0	0.0	5.0	0.0	12508	7.0	49.6	102.6	87.6	9.0
Upper95%C.L		50.6	26.2	0.2	5.0	0.5	13509	7.7	66.8	117.2	94.5	13.8

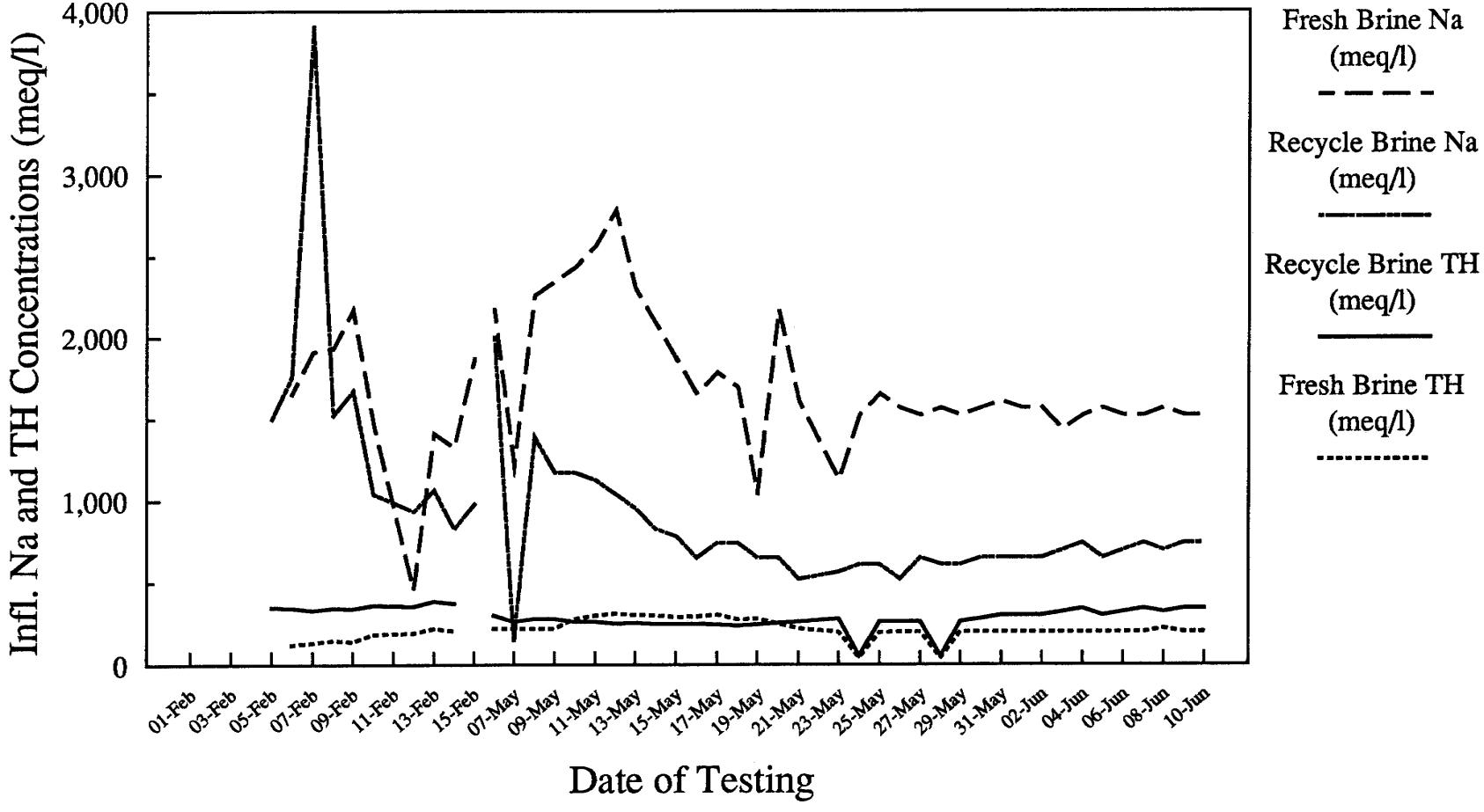
CLEARWELL 5 - SAMPLE TAP SW5D ION EXCHANGE EFFLUENT

Date	Time	TH	Ca	Cl2-F	SiO2	Turb	EC	pH	Cl	Na	SO4
1986		(meq/l)		(mg/l)		(NTU)	(uS/cm)		(meq/l)		
May 1	7:30	39.8	8.1	0.1	NA	0.1	17800	7.7	90.1	178.3	120.8
7	7:30	NA	NA	NA	NA	NA	NA	NA	NA	89.1	NA
8	7:30	23.2	3.9	0.1	NA	0.1	13200	6	56.3	128.3	100.0
9	7:30	21.4	4.7	0.1	NA	0.1	13200	5.3	NA	143.5	NA
10	7:30	36.2	8.0	0.1	NA	0.2	14400	5.6	NA	139.1	NA
11	7:30	30.6	6.0	0.1	NA	0.1	13600	5.5	NA	137.0	NA
12	7:30	32.1	6.3	0.1	NA	0.1	13100	4.7	NA	137.0	NA
13	7:30	37.2	7.2	0.1	NA	0.1	13600	7.3	68.3	137.0	110.4
14	7:30	30.7	6.8	0.1	NA	0.1	12000	5.6	NA	123.9	NA
15	7:30	36.3	7.2	NA	NA	0.1	12500	5.7	51.3	119.6	93.8
16	7:30	33.4	8.3	0.1	NA	0.1	12200	5.4	NA	100.0	NA
17	7:30	32.1	6.8	NA	0.5	0.1	12200	5.1	NA	100.0	NA
18	7:30	30.4	6.0	0.1	0.5	0.1	12300	5.1	NA	104.3	NA
19	7:30	31.3	6.8	0.1	0.5	0.1	12200	5.4	NA	82.6	NA
20	7:30	NA	NA	0.1	NA	0.1	13100	5.5	46.5	87.0	112.5
21	7:30	22.6	4.0	0.1	0.5	0.1	12900	5.7	NA	126.1	NA
22	7:30	21.6	3.8	0.1	NA	0.1	12800	5.4	51.3	139.1	91.7
23	7:30	23.8	5.0	0.1	NA	0.1	12900	5.8	NA	126.1	NA
24	7:30	22.8	5.0	NA	0.5	0.1	12800	4.6	NA	130.4	NA
25	7:30	22.6	5.2	0.1	0.5	0.1	13700	5.5	NA	143.5	NA
26	7:30	23.8	5.4	0.1	0.5	0.4	13700	6.1	NA	137.0	NA
27	7:30	23.2	5.4	0.1	NA	0.1	13800	4.9	67.6	126.1	104.2
28	7:30	23.6	5.6	0.1	0.5	0.1	13700	5.6	NA	126.1	NA
29	7:30	24.6	11.5	0.1	NA	0.1	13900	5.3	80.3	128.3	87.5
30	7:30	24.2	6.0	0.1	0.5	0.7	13900	NA	NA	121.7	NA
31	7:30	24.4	6.0	NA	0.5	0.8	14300	6.1	NA	143.5	NA
Jun 1	7:30	29.0	10.0	0.1	0.5	1.3	14600	6.3	NA	150.9	NA
2	7:30	37.4	10.0	0.1	0.5	0.1	14900	5.2	NA	155.2	NA
3	7:30	34.8	7.0	0.1	NA	0.2	15300	4.6	70.4	148.7	93.8
4	7:30	19.0	5.0	0.1	0.5	0.4	15500	4.8	NA	155.2	NA
5	7:30	30.8	8.0	NA	NA	0.2	15000	5.7	76.1	159.6	97.9
6	7:30	28.2	7.5	NA	0.5	0.1	15400	4	NA	157.4	NA
7	7:30	29.2	9.0	0.1	0.5	0.2	15600	3.8	NA	159.6	NA
8	7:30	30.2	11.5	0.1	0.5	0.6	15800	5.6	NA	166.5	NA
9	7:30	30.0	8.0	0.1	0.5	0.8	15700	6.2	NA	159.6	NA
10	7:30	33.8	9.0	0.1	NA	0.9	15100	5.8	69.0	150.9	83.3
Num.of Anal.		34	34	29	18	35	35	34	11	36	11
Mean		49.7	25.1	0.1	5.0	0.3	13906	5.5	66.1	133.8	99.6
StandardDev.		2.7	3.3	0.1	0.0	0.5	1329	0.8	13.5	23.0	11.4
Lower95%C.L.		48.7	24.0	0.0	5.0	0.0	13451	5.0	57.9	126.1	92.7
Upper95%C.L.		50.6	26.2	0.2	5.0	0.5	13509	5.8	74.3	141.6	106.5

Influent Total Hardness and Sodium Concentration

Ion Exchange Regenerant Brines

February and May through June, 1986



ION EXCHANGE FRESH BRINE
BRINE TANK 1 - SAMPLE TAP ST1D

Date	Time	Na	TH	Ca	EC	Temp.	TDS	SO4	Cl
1986		(meq/l)			(uS/cm)	(C)	(mg/l)	(meq/l)	
May 1	7:30	2130	244	39.0	73400	18.0	NA	NA	NA
2	7:30	2174	220	45.6	74400	NA	NA	NA	NA
7	7:30	1217	220	37.0	74700	NA	NA	NA	NA
8	7:30	2261	220	35.8	82000	NA	NA	NA	NA
9	7:30	2348	220	41.4	77600	NA	NA	NA	NA
10	7:30	2435	280	35.8	78000	NA	NA	NA	NA
11	7:30	2565	300	35.0	78000	NA	NA	NA	NA
12	7:30	2783	310	32.6	77000	NA	NA	NA	NA
13	7:30	2304	303	34.2	77000	NA	NA	NA	NA
14	7:30	2087	301	39.8	65400	NA	NA	NA	NA
15	7:30	1870	288	38.6	61000	NA	NA	813	479
16	7:30	1652	294	32.6	71000	NA	NA	NA	NA
17	7:30	1783	302	31.8	67700	NA	NA	NA	NA
18	7:30	1696	274	34.4	64000	NA	NA	NA	NA
19	7:30	1043	280	30.7	68000	NA	NA	NA	NA
20	7:30	2174	NA	NA	112700	NA	NA	469	1549
21	7:30	1609	220	42.0	89100	NA	NA	NA	NA
22	7:30	NA	NA	NA	92800	NA	NA	521	1268
23	7:30	1130	200	44.0	71800	NA	NA	NA	NA
24	7:30	1522	40	10.1	101500	NA	NA	NA	NA
25	7:30	1652	198	47.4	107000	NA	NA	NA	NA
26	7:30	1565	200	44.2	112000	NA	NA	NA	NA
27	7:30	1522	200	48.4	107500	NA	NA	521	1577
28	7:30	1565	36	48.5	109100	NA	NA	NA	NA
29	7:30	1522	200	55.0	112300	NA	NA	469	1493
30	7:30	1565	200	50.0	106800	NA	NA	NA	NA
31	7:30	1609	200	55.0	108700	NA	NA	NA	NA
June 1	7:30	1565	200	50.0	97600	NA	NA	NA	NA
2	7:30	1565	200	55.0	106600	NA	NA	NA	NA
3	7:30	1435	200	50.0	107400	NA	NA	333	1437
4	7:30	1478	200	55.0	108300	NA	NA	NA	NA
5	7:30	1522	200	55.0	107800	NA	NA	333	1324
6	7:30	1435	200	55.0	88400	NA	NA	NA	NA
7	7:30	1522	200	65.0	89100	NA	NA	NA	NA
8	7:30	1565	220	55.0	94800	NA	NA	NA	NA
9	7:30	1522	200	55.0	98000	NA	NA	NA	NA
10	7:30	1522	200	50.0	97600	NA	NA	354	1408
Num.of Anal.		36	35	35	37	1	0	8	8
Mean		1748	61	43.8	89627	18.0	NA	477	1317
StandardDev.		1425	201	10.7	16710	NA	NA	157	355
Lower95%C.L.		1885	243	40.2	32767	NA	NA	365	923
Upper95%C.L.		1917	243	47.5	95179	NA	NA	588	1568

BRINE TANK 4 - SAMPLE TAP ST4D

Date	Time	Na	TH	Ca	EC	Temp.	TDS	SO4	Cl
1986		(meq/l)			(uS/cm)	(C)	(mg/l)	(meq/l)	
May 1	7:30	1957	296	34.4	75700	NA	NA	NA	NA
6	7:30	2000	300	41.0	76700	NA	NA	NA	NA
7	7:30	1348	260	35.9	68100	NA	NA	NA	NA
8	7:30	1391	280	38.6	65700	NA	NA	NA	NA
9	7:30	1174	280	40.2	57100	NA	NA	NA	NA
10	7:30	1174	260	37.5	54000	NA	NA	NA	NA
11	7:30	1130	260	40.0	52000	NA	NA	NA	NA
12	7:30	1043	252	37.6	49000	NA	NA	NA	NA
13	7:30	957	255	41.8	48000	NA	NA	NA	NA
14	7:30	826	249	42.8	44200	NA	NA	NA	NA
15	7:30	783	248	41.0	44000	NA	NA	229	507
16	7:30	652	246	39.4	47600	NA	NA	NA	NA
17	7:30	739	244	34.8	44500	NA	NA	NA	NA
18	7:30	739	238	37.0	4500	NA	NA	NA	NA
19	7:30	652	244	38.4	4600	NA	NA	NA	NA
20	7:30	652	NA	NA	49600	NA	NA	242	507
21	7:30	522	260	46.0	50100	NA	NA	NA	NA
22	7:30	NA	NA	NA	53900	NA	NA	188	620
23	7:30	565	280	0.0	58300	NA	NA	NA	NA
24	7:30	609	53	9.7	56600	NA	NA	NA	NA
25	7:30	609	260	48.8	63000	NA	NA	NA	NA
26	7:30	522	260	0.0	64000	NA	NA	NA	NA
27	7:30	652	260	65.0	60900	NA	NA	167	845
28	7:30	609	51	60.0	62800	NA	NA	NA	NA
29	7:30	609	260	70.0	63900	NA	NA	133	761
30	7:30	652	280	70.0	67100	NA	NA	NA	NA
31	7:30	739	300	70.0	69700	NA	NA	NA	NA
June 1	7:30	739	300	75.0	68800	NA	NA	NA	NA
2	7:30	739	300	85.0	75300	NA	NA	NA	NA
3	7:30	783	320	90.0	77300	NA	NA	NA	NA
4	7:30	783	340	95.0	79100	NA	NA	NA	NA
5	7:30	826	300	85.0	75200	NA	NA	146	901
6	7:30	652	320	85.0	67700	NA	NA	NA	NA
7	7:30	739	340	95.0	68800	NA	NA	NA	NA
8	7:30	783	320	95.0	70800	NA	NA	NA	NA
9	7:30	696	340	90.0	72900	NA	NA	NA	NA
10	7:30	739	340	95.0	74700	NA	NA	117	1042
Num.of Anal.		35	35	35	37	0	0	7	7
Mean		855	268	83.1	61300	NA	NA	174	740
StandardDev.		351	63	106.8	11241	NA	NA	48	205
Lower95%C.L.		737	247	46.7	32767	NA	NA	138	586
Upper95%C.L.		973	290	119.6	65035	NA	NA	210	895

State of California DEPARTMENT OF WATER RESOURCES The Resources Agency

OFFICE MEMO

TO: Distribution List	DATE: April 23, 1986
	SUBJECT: Six-Week Desalting Test Plan Startup
FROM: Brian Smith	

Attached is a set of three operation test plans that were developed for the Los Banos facility. Please review these and prepare for startup of Desalting Test 1 on Monday, April 28.

General startup and operation instructions and other instructions and information concerning the ion-exchange system are also attached. The ion-exchange system is to be operated in the dry run mode immediately.

Basically each test plan is for a period of two weeks. The first two test plans employ the IX/RO2/RO3/EDR process flow scheme. The third test plan uses IX/RO1/RO2/RO3 process flow scheme.

All three plans will use brine generated from the third desalting stage to regenerate the ion-exchange resin. Test 1 will concentrate brine to the maximum allowable (one bed volume) as dictated by the ion-exchange regeneration process. Test 2 concentrates the brine to a concentration similar to that brine which will be generated in Test 3. Other information concerning operation parameters and other factors are contained in the individual test plan.

If you have any questions in this regard, please phone me at (209) 445-5487 or Kurt Kovac at (209) 445-5578.

Attachments

Distribution List

Tony Castaneda
Bob Clark
Mark Cowin
Sylvia Hedlind
Dale Hoffman-Floerke
Kurt Kovac
Riz Parangalan
Kenji Yamamoto

DWR 100a (Est. 4/80)

☐ OVER

13826-750 250 M - OCP

DESALTING TEST 1

Purpose

The purpose of Test 1 is to operate on a continuous basis during the entire process of softening and desalting of the agricultural drainage water while employing the reject brine from the desalting process to regenerate the softening resin. The volume of reverse-osmosis reject brine produced in Test 1 is the minimum amount as required by the softening process.

Test Period

Test 1 is to last for a period of two weeks. Testing within this time frame will enable the systems to stabilize so that proper evaluation of the systems can be made.

System Operation Parameters

The treatment systems are to be operated according to the parameters that are listed below.

Ion-Exchange: Service flow = 110 gallons per minute.
Fresh brine volume = 1,280 gallons.
Brine contact time = 50 minutes.

The ion-exchange system is to be operated according to the attached schedules. There are two schedules for Test 1, one for each week. Week 1's schedule enables the ion-exchange system to build an adequate volume of recycled regenerated brine in Tanks 2, 3, and 4 by wasting only one-half the volume of brine regenerated during the ion-exchange cycle. Week 2's schedule wastes the entire brine volume that is generated during the cycle.

Desalting:

Unit	Flows (gpm)	
	Influent	Brine
RO2	92	46
RO3	46	23
EDR	23	6

Data Collection and Sampling

The data collected will be as determined by equipment manufacturers and as otherwise directed by plant engineering. The schedule for sampling and analyses performed is listed below.

Location	Tap Number	Analyses Performed
		Sunday, Monday, Wednesday, Friday, and Saturday
CW1	SW1D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, Temp.
CW2	SW2D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH
CW3	SW3D	Na, TH, Ca, CL_{2f}, SiO_2, Turb., EC, pH
CW5	SW5D	Na, TH, Ca, CL_{2f}, SiO_2, Turb., EC, pH
CW6	SW6D	Na, TH, Ca, CL_{2f}, SiO_2, Turb., EC, pH
CW8	SW8D	Na, TH, Ca, SiO_2, Turb., EC, pH
T1	ST1D	Na, TH, Ca, EC, Temp.
T2	ST2D	Na, TH, Ca, EC
T3	ST3D	Na, TH, Ca, EC
T4	ST4D	Na, TH, Ca, EC
		Tuesday and Thursday
CW1	SW1D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, Temp., SO_4, Cl
CW2	SW2D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, SO_4, Cl
CW3	SW3D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, SO_4, Cl
CW5	SW5D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, SO_4, Cl
CW6	SW6D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, SO_4, Cl
CW8	SW8D	Na, TH, Ca, SiO_2, Turb., EC, pH, SO_4, Cl
T1	ST1D	Na, TH, Ca, EC, Temp., SO_4, Cl
T2	ST2D	Na, TH, Ca, EC, SO_4, Cl
T3	ST3D	Na, TH, Ca, EC, SO_4, Cl
T4	ST4D	Na, TH, Ca, EC, SO_4, Cl
		Twice Daily (Morning and Afternoon)
Filter 1	SF1E	SDI
Filter 2	SF2E	SDI
CW2	SW2D	SDI
CW5	SW5D	SDI
CW6	SW6D	SDI

LOS BANOS DEMONSTRATION DESALTING FACILITY
ION-EXCHANGE OPERATIONS SCHEDULE
REVERSE-OSMOSOS/ELECTRODIALYSIS BRINE REGENERATION
April 28, 1986

Test 1, Week 1.
Two-unit continuous operation.
Service flow at 110 gallons per minute.

Waste brine to IX sump.
Used brine to T2 or T3.
Rinse to RWPS.

Event Number	Event Description	Duration (minutes)	Component Operation or Valve Open		Process Flow		
			Unit 1	Unit 2	Unit	From	To
1	Recycled brine regeneration 1	10	IP 5, A 1 IV 15,12,7,9,22	IP 5, A 2 IV 115,112,107,109,122	1 2	T4 T4	IX sump IX sump
2	Recycled brine regeneration 2	32	IP 5, A 1 IV 15,12,7,4,23	IP 5, A 2 IV 115,112,107,104,123	1 2	T4 T4	T2 T3
3	Fresh brine regeneration	8	IP 1, A 1 IV 17,39m,13,7,4,23	IP 1, A 2 IV 18,139m,113,107,104,123	1 2	T1 T1	T2 T3
4	Rinse A	5	IP 7, A 1 IV 1,7,19,23	IP 9, A 2 IV 101,107,119,123	1 2	CW1 CW2	T2 T3
5	Rinse B	4	IP 7, A 1 IV 2,7,19,23	IP 9, A 2 IV 102,107,119,123	1 2	CW1 CW2	T2 T3
6	Rinse C	0	IP 7, A 1 IV 2,7,10,22	IP 9, A 2 IV 102,107,110,122	1 2	CW1 CW2	IX sump IX sump
7	Rinse D	16	IP 7 IV 2,7,10,21	IP 9 IV 102,107,110,121	1 2	CW1 CW2	RWPS RWPS
8	Service	180	IP 7 IV 1,7,11 CSOV 1	IP 9 IV 101,107,111 CSOV 6	1 2	CW1 CW2	CW3 CW3
9	Settling in T2 or T3 during service	120	A 1*	A 2*	1 2	Settling in T2 Settling in T3	
10	Set up for regeneration to T4 during service	28	IP 6 IV 5	IP 6 IV 105	1 2	T2 T3	T4 T4
11	Drain	3	IV 6,10,21 A 1	IV 106,110,121 A 2	1 2	Unit 1 Unit 2	RWPS RWPS
12	Delay	32	A 1	A 2			

*Agitators are not in operation during event 7 and part of event 8. Agitators are placed back into operation after event 10 is completed during event 8. (During all other events, agitators are in operation.)

Abbreviations:
A = agitator
CW = clearwell
CSOV = chlorine solenoid valve
IP = ion-exchange pump
IV = ion-exchange valve
IX = ion exchange
m = manual valve
RWPS = return water pump station
T = brine tank

LOS BANOS DEMONSTRATION DESALTING FACILITY
ION-EXCHANGE OPERATIONS SCHEDULE
REVERSE-OSMOSOS/ELECTRODIALYSIS BRINE REGENERATION
May 5, 1986

Test 1, Week 2.
Two-unit continuous operation.
Service flow at 110 gallons per minute.

Waste brine to IX sump.
Used brine to T2 or T3.
Rinse to RWPS.

Event Number	Event Description	Duration (minutes)	Component Operation or Valve Open: Unit 1	Component Operation or Valve Open: Unit 2	Process Flow: Unit	Process Flow: From	Process Flow: To
1	Recycled brine regeneration 1	13	IP 5, A 1 IV 15,12,7,9,22	IP 5, A 2 IV 115,112,107,109,122	1 2	T4 T4	IX sump IX sump
2	Recycled brine regeneration 2	29	IP 5, A 1 IV 15,12,7,4,23	IP 5, A 2 IV 115,112,107,104,123	1 2	T4 T4	T2 T3
3	Fresh brine regeneration	8	IP 1, A 1 IV 17,39m,13,7,4,23	IP 1, A 2 IV 18,139m,113,107,104,123	1 2	T1 T1	T2 T3
4	Rinse A	5	IP 7, A 1 IV 1,7,19,23	IP 9, A 2 IV 101,107,119,123	1 2	CW1 CW2	T2 T3
5	Rinse B	4	IP 7, A 1 IV 2,7,19,23	IP 9, A 2 IV 102,107,119,123	1 2	CW1 CW2	T2 T3
6	Rinse C	0	IP 7, A 1 IV 2,7,10,22	IP 9, A 2 IV 102,107,110,122	1 2	CW1 CW2	IX sump IX sump
7	Rinse D	16	IP 7 IV 2,7,10,21	IP 9 IV 102,107,110,121	1 2	CW1 CW2	RWPS RWPS
8	Service	180	IP 7 IV 1,7,11 CSOV 1	IP 9 IV 101,107,111 CSOV 6	1 2	CW1 CW2	CW3 CW3
9	Settling in T2 or T3 during service	120	A 1*	A 2*	1 2	Settling in T2 Settling in T3	
10	Set up for regeneration to T4 during service	28	IP 6 IV 5	IP 6 IV 105	1 2	T2 T3	T4 T4
11	Drain	3	IV 6,10,21 A 1	IV 106,110,121 A 2	1 2	Unit 1 Unit 2	RWPS RWPS
12	Delay	32	A 1	A 2			

*Agitators are not in operation during event 7 and part of event 8. Agitators are placed back into operation after event 10 is completed during event 8. (During all other events, agitators are in operation.)

Abbreviations:
A = agitator
CW = clearwell
CSOV = chlorine solenoid valve
IP = ion-exchange pump
IV = ion-exchange valve
IX = ion exchange
m = manual valve
RWPS = return water pump station
T = brine tank

DESALTING TEST 2

Purpose

The purpose of Test 2 is to operate on a continuous basis during the entire process of softening and desalting of the agricultural drainage water while employing the reject brine of the desalting process to regenerate the softening resin. The reverse-osmosis reject brine produced for Test 2 is similar in volume (for regeneration concerns) and concentration as that produced when all three reverse-osmosis systems are in operation.

Test Period

Test 2 is to last for a period of two weeks. Testing within this time frame will enable the systems to stabilize so that proper evaluation of the systems can be made.

System Operation Parameters

The treatment systems are to be operated according to the parameters that are listed below.

Ion-Exchange: Service flow = 110 gallons per minute.
Fresh brine volume = 2,240 gallons.
Brine contact time = 50 minutes.

The ion-exchange system is to be operated according to the attached schedule.

Desalting:

Unit	Flows (gpm)	
	Influent	Brine
RO2	92	46
RO3	46	23
EDR	23	9

Data Collection and Sampling

The data collected will be as determined by equipment manufacturers and as otherwise directed by plant engineering. The schedule for sampling and analyses performed is listed below.

Location	Tap Number	Analyses Performed
		Sunday, Monday, Wednesday, Friday, and Saturday
CW1	SW1D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, Temp.
CW2	SW2D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH
CW3	SW3D	Na, TH, Ca, CL_{2f}, SiO_2, Turb., EC, pH
CW5	SW5D	Na, TH, Ca, CL_{2f}, SiO_2, Turb., EC, pH
CW6	SW6D	Na, TH, Ca, CL_{2f}, SiO_2, Turb., EC, pH
CW8	SW8D	Na, TH, Ca, SiO_2, Turb., EC, pH
T1	ST1D	Na, TH, Ca, EC, Temp.
T2	ST2D	Na, TH, Ca, EC
T3	ST3D	Na, TH, Ca, EC
T4	ST4D	Na, TH, Ca, EC
		Tuesday and Thursday
CW1	SW1D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, Temp., SO_4, Cl
CW2	SW2D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, SO_4, Cl
CW3	SW3D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, SO_4, Cl
CW5	SW5D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, SO_4, Cl
CW6	SW6D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, SO_4, Cl
CW8	SW8D	Na, TH, Ca, SiO_2, Turb., EC, pH, SO_4, Cl
T1	ST1D	Na, TH, Ca, EC, Temp., SO_4, Cl
T2	ST2D	Na, TH, Ca, EC, SO_4, Cl
T3	ST3D	Na, TH, Ca, EC, SO_4, Cl
T4	ST4D	Na, TH, Ca, EC, SO_4, Cl
		Twice Daily (Morning and Afternoon)
Filter 1	SF1E	SDI
Filter 2	SF2E	SDI
CW2	SW2D	SDI
CW5	SW5D	SDI
CW6	SW6D	SDI

LOS BANOS DEMONSTRATION DESALTING FACILITY
ION-EXCHANGE OPERATIONS SCHEDULE
REVERSE-OSMOSOS/ELECTRODIALYSIS BRINE REGENERATION
May 12, 1986

Test 2.
Two-unit continuous operation.
Service flow at 110 gallons per minute.

Waste brine to IX sump.
Used brine to T2 or T3.
Rinse to RWPS.

Event Number	Event Description	Duration (minutes)	Component Operation or Valve Open: Unit 1	Component Operation or Valve Open: Unit 2	Process Flow: Unit	Process Flow: From	Process Flow: To
1	Recycled brine regeneration 1	13	IP 5, A 1 IV 15,12,7,9,22	IP 5, A 2 IV 115,112,107,109,122	1 2	T4 T4	IX sump IX sump
2	Recycled brine regeneration 2	22	IP 5, A 1 IV 15,12,7,4,23	IP 5, A 2 IV 115,112,107,104,123	1 2	T4 T4	T2 T3
3	Fresh brine regeneration	15	IP 1, A 1 IV 17,39m,13,7,4,23	IP 1, A 2 IV 18,139m,113,107,104,123	1 2	T1 T1	T2 T3
4	Rinse A	5	IP 7, A 1 IV 1,7,19,23	IP 9, A 2 IV 101,107,119,123	1 2	CW1 CW2	T2 T3
5	Rinse B	4	IP 7, A 1 IV 2,7,19,23	IP 9, A 2 IV 102,107,119,123	1 2	CW1 CW2	T2 T3
6	Rinse C	0	IP 7, A 1 IV 2,7,10,22	IP 9, A 2 IV 102,107,110,122	1 2	CW1 CW2	IX sump IX sump
7	Rinse D	16	IP 7 IV 2,7,10,21	IP 9 IV 102,107,110,121	1 2	CW1 CW2	RWPS RWPS
8	Service	180	IP 7,2 IV 1,7,11 CSOV 1	IP 9,102 IV 101,107,111 CSOV 6	1 2	CW1 CW2	CW3 CW3
9	Settling in T2 or T3 during service	120	A 1*	A 2*	1 2	Settling in T2 Settling in T3	
10	Set up for regeneration to T4 during service	28	IP 6 IV 5	IP 6 IV 105	1 2	T2 T3	T4 T4
11	Drain	3	IV 6,10,21 A 1	IV 106,110,121 A 2	1 2	Unit 1 Unit 2	RWPS RWPS
12	Delay	32	A 1	A 2			

*Agitators are not in operation during event 7 and part of event 8. Agitators are placed back into operation after event 10 is completed during event 8. (For all other events, agitators are in operation.)

Abbreviations:
A = agitator
CW = clearwell
CSOV = chlorine solenoid valve
IP = ion-exchange pump
IV = ion-exchange valve
IX = ion exchange
m = manual valve
RWPS = return water pump station
T = brine tank

DESALTING TEST 3

Purpose

The purpose of Test 3 is to operate on a continuous basis during the entire process of softening and desalting agricultural drainage water while employing the desalting process reject brine to regenerate the softening resin. Test 3 encompasses the use of all three reverse-osmosis units along with full service flow (230 gpm) through the ion-exchange system.

Test Period

Test 3 is to last for a period of two weeks. Testing within this time frame will enable the systems to stabilize so that proper evaluation of the systems can be made.

System Operation Parameters

The treatment systems are to be operated according to the parameters that are listed below.

Ion-Exchange: Service flow = 230 gallons per minute.
Fresh brine volume = 2,070 gallons.
Brine contact time = 50 minutes.

The ion-exchange system is to be operated according to the attached schedule.

Desalting:

Unit	Flows (gpm)	
	Influent	Brine
RO1	230	92
RO2	92	46
RO3	46	23

Data Collection and Sampling

The data collected will be as determined by equipment manufacturers and as otherwise directed by plant engineering. The schedule for sampling and analyses performed is listed below.

Location	Tap Number	Analyses Performed
		Sunday, Monday, Wednesday, Friday, and Saturday
CW1	SW1D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, Temp.
CW2	SW2D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH
CW3	SW3D	Na, TH, Ca, CL_{2f}, SiO_2, Turb., EC, pH
CW4	SW4D	Na, TH, Ca, CL_{2f}, SiO_2, Turb., EC, pH
CW5	SW5D	Na, TH, Ca, CL_{2f}, SiO_2, Turb., EC, pH
CW6	SW6D	Na, TH, Ca, CL_{2f}, SiO_2, Turb., EC, pH
CW8	SW8D	Na, TH, Ca, SiO_2, Turb., EC, pH
T1	ST1D	Na, TH, Ca, EC, Temp.
T2	ST2D	Na, TH, Ca, EC
T3	ST3D	Na, TH, Ca, EC
T4	ST4D	Na, TH, Ca, EC
		Tuesday and Thursday
CW1	SW1D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, Temp., SO_4, Cl
CW2	SW2D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, SO_4, Cl
CW3	SW3D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, SO_4, Cl
CW4	SW4D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, SO_4, Cl
CW5	SW5D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, SO_4, Cl
CW6	SW6D	Na, TH, Ca, Cl_{2f}, SiO_2, Turb., EC, pH, SO_4, Cl
CW8	SW8D	Na, TH, Ca, SiO_2, Turb., EC, pH, SO_4, Cl
T1	ST1D	Na, TH, Ca, EC, Temp., SO_4, Cl
T2	ST2D	Na, TH, Ca, EC, SO_4, Cl
T3	ST3D	Na, TH, Ca, EC, SO_4, Cl
T4	ST4D	Na, TH, Ca, EC, SO_4, Cl
		Twice Daily (Morning and Afternoon)
Filter 1	SF1E	SDI
Filter 2	SF2E	SDI
CW2	SW2D	SDI
CW4	SW4D	SDI
CW5	SW5D	SDI
CW6	SW6D	SDI

LOS BANOS DEMONSTRATION DESALTING FACILITY
ION-EXCHANGE OPERATIONS SCHEDULE
REVERSE-OSMOSOS BRINE REGENERATION
May 26, 1986

Test 3.
Two-unit continuous operation.
Service flow at 230 gallons per minute.

Waste brine to IX sump.
Used brine to T2 or T3.
Rinse to RWPS.

Event Number	Event Description	Duration (minutes)	Component Operation or Valve Open		Process Flow		
			Unit 1	Unit 2	Unit	From	To
1	Recycled brine regeneration 1	13	IP 5, A 1 IV 15,12,7,9,22	IP 5, A 2 IV 115,112,107,109,122	1 2	T4 T4	IX sump IX sump
2	Recycled brine regeneration 2	23	IP 5, A 1 IV 15,12,7,4,23	IP 5, A 2 IV 115,112,107,104,123	1 2	T4 T4	T2 T3
3	Fresh brine regeneration	14	IP 1, A 1 IV 17,39m,13,7,4,23	IP 1, A 2 IV 18,139m,113,107,104,123	1 2	T1 T1	T2 T3
4	Rinse A	5	IP 7, A 1 IV 1,7,19,23	IP 9, A 2 IV 101,107,119,123	1 2	CW1 CW2	T2 T3
5	Rinse B	4	IP 7, A 1 IV 2,7,19,23	IP 9, A 2 IV 102,107,119,123	1 2	CW1 CW2	T2 T3
6	Rinse C	0	IP 7, A 1 IV 2,7,10,22	IP 9, A 2 IV 102,107,110,122	1 2	CW1 CW2	IX sump IX sump
7	Rinse D	16	IP 7 IV 2,7,10,21	IP 9 IV 102,107,110,121	1 2	CW1 CW2	RWPS RWPS
8	Service	87	IP 7,2 IV 7,11 CSOV 1	IP 9,102 IV 107,111 CSOV 6	1 2	CW1 CW2	CW3 CW4
9	Settling in T2 or T3 during service	60	A 1*	A 2*	1 2	Settling in T2 Settling in T3	
10	Set up for regeneration to T4 during service	28	IP 6 IV 5	IP 6 IV 105	1 2	T2 T3	T4 T4
11	Drain	3	IV 6,10,21 A 1	IV 106,110,121 A 2	1 2	Unit 1 Unit 2	RWPS RWPS
12	Delay	0	A 1	A 2			

*Agitators are not in operation during event 7 and part of event 8. Agitators are placed back into operation after event 10 is completed during event 8. (For all other events, agitators are in operation.)

Abbreviations:
A = agitator
CW = clearwell
CSOV = chlorine solenoid valve
IP = ion-exchange pump
IV = ion-exchange valve
IX = ion exchange
m = manual valve
RWPS = return water pump station
T = brine tank

GENERAL STARTUP AND OPERATION INSTRUCTIONS FOR DESALTING TEST 1

1. Verify that all items on ion-exchange system startup preparation list have been performed.

2. Start ion-exchange units. Operate units according to operation schedule.

3. When CW3 is at 15 feet, transfer the process water from the CW3 to CW5 using one transfer pump. Adjust the flowrate into CW5 by throttling the pump discharge valve. The flowrate from CW3 into CW5 is to be that of the RO2 influent rate (92 gpm).

4. Acidify the process water during transfer to CW5 as required by RO2.

5. Check free chlorine content in CW5. The free chlorine content is to be in the range of 0.5 to 1.0 mg/L. If necessary, inject chlorine into CW5 through CSOV7.

6. Start RO2 and data acquisition system when CW5 reaches 12 feet. Product and reject rates are to be 46 gpm each. Dechlorinate influent as required by manufacturer.

7. Chlorinate the RO2 reject brine as it enters CW6 to the range as stated in Item 5 above.

8. Start RO3 when CW6 reaches 12 feet. Dechlorinate influent process water as required. Product and reject rates are to be 23 gpm.

9. Start EDR unit when adequate supply of feedwater is available in CW8. Operate EDR so that reject brine flowrate is 6 gpm.

10. Periodically check water levels in CW2, CW3, CW5, CW6, and CW8. These levels should remain relatively constant. Adjust flowrates as necessary.

11. Periodically check brine levels in T1, T2, T3, and T4. Levels in T1 and T4 should remain relatively constant when all systems are in operation. Levels in T2 and T3 should be gaining about 4 inches per regeneration for the first week of operation and remain in a constant range for the remainder of the test program.

12. The free chlorine content in CW1, CW2, CW3, CW4, CW5, and CW6 should remain within the range of 0.5 to 1.0 mg/L. Dosage rates are to be adjusted accordingly. For CW1 and CW2, this range is critical due to the degradation of the ion-exchange resin with Cl_2 content over 1.0 mg/L.

13. The data acquisition system is to be initiated whenever the RO system is in operation. Notify computer operations (Sylvia, Tony, or Mark) before RO startup.

14. Scale inhibitor (SHMP) is not to be used in operation of the RO system.

ION-EXCHANGE SYSTEM STARTUP PREPARATION LIST
April 23, 1986

The following items should be checked or performed before operation of the ion-exchange system:

1. CSOV1 and CSOV6 switches in chlorine shed placed in AUTO mode.
2. CW1 and CW2 isolation valves open.
3. IX1 isolation valves open.
4. IX2 isolation valves open.
5. T1, T2, T3, and T4 isolation valves open.
6. Check level of brine in T1, T2, T3, and T4. Transfer brine as necessary.
7. IX valve switches in remote control panel on AUTO position (IV21, IV121, IV22, IV122, IV23, and IV123).
8. CW3 isolation valves open. (Note: CW4 will not be used during Desalting Test 1.)
9. Chlorine pipeline isolation valve into CW3 and CW4 open.
10. Cartridge filter isolation valves open.
11. Main circuit breakers for IX pumps to ON position (IP1, IP5, IP6, IP7, IP8, and IP9).
12. IX valve and pump switches in RO/IX office on AUTO position (except IP2 and IP3 are to be OFF).
13. IX control program on Analog computer initiated.
14. AUTO button on Analog computer pressed in.
15. Adjust event durations according to current schedule.

Preparation complete.

INSTRUCTIONS FOR DRY RUN OF ION-EXCHANGE SYSTEM
April 23, 1986

1. Place main circuit breakers for IP1, IP2, IP3, IP5, IP6, IP7, IP8, and IP9 to OFF position.

2. Close isolation valves for:

   a. CW1, CW2, CW3, and CW4
   b. T1, T2, T3, and T4.
   c. IX1.
   d. IX2.
   e. Cartridge filters.
   f. Chlorine line into CW3 and CW4.

3. Place IX valve switches in remote control panel to AUTO position (IV21, IV121, IV22, IV122, IV23, and IV123).

4. Place IX valve and pump switches in RO/IX office to AUTO position.

5. Initiate IX operations program.

6. AUTO button on Analog computer pressed in.

7. Adjust event times for both IX units according to the following schedule:

Event Number	Description	Duration (minutes)
1	Recycled brine regeneration 1	3
2	Recycled brine regeneration 2	3
3	Fresh brine regeneration	3
4	Rinse A	3
5	Rinse B	3
6	Rinse C	3
7	Rinse D	3
8	Service	33
9	Settling in T2 or T3	3
10	Setup for regeneration: T2 or T3 to T4	13
11	Drain	3
12	Delay	3

8. Start IX1.

9. Start IX2.

10. Verify valve openings and other operations for the cycle.

11. Document malfunctioning valves or errant operations.

ION-EXCHANGE SYSTEM DEFAULT TIMES*
April 23, 1986

Event Number	Description	Duration (minutes)
1	Recycled brine regeneration 1	13
2	Recycled brine regeneration 2	29
3	Fresh brine regeneration	8
4	Rinse A	5
5	Rinse B	4
6	Rinse C	0
7	Rinse D	16
8	Service	180
9	Settling in T2 or T3	120
10	Setup for T4	28
11	Drain	3
12	Delay	32

*Default times are based upon the following criteria:

1. EDR brine flow into T1 is 6 gpm.
2. Influent to RO2 is 92 gpm.

APPENDIX G

MAIN UNIT PERIOD 4 OPERATIONS

Ion-Exchange System
July and August 1986

Operation Log
Operation Parameters and Results
Reverse-Osmosis Reject Brine Analyses
Results of Hardness Leakage Test
Instructions for Dry Run of IX System
General Start-Up Preparation List

OPERATION LOG - 1986

Date	Unit	Time	Action/Comments
July 1	1 & 2	14:30	off
7	1 & 2	7:30	Obtained resin samples from each column.
8	1 & 2	9:05	Backwashed for 50 min. and stored Unit 2 in T1 brine.
	1	12:07	Reinstalled Unit 1's 110 gpm flow valve.
9	1	15:30	Obtained oper. pressures through 110 gpm flow valve.
10	1	15:40	Reinstalled 100 gpm flow valve.
11	1	16:40	Stored in T1 brine.
18	2	18:48	I/S to CWs 3 and 4.
	2	21:50	S/D
21	2	8:07	Column B glass gage leak repaired.
	2	14:37	I/S to CWs 3 and 4
	2	16:05	I/S to CWs 3 and 4
	2	18:08	S/D in regeneration
	2	19:35	I/S to CWs 3 and 4
		19:50	Pumped brine from s.s.pond to T1 to 11 ft..
	2	21:39	S/D -acid pump suction line leaking.
		10:55	CW3 at 20'2",CW4 at 19'11" and CW5 at 18'7".
22	2	12:00	I/S start regeneration
		22:55	EDR I/S
23	2	16:10	I/S regeneration
		16:13	Voltage dip, lost plant operations
	2	17:35	I/S regeneration
25	2	17:00	6" drained from T4 to IX sump
	2	17:45	8" drained from T3 to IX sump
27		20:30	IX computer malfunction, lost program
	2	21:00	start regeneration by hand
	2	23:30	S/D by hand, problems with IX computer and acid pump
		23:37	S/D EDR, RO2, RO3 and acid and transfer pumps
28	2	15:10	I/S
		15:35	I/S RO2, RO3 and EDR
29	2	4:20	IX computer screen found blank, computer not
		12:18	operating. Attempt to halt and restart failed, stuck
		12:45	in run mode.
	2	6:47	I/S by hand
	2	8:22	S/D
30	2	MN Cond.	I/S to CWs 3 and 4 to CW5
		10:13	EDR S/D, leaking electrode line
31	2	MN Cond.	I/S to CWs 3 and 4 to CW5; EDR S/D
		3:30	IX computer not working
	2	9:15	I/S event 8, service
Aug. 1	2	MN Cond.	I/S to CWs 3 and 4 to CW5; EDR to T1
		8:00	EDR S/D for repairs
		12:00	EDR I/S
2	2	MN Cond.	I/S to CWs 3 and 4 to CW5; EDR to T1
3	2	MN Cond.	I/S to CWs 3 and 4 to CW5; EDR to T1
		22:10	EDR S/D; T1 at 12'4"

OPERATION LOG - 1986

Date	Unit	Time	Action/Comments
Aug. 4	2	MN Cond.	I/S to CWs 3 and 4 to CW5; EDR S/D
		9:50	Regeneration times changed according
		7:30	to new operations schedule
		10:55	RO1 I/S
5	2	MN Cond.	I/S to CWs 3 and 4 to RO1, RO3 to T1
6	1 & 2	MN Cond.	I/S to CWs 3 and 4 to RO1, RO3 to T1
	1 & 2	11:27	Tested for leakage through both units
		12:00	in Rinse D and Service
7	1 & 2	MN Cond.	I/S to CWs 3 and 4 to RO1, RO3 to T1
		21:46	Problems with IX computer
8	1 & 2	MN Cond.	I/S to CWs 3 and 4 to RO1, RO3 to T1
	1	9:56	S/D, RO1 pump seal failure
10	2	12:50	IX computer malfunction
	2	14:01	I/S
11	2	13:46	Sample taken at end of service: Ca 1.0 and
	1,2	MN Cond.	TH 3.4 as meq/l
12		14:50	EDR S/D
		17:35	EDR I/S but no voltage on stg 2 in cathode
		8:55	polarity
13		1:00	EDR stg. 2 negative voltage working
		15:00	IX computer screen dark, but regained screen
	1,2	MN Cond.	by tapping return
14		7:20	EDR S/D for service/repair/modifications
		12:20	EDR I/S
18		9:45	IX program change: Event1 to RWPS instead
		15:08	of IX sump
		13:35	EDR S/D due to RO3 S/D
20	2	14:30	S/D with RO2 because of RO3 troubles,
			and high SiO2 and SDI levels

Note: Both units remained OFF for remainder of month due to high SiO2 and SDI.

Total hardness removed during Service Event for operation conditions

Month: July and August, 1986 SERVICE
Bed Volume: 4860 liters

Date	Flow (gpm)	Duration (minutes)	Total Hardness Influent (meq/l)	Total Hardness Effluent (meq/l)	Calcium Effluent (meq/l)	Influent Na:TH (ratio)	T.Hardness Removed (eq/l of resin)
July 16			IX System OFF				
17			IX System OFF				
18	230	120	28.0	NA	1.3	1.69	NA
19			IX System OFF				
20			IX System OFF				
21	230	120	28.2	NA	NA	1.36	NA
22	230	120	29.6	15.6	6.0	1.11	0.301
23	230	120	20.0	14.4	5.5	1.47	0.120
24	230	120	17.2	3.2	0.7	1.64	0.301
25	230	120	19.4	2.6	1.0	1.34	0.361
26	230	120	20.4	2.8	1.3	1.49	0.378
27	230	120	19.2	3.6	1.5	1.82	0.335
28	230	120	16.6	2.8	1.0	1.77	0.297
29	230	120	13.5	2.8	1.0	2.01	0.230
30	230	120	11.2	2.6	1.0	1.72	0.185
31	230	120	22.4	2.8	1.0	1.21	0.421
Aug. 1	230	120	3.6	2.8	1.0	6.88	0.017
2	230	120	10.8	2.6	1.0	2.94	0.176
3	230	120	10.4	1.8	1.0	1.19	0.185
4	230	120	11.6	1.8	1.0	1.27	0.211
5	230	120	10.4	7.2	4.0	1.19	0.069
6	230	120	11.4	2.2	1.5	1.18	0.198
7	230	120	11.2	2.4	1.5	2.12	0.189
8	230	120	11.0	3.4	3.5	NA	0.163
9	230	120	12.4	4.6	2.5	1.91	0.168
10	230	120	11.8	3.6	1.0	2.30	0.176
11	230	120	11.4	6.2	1.0	2.29	0.112
12	230	120	13.6	3.6	1.0	1.92	0.215
13	230	120	11.6	5.0	1.0	NA	0.142
14	230	120	13.6	2.4	1.0	2.08	0.241
15	230	120	12.4	2.6	1.0	NA	0.211
16	230	120	13.4	2.2	1.5	1.85	2.410
17	230	120	12.6	NA	1.3	2.42	NA
18	230	120	13.6	NA	1.3	NA	NA
19	230	120	14.6	NA	1.5	NA	NA
20			IX System OFF				
21			IX System OFF				

Sodium Throughput during regeneration for operating conditions
Month: July and August, 1986

REGENERATION

Date	Flow		Duration		Sodium		Sodium Throughput		
	Recycle Brine	Fresh Brine	Recycle Brine	Fr. Brine	Recycle Brine	Fresh Brine	Recycle Brine	Fresh Brine	Total
	(gpm)		(minutes)		(meq/l)		(eq/l of resin)		
July 16	1540	NA	NA	1325	NA	NA	NA	NA	NA
17	1320	NA	NA	1175	NA	NA	NA	NA	NA
18	1400	NA	25	1090	NA	NA	NA	NA	NA
19	730	NA	30	990	NA	NA	NA	NA	NA
20	NA	NA	NA	910	NA	NA	NA	NA	NA
21	1410	NA	NA	885	NA	NA	NA	NA	NA
22	1480	780	120	755	NA	NA	NA	NA	NA
23	1000	720	110	675	NA	NA	NA	NA	NA
24	860	160	14	650	NA	NA	NA	NA	NA
25	970	130	20	600	NA	NA	NA	NA	NA
26	1020	140	25	700	NA	NA	NA	NA	NA
27	960	180	30	805	NA	NA	NA	NA	NA
28	830	140	20	675	NA	NA	NA	NA	NA
29	676	140	20	625	NA	NA	NA	NA	NA
30	560	130	20	442	NA	NA	NA	NA	NA
31	1120	140	20	625	NA	NA	NA	NA	NA
Aug. 1	180	140	20	570	NA	NA	NA	NA	NA
2	540	130	20	730	NA	NA	NA	NA	NA
3	520	90	20	285	NA	NA	NA	NA	NA
4	580	90	20	340	NA	NA	NA	NA	NA
5	520	360	80	285	NA	NA	NA	NA	NA
6	570	110	30	310	NA	NA	NA	NA	NA
7	560	120	30	545	NA	NA	NA	NA	NA
8	550	170	70	NA	NA	NA	NA	NA	NA
9	620	230	50	545	NA	NA	NA	NA	NA
10	590	180	20	625	NA	NA	NA	NA	NA
11	570	310	20	600	NA	NA	NA	NA	NA
12	680	180	20	600	NA	NA	NA	NA	NA
13	580	250	20	NA	NA	NA	NA	NA	NA
14	680	120	20	650	NA	NA	NA	NA	NA
15	620	130	20	NA	NA	NA	NA	NA	NA
16	670	110	30	570	1500.0	NA	11.60	NA	NA
17	630	NA	25	700	1760.9	1652.2	13.61	1.47	15.09
18	680	NA	25	NA	3913.0	1913.0	30.25	1.71	31.96
19	730	NA	30	NA	1521.7	1934.8	11.76	1.73	13.49
20	IX System OFF				1673.9	2173.9	12.94	1.94	14.88
21	IX System OFF				1043.5	1478.3	8.22	1.15	9.38

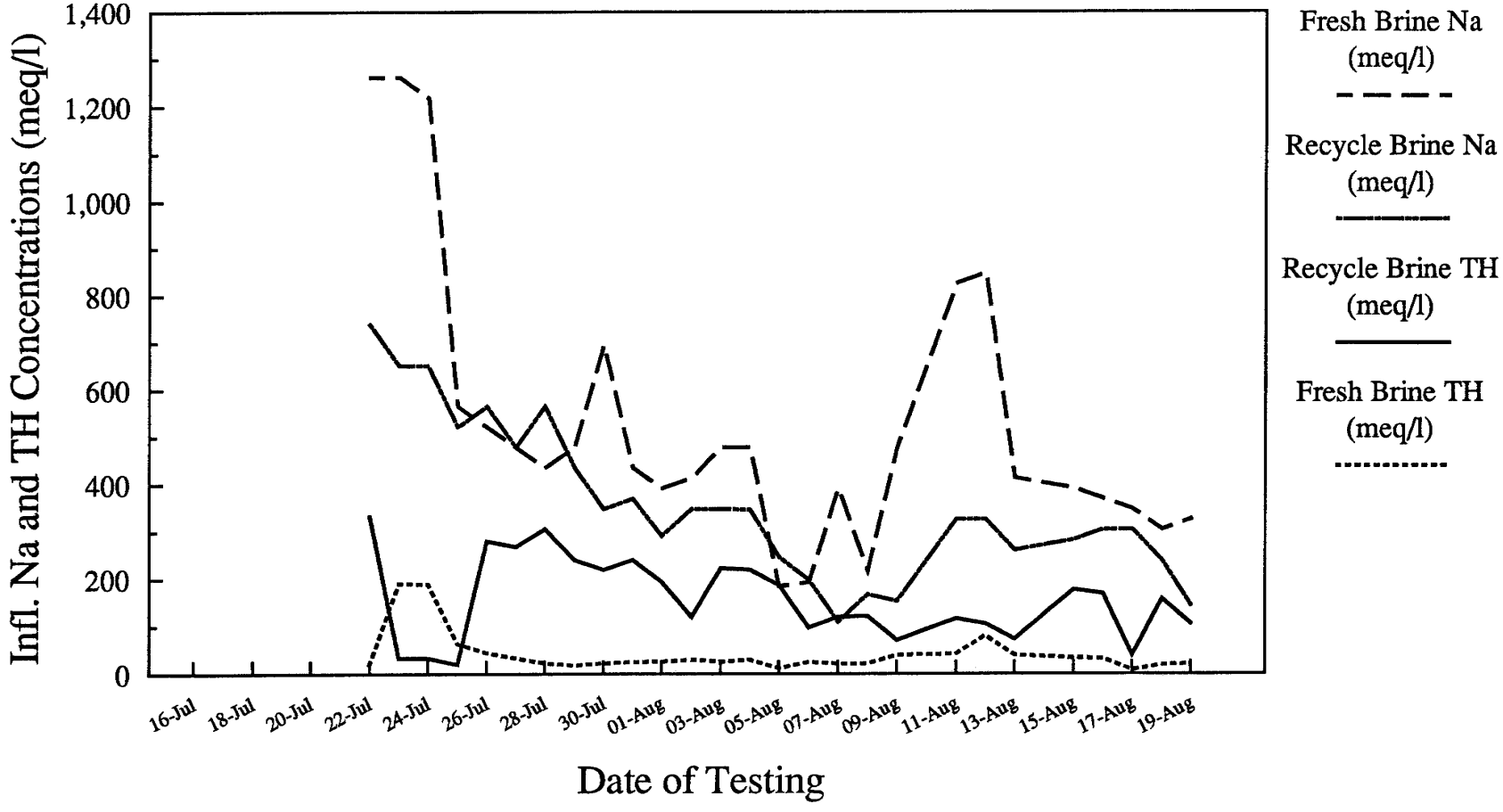
Month: July and August, 1986
IX Unit: 2
Comparison of Total Hardness and Sodium in regenerant brines

	Recycle Brine			Frech Brine		
	TH	Na	Ratio	TH	Na	Ratio
Date			Na:TH			Na:TH
July 16			IX System Off			
17			IX System Off			
18	NA	NA	NA	NA	NA	NA
19			IX System Off			
20			IX System Off			
21	NA	NA	NA	NA	NA	NA
22	332.8	739.5	2.2	20.8	1261.4	60.6
23	34.0	652.5	19.2	190.6	1261.4	6.6
24	34.0	652.5	19.2	190.0	1217.9	6.4
25	20.0	522.0	26.1	63.6	565.5	8.9
26	280.0	565.5	2.0	44.0	522.0	11.9
27	268.0	478.5	1.8	34.0	478.5	14.1
28	306.0	565.5	1.8	22.0	435.0	19.8
29	240.0	435.0	1.8	17.2	478.5	27.8
30	220.0	348.0	1.6	22.0	696.0	31.6
31	240.0	369.7	1.5	24.6	435.0	17.7
Aug. 1	194.0	291.4	1.5	26.0	391.5	15.1
2	120.0	348.0	2.9	30.0	413.2	13.8
3	224.0	348.0	1.6	26.0	478.5	18.4
4	220.0	347.1	1.6	30.0	478.5	15.9
5	186.4	246.0	1.3	12.2	184.4	15.1
6	98.0	197.7	2.0	25.4	193.3	7.6
7	120.8	109.8	0.9	21.0	391.5	18.6
8	121.6	167.0	1.4	21.6	217.5	10.1
9	70.8	154.0	2.2	39.2	478.5	12.2
10	NA	NA	NA	NA	NA	NA
11	116.4	326.2	2.8	42.2	826.4	19.6
12	106.0	326.2	3.1	80.0	848.2	10.6
13	73.6	261.0	3.5	40.0	413.2	10.3
14	NA	NA	NA	NA	NA	NA
15	177.2	282.7	1.6	33.6	391.5	11.7
16	168.0	304.5	1.8	32.0	369.7	11.6
17	40.0	304.5	7.6	8.6	348.0	40.5
18	158.0	239.2	1.5	19.2	304.5	15.9
19	106.0	144.8	1.4	21.8	326.2	15.0
20			IX System Off			

Influent Total Hardness and Sodium Concentration

Ion Exchange Regenerant Brines

July and August, 1986



CLEARWELL 1 - SAMPLE TAP SW1D ION EXCHANGE INFLUENT

Date	Time	TH	Ca	Cl2-F	SiO2	Turb	EC	pH	Cl	Na	SO4	TOC
1986		(meq/l)		(mg/l)		(NTU)	(uS/cm)		(meq/l)			(mg/l)
July 15	7:30	36.0	16.5	0.2	19	0.1	7200	7.4	25.8	60.0	60.4	NA
16	7:30	30.8	14.0	0.2	15	0.6	6600	7.4	NA	51.1	NA	5
17	7:30	28.0	14.0	0.2	13	0.2	6000	7.5	20.7	46.5	56.3	NA
18	7:30	28.0	13.0	0.2	19	0.1	5900	7.5	NA	46.3	NA	7
19	7:30	26.4	13.0	0.2	20	0.7	5400	7.5	NA	41.7	NA	NA
20	7:30	21.0	15.0	0.1	15	0.2	5300	7.2	NA	36.1	NA	NA
21	7:30	35.6	28.0	0.2	5	0.1	4600	7.3	NA	33.9	NA	7
22	7:30	25.6	10.0	0.1	19	0.1	4700	7.3	15.9	36.1	31.3	NA
23	7:30	26.2	12.0	0.5	18	0.1	4200	7.2	NA	30.4	NA	7
24	7:30	18.6	8.0	0.3	19	0.1	4600	7.3	10.8	29.3	29.2	NA
25	7:30	18.4	9.0	0.3	18	0.2	3900	7.2	NA	26.1	NA	6
26	7:30	24.8	11.0	0.3	15	5.2	3800	7.3	NA	30.4	NA	NA
27	7:30	22.8	8.0	0.4	20	0.5	4400	7.2	NA	30.4	NA	NA
28	7:30	15.8	18.0	0.2	20	0.2	3800	7.5	NA	30.4	NA	2
29	7:30	13.2	7.0	0.2	20	0.1	3400	7.5	14.1	26.1	20.8	NA
30	7:30	10.8	6.0	0.2	22	0.1	2560	7.1	NA	18.1	NA	3
31	7:30	31.6	10.5	0.1	21	0.3	3800	7.3	13.1	27.2	25.4	NA
Aug 1	7:30	4.6	1.5	0.2	22	0.2	3800	7.6	NA	27.2	NA	1
2	7:30	11.4	6.0	0.2	18	1.6	2800	7.7	NA	18.0	NA	NA
3	7:30	10.2	5.5	0.2	25	0.6	2600	7.5	NA	12.4	NA	NA
4	7:30	10.8	6.5	0.2	25	0.3	2400	7.5	NA	43.3	NA	1
5	7:30	10.4	6.0	0.2	32	0.3	2200	7.4	32.4	12.4	14.2	NA
6	7:30	10.8	5.5	0.3	32	0.3	2700	7.4	NA	13.5	NA	1
7	7:30	11.0	6.0	0.2	26	0.3	2600	7.2	8.0	20.4	16.3	NA
8	7:30	12.8	7.0	0.2	35	0.2	3000	7.4	NA	NA	NA	NA
9	7:30	13.2	7.0	0.1	35	1.2	3200	7.4	NA	22.6	NA	NA
10	7:30	153.6	6.5	0.2	40	0.4	3500	7.3	NA	24.8	NA	NA
11	7:30	11.2	6.0	0.1	34	0.5	3400	7.1	NA	24.8	NA	NA
12	7:30	12.2	6.0	0.2	35	0.5	3000	7.3	7.0	27.2	21.7	NA
13	7:30	15.4	6.5	0.1	34	1.1	3000	7.5	NA	NA	NA	NA
14	7:30	13.4	6.0	0.2	34	0.9	3100	7	10.3	29.3	19.2	NA
15	7:30	13.0	6.5	0.2	40	1	3075	7.4	NA	NA	NA	NA
16	7:30	13.2	7.0	0.2	52	1.1	3300	7.3	NA	24.8	NA	NA
17	7:30	12.0	7.0	0.2	40	1.1	3900	7.4	NA	28.3	NA	NA
18	7:30	13.8	7.0	0.2	48	3.9	3500	7.2	NA	NA	NA	NA
19	7:30	14.0	7.5	0.3	38	1	3500	7.2	NA	NA	NA	NA
20	7:30	13.6	7.5	0.1	36	1	3570	7	NA	NA	NA	NA
21	7:30	13.8	7.5	0.1	38	0.9	3500	7.1	NA	NA	NA	NA
22	7:30	14.2	7.5	NA	38	0.9	3500	7.3	NA	NA	NA	NA
23	7:30	15.4	7.5	0.1	40	1.1	3600	7.6	NA	NA	NA	NA
24	7:30	15.6	9.0	0.1	48	0.8	4300	7.6	NA	NA	NA	NA
25	7:30	14.2	7.5	0.1	40	1	3700	7.2	NA	NA	NA	NA
Num.of Anal.		42	42	41	42	42	42	42	10	31	10	10
Mean		20.7	9.0	0.2	28.1	0.7	3831	7.3	15.8	30.0	29.5	4.0
StandardDev.		22.4	4.6	0.1	11.1	1	1125	0.2	8.2	11.2	16.1	2.7
Lower95%C.L		13.8	7.6	0.0	24.0	0.0	3483	7.0	10.6	25.9	19.2	2.0
Upper95%C.L		27.6	10.4	0.2	31.6	1.0	4178	7.4	21.0	34.0	39.7	5.7

CLEARWELL 2 - SAMPLE TAP SW2D ION EXCHANGE INFLUENT

Date	Time	TH	Ca	Cl2-F	SiO2	Turb	EC	pH	Cl	Na	SO4	TOC
1986		(meq/l)		(mg/l)		(NTU)	(uS/cm)		(meq/l)			(mg/l)
July 15	7:30	35.2	19.5	0.2	16	1	8600	7.3	29.2	70.9	70.8	NA
16	7:30	30.8	17.5	0.2	16	0.2	7200	7.4	NA	57.6	NA	5
17	7:30	26.4	14.0	0.2	14	0.3	6600	7.4	21.5	51.1	52.1	NA
18	7:30	28.0	14.0	0.2	19	0.6	5600	7.6	NA	47.4	NA	7
19	7:30	24.0	15.5	0.1	20	3.5	5300	7.2	NA	43.0	NA	NA
20	7:30	25.2	12.0	0.1	14	0.4	5300	7.3	NA	39.6	NA	NA
21	7:30	28.2	32.0	0.2	5	0.1	5000	7.2	NA	38.5	NA	9
22	7:30	29.6	9.5	0.1	19	0.3	4600	7.3	14.1	32.8	34.4	NA
23	7:30	20.0	12.3	0.3	18	0.2	4200	7.3	NA	29.3	NA	6
24	7:30	17.2	11.0	0.3	18	0.1	3800	7.3	10.3	28.3	31.3	NA
25	7:30	19.4	9.5	0.3	18	0.5	4000	7.1	NA	26.1	NA	5
26	7:30	20.4	9.0	0.4	17	1.7	3700	7.3	NA	30.4	NA	NA
27	7:30	19.2	8.0	0.4	20	0.4	3900	7.3	NA	35.0	NA	NA
28	7:30	16.6	7.5	0.2	18	0.1	3800	7.5	NA	29.3	NA	2
29	7:30	13.5	7.5	0.2	17	0.1	3500	7.5	11.7	27.2	25.0	NA
30	7:30	11.2	6.5	0.2	22	0.2	2600	7.1	NA	19.2	NA	1
31	7:30	22.4	12.0	0.2	22	0.3	4200	7.2	13.1	27.2	24.6	NA
Aug 1	7:30	3.6	2.0	0.2	22	0.2	3700	7.6	NA	24.8	NA	1
2	7:30	10.8	6.0	0.2	20	2.3	2900	7.6	NA	31.7	NA	NA
3	7:30	10.4	6.0	0.2	25	0.3	2200	7.5	NA	12.4	NA	NA
4	7:30	11.6	6.5	0.2	27	0.2	2400	7.4	NA	14.8	NA	2
5	7:30	10.4	6.5	0.2	32	0.3	2350	7.3	31.0	12.4	14.6	NA
6	7:30	11.4	5.5	0.3	32	0.2	2400	7.4	NA	13.5	NA	1
7	7:30	13.0	7.0	0.2	28	0.2	2600	7.3	8.0	23.7	14.6	NA
8	7:30	11.0	7.0	0.1	35	0.4	2900	7.4	NA	NA	NA	NA
9	7:30	12.4	15.5	0.2	34	0.9	3300	7.3	NA	23.7	NA	NA
10	7:30	11.8	6.5	0.2	44	0.5	3200	7.2	NA	27.2	NA	NA
11	7:30	11.4	6.0	0.2	36	0.4	3000	7	NA	26.1	NA	NA
12	7:30	13.6	6.5	NA	35	0.5	3100	7.3	8.9	26.1	23.3	NA
13	7:30	11.6	6.0	0.2	36	1	3200	7.4	NA	NA	NA	NA
14	7:30	13.6	6.0	0.4	34	0.9	3200	7.1	9.9	28.3	50.0	NA
15	7:30	12.4	6.5	0.3	40	1	3200	7.3	NA	NA	NA	NA
16	7:30	13.4	7.0	0.3	40	1.6	3000	7.2	NA	24.8	NA	NA
17	7:30	12.6	14.5	0.2	32	1.1	3600	7.3	NA	30.4	NA	NA
18	7:30	13.6	7.0	0.1	40	1.2	3500	7.2	NA	NA	NA	NA
19	7:30	14.6	7.0	0.3	38	1.1	3500	7.2	NA	NA	NA	NA
20	7:30	12.4	7.0	0.2	36	1	3570	7.1	NA	NA	NA	NA
21	7:30	13.4	7.0	0.2	36	1	3500	7	NA	NA	NA	NA
22	7:30	14.2	7.5	NA	40	1	3600	7.3	NA	NA	NA	NA
23	7:30	15.0	7.5	0.2	40	1.2	3800	7.5	NA	NA	NA	NA
24	7:30	14.2	7.5	0.2	40	1.1	3800	7.5	NA	NA	NA	NA
25	7:30	14.0	7.5	0.1	40	1.1	3800	7.2	NA	NA	NA	NA
Num.of Anal.		42	42	40	42	42	42	42	10	31	10	10
Mean		16.5	9.5	0.2	27.5	0.7	3834	7.3	15.8	30.7	34.1	3.9
StandardDev.		6.9	5.2	0.1	10.1	0.7	1305	0.2	8.5	12.9	18.2	2.9
Lower95%C.L		14.3	7.8	0.0	24.0	0.0	3431	7.0	10.4	26.1	22.5	2.0
Upper95%C.L		18.6	11.0	0.2	30.6	0.9	4236	7.4	21.1	35.3	45.6	5.7

CLEARWELL 3 - SAMPLE TAP SW3D ION EXCHANGE EFFLUENT

Date	Time	TH	Ca	Cl2-F	SiO2	Turb	EC	pH	Cl	Na	SO4
1986		(meq/l)		(mg/l)		(NTU)	(uS/cm)		(meq/l)		
Aug. 4	7:30	1.8	4.5	NA	27.0	0.5	3600	7.6	NA	22.6	NA
5	7:30	7.2	4.0	NA	30.0	0.3	3000	7.3	14.1	18.1	18.8
6	7:30	2.2	0.5	NA	34.0	0.2	3000	7.5	NA	24.8	NA
7	7:30	2.0	1.5	NA	36.0	0.2	3200	7.4	14.1	29.3	20.8
8	7:30	3.4	1.5	0.1	36.0	0.3	3100	6.9	NA	NA	NA
9	7:30	4.6	2.5	0.4	36.0	0.3	3500	7.3	NA	35.4	NA
10	7:30	3.6	1.0	0.1	33.0	2.2	4300	7.4	NA	760.9	NA
12	7:30	3.6	1.0	0.3	36.0	0.4	3800	7.4	9.4	37.4	28.1
13	7:30	5.0	1.0	NA	39.0	0.5	3500	7.2	NA	NA	NA
16	7:30	2.2	1.5	NA	44.0	0.7	2400	7.2	NA	31.7	NA
Num.of Anal.		10	10	4	10	10	10	10	3	8	3
Mean		3.6	1.9	0.2	35.1	0.6	3340	7.3	12.5	120.0	22.6
StandardDev.		1.7	1.4	0.1	4.7	0.6	521	0.2	2.7	259.0	4.9
Lower95%C.L.		2.5	1.0	0.0	32.0	0.0	3010	7.0	9.4	-63.1	16.9
Upper95%C.L.		4.6	2.8	0.4	38.0	0.9	3670	7.4	15.6	303.2	28.3

CLEARWELL 5 - SAMPLE TAP SW5D ION EXCHANGE EFFLUENT

Date	Time	TH	Ca	Cl2-F	SiO2	Turb	EC	pH	Cl	Na	SO4
1986		(meq/l)		(mg/l)		(NTU)	(uS/cm)		(meq/l)		
July 22	7:30	15.6	6.0	NA	NA	0.3	8200	NA	20.6	71.3	47.9
23	7:30	14.4	5.5	NA	18	0.2	105300	5.9	NA	48.7	NA
24	7:30	3.2	0.7	0.2	NA	0.2	45000	3.4	10.8	44.3	28.1
25	7:30	2.6	1.0	0.2	NA	0.1	4600	5.9	NA	37.6	NA
26	7:30	2.8	1.0	0.2	NA	0.1	4000	5.6	NA	44.3	NA
27	7:30	3.6	1.5	0.2	NA	0.1	4100	6.2	NA	42.2	NA
28	7:30	2.8	1.0	0.2	NA	0.1	4400	6.3	NA	37.6	NA
29	7:30	2.8	1.0	0.1	NA	0.1	4100	6.2	20.7	40.0	21.9
30	7:30	2.6	1.0	0.1	21	0.1	3200	5.1	NA	28.8	NA
31	7:30	2.8	1.0	0.1	NA	0.3	3400	5.9	12.3	28.9	20.8
Aug. 1	7:30	2.8	1.0	0.1	21	0.2	4300	5.4	NA	42.2	NA
2	7:30	2.6	1.0	0.1	NA	0.2	3500	6.4	NA	28.3	NA
3	7:30	1.8	1.0	0.1	NA	0.2	2900	6.5	NA	33.3	NA
4	7:30	2.6	1.0	0.1	NA	0.2	5700	6.6	NA	21.5	NA
5	7:30	10.2	5.0	0.1	NA	0.7	5900	5.8	54.9	48.7	18.8
6	7:30	4.4	1.5	0.2	NA	0.9	6000	6.4	NA	55.4	NA
7	7:30	4.4	1.5	0.2	NA	0.8	6200	5.9	19.7	49.8	46.9
8	7:30	5.0	3.5	0.1	NA	0.4	6600	5.2	NA	NA	NA
9	7:30	5.6	2.5	0.1	NA	0.2	3600	6.7	NA	31.1	NA
10	7:30	3.6	1.5	0.1	NA	0.3	3600	6.8	NA	39.6	NA
11	7:30	6.2	3.0	0.1	NA	0.3	3600	4.8	NA	36.1	NA
12	7:30	3.6	1.5	NA	NA	0.4	3400	7.1	9.4	36.1	26.0
13	7:30	4.2	1.0	0.1	NA	0.5	3500	5.4	NA	NA	NA
14	7:30	2.4	1.0	0.2	NA	0.7	3500	5.6	9.9	39.6	24.0
15	7:30	2.6	1.0	0.2	NA	0.9	3490	5.8	NA	NA	NA
16	7:30	2.4	1.5	0.1	NA	0.9	3500	5.6	NA	31.7	NA
17	7:30	3.2	1.3	0.1	NA	1.1	3800	6	NA	38.5	NA
18	7:30	3.2	1.3	0.2	NA	0.9	3800	6	NA	NA	NA
19	7:30	4.6	1.5	0.3	NA	1	3700	5.7	NA	NA	NA
20	7:30	3.6	1.0	0.1	NA	0.7	3880	5.5	NA	NA	NA
21	7:30	2.4	1.3	0.1	NA	1	3800	5.9	NA	NA	NA
22	7:30	3.4	1.5	NA	NA	1	3900	6	NA	NA	NA
23	7:30	4.0	1.0	0.1	NA	1.3	3900	6	NA	NA	NA
24	7:30	4.8	1.0	0.1	NA	1.1	3900	5.8	NA	NA	NA
25	7:30	3.4	1.0	0.1	NA	0.9	3900	5.9	NA	NA	NA
Num.of Anal.		35	35	31	3	35	35	34	8	24	8
Mean		4.3	1.7	0.1	20.0	0.5	8291	5.9	19.8	39.8	29.3
StandardDev.		3.1	1.3	0.1	1.7	0.4	18265	0.7	15.0	10.4	11.5
Lower95%C.L.		3.2	1.2	0.0	18.0	0.0	2050	0.5	9.2	35.6	21.1
Upper95%C.L.		5.3	2.2	0.2	22.0	0.7	14530	6.1	30.4	44.0	37.5

CLEARWELL 6 - SAMPLE TAP SW6D REVERSE OSMOSIS UNIT 2 EFFLUENT

Date	Time	TH	Ca	Cl2-F	SiO2	Turb	EC	pH	Cl	Na	SO4
1986		(meq/l)		(mg/l)		(NTU)	(uS/cm)		(meq/l)		
July 22	7:30	26.0	9.0	NA	NA	7.2	12800	NA	39.4	124.3	104.2
23	7:30	9.6	7.3	NA	42	0.2	83400	5.3	NA	115.2	NA
24	7:30	12.8	2.0	0.1	39	0.1	5100	5.9	21.1	102.0	85.4
25	7:30	4.2	1.5	0.1	33	0.2	9500	5.7	NA	99.8	NA
26	7:30	2.8	1.0	0.1	30	0.7	8500	5.9	NA	110.9	NA
27	7:30	8.0	2.0	0.1	60	0.1	8900	5.8	NA	110.9	NA
28	7:30	4.8	1.5	0.1	45	0.1	9100	5.9	NA	108.7	NA
29	7:30	3.8	1.5	0.1	45	0.1	8700	5.6	24.8	102.0	52.1
30	7:30	3.8	1.5	0.1	39	0.1	6900	5.3	NA	68.7	NA
31	7:30	3.4	1.0	0.1	48	0.2	6900	5.9	20.7	66.5	46.9
Aug. 1	7:30	3.8	1.5	0.1	48	0.4	8900	5.9	NA	88.7	NA
2	7:30	4.4	1.5	0.1	52	0.4	8000	6.2	NA	64.3	NA
3	7:30	4.0	1.0	0.1	48	0.5	6500	6.3	NA	64.3	NA
4	7:30	2.6	1.5	0.1	64	0.6	5900	6.7	NA	325.2	NA
5	7:30	7.4	4.5	0.1	120	1.9	10600	6.7	36.6	115.2	83.3
6	7:30	9.4	4.0	0.2	145	1	10800	6.5	NA	110.9	NA
7	7:30	6.8	3.5	0.2	112	0.9	11700	7	22.5	133.0	97.9
8	7:30	9.6	4.5	0.1	140	0.7	12200	4.7	NA	NA	NA
9	7:30	12.0	6.5	0.1	78	0.4	7200	6.6	NA	66.5	NA
10	7:30	7.2	3.5	0.1	72	0.4	7300	6.6	NA	84.8	NA
11	7:30	10.6	6.0	0.1	66	0.4	7100	5	NA	78.0	NA
12	7:30	6.2	3.5	NA	140	0.5	6900	7.2	19.7	78.3	58.3
13	7:30	6.0	2.0	0.1	78	1	6900	3.8	NA	NA	NA
14	7:30	4.6	2.0	0.2	78	1.1	7000	5.7	20.7	85.9	56.3
15	7:30	5.6	2.0	0.1	80	1.4	6900	5.6	NA	NA	NA
16	7:30	4.4	2.0	0.1	72	1.6	7000	5.3	NA	68.9	NA
17	7:30	4.2	1.8	0.1	72	1.3	6500	5	NA	71.3	NA
18	7:30	4.8	2.0	0.2	78	1.9	7270	5.8	NA	NA	NA
19	7:30	5.4	2.5	0.5	78	1.3	7100	4.7	NA	NA	NA
20	7:30	5.0	2.5	0.6	7.8	1.3	7750	4.6	NA	NA	NA
21	7:30	5.2	12.5	0.2	78	1.3	7700	4.3	NA	NA	NA
22	7:30	6.6	2.5	NA	78	1.3	7700	4.2	NA	NA	NA
23	7:30	6.4	2.5	0.2	72	1.4	7900	4.1	NA	NA	NA
24	7:30	6.6	2.0	0.2	80	1.3	7800	4.4	NA	NA	NA
25	7:30	5.6	2.5	0.2	78	1.2	7900	4.3	NA	NA	NA
Num.of Anal.		35	35	31	34	35	35	34	8	24	8
Mean		6.7	3.1	0.2	70.5	1.0	10238	5.5	25.7	101.9	73.0
StandardDev.		4.2	2.5	0.1	31.7	1.2	12849	1.0	7.8	52.0	22.3
Lower95%C.L.		5.2	2.3	0.0	59.0	0.0	5848	5.0	20.2	80.6	57.3
Upper95%C.L.		8.1	4.0	0.2	81.5	1.4	14627	5.8	31.2	123.1	88.8

CLEARWELL 8 - SAMPLE TAP SW8D REVERSE OSMOSIS UNIT 3 EFFLUENT

Date	Time	TH	Ca	Cl2-F	SiO2	Turb	EC	pH	Cl	Na	SO4
1986		(meq/l)		(mg/l)		(NTU)	(uS/cm)		(meq/l)		
July 22	7:30	106.8	29.5	NA	NA	1.8	44400	NA	242.3	521.7	416.7
23	7:30	23.2	10.5	NA	75	0.2	83100	4.5	NA	128.9	NA
24	7:30	9.6	2.5	NA	75	0.2	9900	5.6	46.5	201.7	125.0
25	7:30	7.4	3.0	NA	63	0.2	16000	5.4	NA	201.7	NA
26	7:30	5.8	2.0	NA	40	0.1	14600	5.5	NA	195.2	NA
27	7:30	8.0	3.0	NA	60	0.2	15100	5.1	NA	203.9	NA
28	7:30	7.4	3.5	NA	75	0.2	14900	5	NA	199.6	NA
29	7:30	6.4	2.5	NA	66	0.1	15600	4.3	56.3	217.4	108.3
30	7:30	6.4	7.5	NA	80	0.1	14000	2.9	NA	150.9	NA
31	7:30	6.6	4.0	NA	100	0.3	12600	5.9	46.9	137.4	104.2
Aug. 1	7:30	6.4	3.0	NA	96	1	16300	5.1	NA	170.7	NA
2	7:30	8.0	3.0	NA	92	0.7	15600	5.5	NA	168.5	NA
3	7:30	6.0	2.0	NA	92	1	13700	5.6	NA	153.9	NA
4	7:30	5.0	2.5	NA	120	1.1	11800	6.9	NA	148.5	NA
5	7:30	5.8	3.0	NA	130	1.8	11400	6.9	28.2	117.6	83.3
6	7:30	4.2	1.5	NA	130	0.9	10700	7	NA	122.0	NA
7	7:30	98.0	2.5	NA	132	1	12000	6.8	28.2	150.9	112.5
8	7:30	5.0	3.5	NA	150	1	12000	6.6	NA	NA	NA
9	7:30	20.0	13.0	NA	132	0.6	12200	6.8	NA	115.2	NA
10	7:30	12.4	7.0	NA	140	0.4	11700	6.8	NA	148.5	NA
11	7:30	20.4	11.0	NA	132	0.7	12800	4.7	NA	162.0	NA
12	7:30	11.0	6.5	NA	150	0.8	12200	7.4	34.6	146.3	112.5
13	7:30	8.6	4.0	NA	140	1.3	11700	3.5	NA	NA	NA
14	7:30	7.6	4.5	NA	132	2.9	11700	5.6	30.4	146.3	89.6
15	7:30	7.0	3.5	NA	100	1.8	11200	5.2	NA	NA	NA
16	7:30	7.2	3.5	NA	100	2.5	11600	4.8	NA	113.0	NA
17	7:30	6.4	2.5	NA	100	1.9	10800	4.3	NA	130.4	NA
18	7:30	7.4	3.5	NA	100	2.6	11190	5.4	NA	NA	NA
19	7:30	7.2	4.0	NA	114	1.7	10700	3.8	NA	NA	NA
20	7:30	7.6	4.0	NA	120	1.5	12100	3.9	NA	NA	NA
21	7:30	8.2	4.0	NA	119	4.8	11900	3.9	NA	NA	NA
22	7:30	8.0	4.0	NA	126	9.3	11800	3.6	NA	NA	NA
23	7:30	9.4	4.0	NA	112	6.7	11800	3.5	NA	NA	NA
24	7:30	8.2	4.0	NA	128	6.3	11800	4.1	NA	NA	NA
25	7:30	8.2	3.5	NA	126	5.0	12000	3.9	NA	NA	NA
Num.of Anal.		35	35	0	34	35	35	34	8	24	8
Mean		14.0	5.0	NA	106.7	1.8	15503	5.2	64.2	173.0	144.0
StandardDev.		22.5	5.0	NA	27.6	2.1	13039	1.2	72.7	80.5	111.0
Lower95%C.L.		6.3	3.3	NA	97.0	1.0	11048	4.0	12.8	140.1	65.5
Upper95%C.L.		21.7	6.7	NA	116.2	2.5	19957	5.6	115.6	205.9	222.5

BRINE TANK 1 - SAMPLE TAP ST1D ION EXCHANGE FRESH BRINE

Date	Time	Na	TH	Ca	EC	Temp.	TDS	SO4	Cl
1986		(meq/l)			(uS/cm)	(C)	(mg/l)	(meq/l)	
July 22	7:30	1260.9	20.8	56.0	108900	NA	97470	343.8	1239.4
23	7:30	1260.9	190.6	55.0	8600	NA	NA	1.5	703.9
24	7:30	1217.4	190.0	155.0	10100	NA	95300	383.3	1126.8
25	7:30	565.2	63.6	60.0	51400	NA	NA	NA	NA
26	7:30	521.7	44.0	18.5	44900	NA	NA	NA	NA
27	7:30	478.3	34.0	17.5	40800	NA	NA	NA	NA
28	7:30	434.8	22.0	12.5	40800	NA	NA	NA	NA
29	7:30	478.3	17.2	7.5	38400	NA	36300	312.5	147.9
30	7:30	695.7	22.0	8.5	36100	NA	NA	NA	NA
31	7:30	434.8	24.6	10.0	37400	NA	36900	354.2	46.5
Aug. 1	7:30	391.3	26.0	9.0	38100	NA	NA	NA	NA
2	7:30	413.0	30.0	10.5	39500	NA	NA	NA	NA
3	7:30	478.3	26.0	2.5	40700	NA	NA	NA	NA
4	7:30	478.3	30.0	17.0	41000	NA	NA	NA	NA
5	7:30	184.3	12.2	1.5	17600	NA	8800	183.3	56.3
6	7:30	193.3	25.4	8.5	17200	NA	NA	NA	NA
7	7:30	391.3	21.0	0.5	20200	NA	17500	187.5	78.9
8	7:30	217.4	21.6	8.5	20800	NA	NA	NA	NA
9	7:30	478.3	39.2	1.0	29700	NA	NA	NA	NA
11	7:30	826.1	42.2	4.5	31200	NA	NA	NA	NA
12	7:30	847.8	80.0	48.0	32200	NA	31000	245.8	73.2
13	7:30	413.0	40.0	22.5	31100	NA	NA	NA	NA
15	7:30	391.3	33.6	1.5	29900	NA	NA	NA	NA
16	7:30	369.6	32.0	13.0	30200	NA	NA	NA	NA
17	7:30	347.8	8.6	12.0	27300	NA	NA	NA	NA
18	7:30	304.3	19.2	9.5	25620	NA	NA	NA	NA
19	7:30	326.1	21.8	11.0	25900	NA	NA	NA	NA
Num.of Anal.		27	27	27	27	0	7	7	7
Mean		533.3	42.1	21.6	33912	NA	46181	287.2	395.6
StandardDev.		301.0	45.2	31.8	18274	NA	35771	81.6	539.9
Lower95%C.L.		417.4	24.7	9.3	26878	NA	19141	225.5	-12.6
Upper95%C.L.		649.2	59.5	33.8	40945	NA	73222	348.9	803.7

BRINE TANK 4 - SAMPLE TAP ST4D ION EXCHANGE RECYCLE BRINE

Date	Time	Na	TH	Ca	EC	Temp.	TDS	SO4	Cl
1986		(meq/l)			(uS/cm)	(C)	(mg/l)	(meq/l)	
July 22	7:30	739.1	332.8	90.5	85200	NA	71800	120.8	1042.3
23	7:30	652.2	340.0	105.0	19300	NA	NA	NA	NA
24	7:30	652.2	34.0	280.0	81000	NA	72600	120.8	985.9
25	7:30	521.7	20.0	215.0	70300	NA	NA	NA	NA
26	7:30	565.2	280.0	90.0	65800	NA	NA	NA	NA
27	7:30	478.3	268.0	80.0	60400	NA	NA	NA	NA
28	7:30	565.2	306.0	95.0	70200	NA	NA	NA	NA
29	7:30	434.8	240.0	75.0	56800	NA	49200	120.8	619.7
30	7:30	347.8	220.0	65.0	44700	NA	NA	NA	NA
31	7:30	369.6	240.0	80.0	52900	NA	48400	125.0	535.2
Aug. 1	7:30	291.3	194.0	60.0	37400	NA	NA	NA	NA
2	7:30	347.8	120.0	37.5	37600	NA	NA	NA	NA
3	7:30	347.8	224.0	215.0	41200	NA	NA	NA	NA
4	7:30	347.0	220.0	120.0	42700	NA	NA	NA	NA
5	7:30	245.9	186.4	90.0	31000	NA	5800	120.8	259.2
6	7:30	197.6	98.0	33.5	23300	NA	NA	NA	NA
7	7:30	109.8	120.8	55.0	23900	NA	20000	187.5	191.5
8	7:30	167.0	121.6	47.0	21400	NA	NA	NA	NA
9	7:30	281.1	70.8	38.0	27100	NA	NA	NA	NA
11	7:30	326.1	116.4	55.0	17600	NA	NA	NA	NA
12	7:30	326.1	106.0	50.0	17300	NA	16000	129.2	160.6
13	7:30	260.9	73.6	30.5	24300	NA	NA	NA	NA
15	7:30	282.6	177.2	65.0	32500	NA	NA	NA	NA
16	7:30	304.3	168.0	50.0	33200	NA	NA	NA	NA
17	7:30	304.3	40.0	40.0	30900	NA	NA	NA	NA
18	7:30	239.1	158.0	55.0	29400	NA	NA	NA	NA
19	7:30	144.8	106.0	47.5	17900	NA	NA	NA	NA
Num.of Anal.		27	27	27	27	0	7	7	7
Mean		364.8	169.7	83.9	40567	NA	40543	132.2	542.1
StandardDev.		161.7	90.9	60.6	20314	NA	26996	24.6	365.5
Lower95%C.L.		302.5	134.7	60.6	32747	NA	20135	113.5	265.7
Upper95%C.L.		427.0	204.7	107.2	48385	NA	60950	150.8	818.4

BRINE TANK 3 - SAMPLE TAP ST3D ION EXCHANGE USED BRINE

Date	Time	Na	TH	Ca	EC	Temp.	TDS	SO4	Cl
1986		(meq/l)			(uS/cm)	(C)	(mg/l)	(meq/l)	
July 22	7:30	695.7	339.2	93.0	84700	NA	72400	87.5	1014.1
23	7:30	652.2	340.0	90.0	36600	NA	NA	NA	NA
24	7:30	652.2	36.0	270.0	83100	NA	71800	110.4	985.9
25	7:30	608.7	340.0	235.0	76400	NA	NA	NA	NA
26	7:30	565.2	260.0	80.0	61600	NA	NA	NA	NA
27	7:30	478.3	256.0	125.0	57700	NA	NA	NA	NA
28	7:30	434.8	256.0	80.0	57600	NA	NA	NA	NA
29	7:30	391.3	240.0	65.0	53100	NA	46700	125.0	563.4
30	7:30	391.3	242.0	70.0	47400	NA	NA	NA	NA
31	7:30	334.8	228.0	80.0	44200	NA	100000	141.7	450.7
Aug. 1	7:30	321.7	202.0	50.0	37200	NA	NA	NA	NA
2	7:30	294.3	194.0	55.0	33700	NA	NA	NA	NA
3	7:30	307.4	188.0	150.0	34900	NA	NA	NA	NA
4	7:30	263.5	220.0	75.0	35000	NA	NA	NA	NA
5	7:30	259.1	182.4	105.0	31700	NA	6800	141.7	304.2
6	7:30	245.9	154.0	55.0	28700	NA	NA	NA	NA
7	7:30	206.5	146.8	55.0	26800	NA	23000	162.5	206.8
8	7:30	215.2	122.4	50.0	21400	NA	NA	NA	NA
9	7:30	118.7	106.4	48.5	16500	NA	NA	NA	NA
11	7:30	304.3	104.8	46.0	16900	NA	NA	NA	NA
12	7:30	304.3	114.8	55.0	17400	NA	15000	145.8	159.1
13	7:30	149.3	92.0	40.0	17900	NA	NA	NA	NA
15	7:30	136.1	105.2	47.5	18000	NA	NA	NA	NA
16	7:30	193.3	102.8	40.0	18800	NA	NA	NA	NA
17	7:30	180.4	5.0	46.0	18300	NA	NA	NA	NA
18	7:30	140.4	124.0	42.0	19110	NA	NA	NA	NA
19	7:30	153.7	112.0	46.0	18000	NA	NA	NA	NA
Num.of Anal.		27	27	27	27	0	7	7	7
Mean		333.3	178.3	81.3	37508	NA	47957	130.6	526.3
StandardDev.		173.8	88.9	56.4	21107	NA	34830	25.1	351.8
Lower95%C.L.		266.3	144.1	59.6	29383	NA	21627	111.6	260.4
Upper95%C.L.		400.2	212.5	103.0	45632	NA	74286	149.6	792.2

Leakage Test Purpose: To investigate hardness leakage throughout rinsing and service events to determine if rinsing is adequate and verify hardness leakage in service.

Operation Parameters: Both IX units — Bed Vol.: 1286 gallons

Event	Flow Rate Unit 1 (gpm)	Flow Rate Unit 2 (gpm)	Duration (min)	Throughput Unit 1 (bed volume)	Throughput Unit 2 (bed volume)
RecReg1	200	200	19	2.95	2.95
RecReg2	200	200	25	3.89	3.89
FrBrReg	150	150	16	1.87	1.87
UpRinse A	75	75	6	0.35	0.35
UpRinse B	200	200	5	0.78	0.78
Rinse C	100	110	5	0.39	0.43
Rinse D	230	230	9	1.61	1.61
Service	230	230	120	21.46	21.46

Chemical Constituents: (daily samples from CWs and brine tanks)

	Ca (meq/l)	TH (meq/l)	Na (meq/l)	SO4 (meq/l)	Chloride (meq/l)	Ec (uS/cm)	Sample Location
Infl. Water:	5.50	10.40	13.48	NA	NA	2700	CW1
Effl. Water:	0.50	2.20	24.78	NA	NA	3000	CW3
Recycle Brine:	33.50	98.00	197.61	NA	NA	23300	T4
Fresh Brine:	8.50	25.40	193.26	NA	NA	17200	T1

TEST RESULTS:

	Unit 1	Unit2	
	0.17	0.17	Total Hardness Removed during Service (eq/l of resin)
	1.71	1.71	Total Sodium Throughput during Regen. (eq/l of resin)

IX Unit 2 Test Date: Aug. 6, 1986

Event	Time in Event	Leakage Calcium (as CaCO3)	Leakage Total Hard. (as CaCO3)	Total Throughput (bv)	Leakage Calcium (meq/l)	Leakage Total Hard. (meq/l)	TH removed per segment (eq/l of resin)
Influent	NA	288	474	NA	5.76	9.48	
Rinse D	0	498	1158	0.43	9.96	23.16	
" "	4	128	276	1.14	2.56	5.52	
Service	0	68	136	2.04	1.36	2.72	
" "	5	50	88	2.93	1.00	1.76	0.006
" "	10	38	66	3.83	0.76	1.32	0.007
" "	15	42	60	4.72	0.84	1.20	0.007
" "	60	40	64	12.77	0.80	1.28	0.066
" "	110	44	72	21.71	0.88	1.44	0.073
" "	120	42	58	23.50	0.84	1.16	0.015
						Total:	0.174

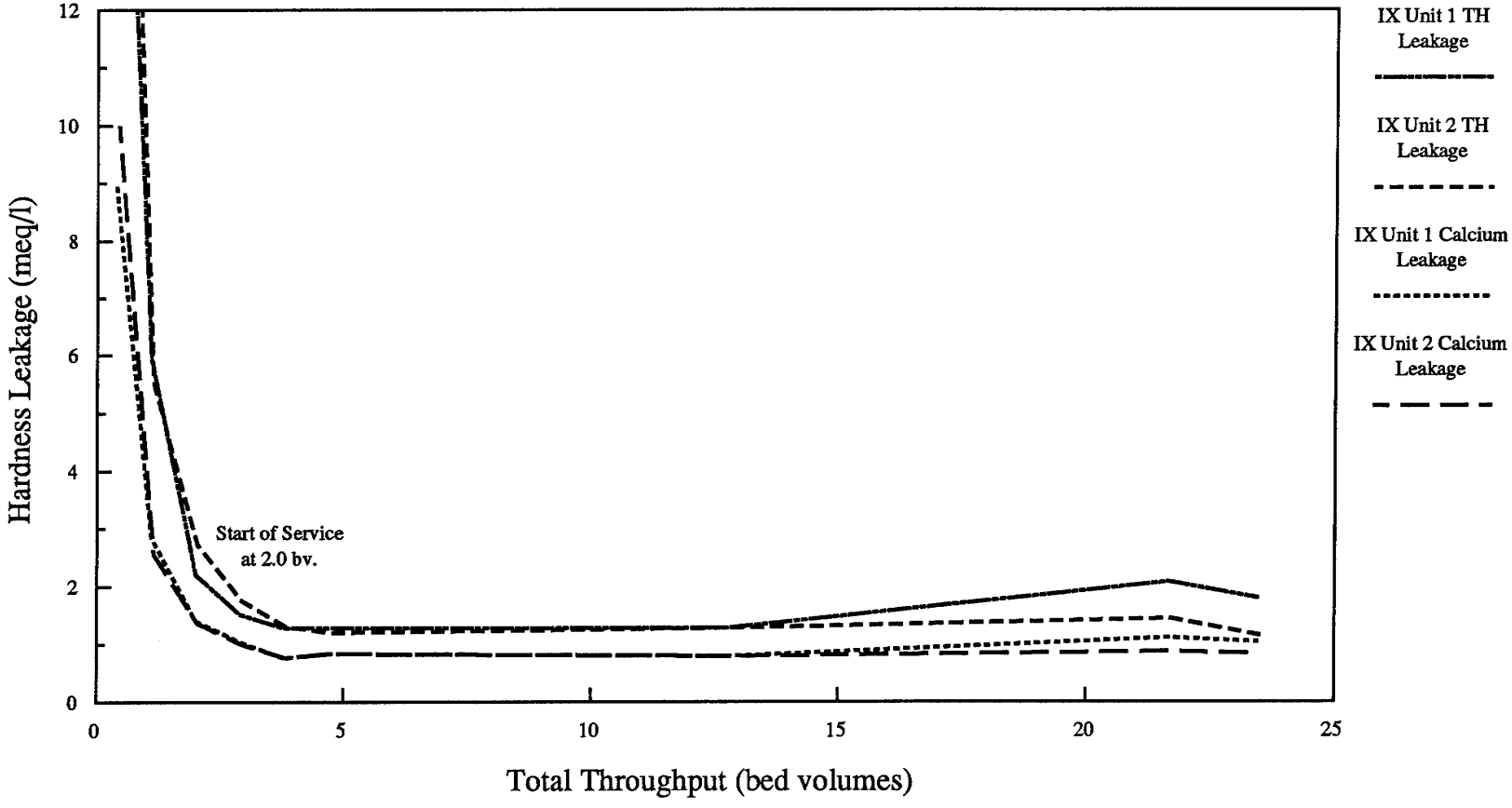
IX Unit 1 Test Date: Aug. 6, 1986

Event	Time in Event	Leakage Calcium (as CaCO3)	Leakage Total Hard. (as CaCO3)	Total Throughput (bv)	Leakage Calcium (meq/l)	Leakage Total Hard. (meq/l)	TH removed per segment (eq/l of resin)
Influent	NA	276	480	NA	5.52	9.60	
Rinse D	0	446	960	0.39	8.92	19.20	
" "	4	142	298	0.42	2.84	5.96	
Service	0	70	110	2.00	1.40	2.20	
" "	5	52	76	2.89	1.04	1.52	0.007
" "	10	38	64	3.79	0.76	1.28	0.007
" "	15	42	64	4.68	0.84	1.28	0.007
" "	60	40	64	12.73	0.80	1.28	0.066
" "	110	56	104	21.67	1.12	2.08	0.070
" "	120	52	90	23.46	1.04	1.80	0.014
						Total:	0.171

Hardness Leakage vs. Process Water Throughput

Leakage Test: IX Units 1 and 2

August 6, 1986



Unit 1	Unit 2
Ca - 5.5	Ca - 5.8
TH - 9.6	TH - 9.5

OPERATION INSTRUCTIONS
REJECT BRINE REGENERATION
UPFLOW RINSE

DATE: 11-Aug-86
SINGLE UNIT OPERATIONS
IX UNIT 2
RO2 infl. flow @ 94 gpm
EDR br. flow @ 7 gpm

EVENT NUMBER	EVENT DESCRIPTION	DURATION (minutes)	FLOW (gpm)	FLOW CONTROL VALVE
1	Recyc.brine regen.1	18	NOT ADJUSTABLE	
2	Recyc.brine regen.2	28	200	IV 112
3	Fr.brine regen.	14	150	IV 113
4	Rinse A Upflow	6	75	IV 114
5	Rinse B Upflow	5	200	IV 112
6	Rinse C	5	NOT ADJUSTABLE	
7	Rinse D	9	NOT ADJUSTABLE	
8	Service	120	230	IV 102
9	Settling in T2 or T3	80	NA	NA
10	Set-up for regen. to T4 from T2/3	30	NA	NA
11	Drain	3	NA	NA
12	Delay	98	NA	NA

Other instructions:

1. Place CSOV 1 and 6 in AUTO position previous to start-up.
2. Place IV 123 in OPEN position previous to start-up.
   VERIFY valve is OPEN.
3. Open manual valves IV 123m and 139m.
4. Adjust Event 12 - Delay as necessary to maintain relatively stable levels in CWs 3 and 4.

INSTRUCTIONS FOR DRY RUN OF IX SYSTEM 7/17/86

1. Place main circuit breakers for pumps IP 1, 2, 3, 5, 6, 7, 8, and 9 to OFF position.

2. Close isolation valves:
   a) CW's 1, 2, 3 and 4
   b) Tanks T 1, 4, 3 and 2
   c) IX Unit 1
   d) IX Unit 2
   e) Cartridge filters
   f) Chlorine line into clearwells 3 and 4.

3. Place IX valve switches in REMOTE control panel to AUTO position (Valves IV 21, 121, 22, and 122).

4. Place valves IV 23 and 123 in Remote control panel to OPEN position.

5. Place IX valve and pump switches in RO/IX office to AUTO position.

6. Initiate IX operations program.

7. AUTO button on Analog computer pressed in.

8. Adjust event times for both IX units according to the following schedule:

Event #	Event	Duration (minutes)
1.	Recycle Brine Reg. 1	3
2.	Recycle Brine Reg. 2	3
3.	Fresh Brine Regeneration	3
4.	Upflow Rinse A	3
5.	Upflow Rinse B	3
6.	Rinse C	3
7.	Rinse D	3
8.	Service	33
9.	Settling in T2 or T3	3
10.	Set-up for Regeneration: T2 or T3 to T4	
11.	Drain	3
12.	Delay	3

9. Start IX Unit 1.

10. Start IX Unit 2.

11. Verify valve openings and other operations for the schedule.

12. Document malfuncting valves or errant operations.

GENERAL START-UP PREPARATION LIST 7/18/86

The following items should be checked or performed previous to operation of the IX system.

1. CSOV #1 and #6 switches in chlorine shed placed in AUTO mode.
2. CW's 1 and 2 isolation valves open.
3. IX Unit 2 isolation valves open.
4. IX Unit 1 isolation valves open.
5. Tanks T 1, 4, 3 and 2 isolation valves open.
6. Check level of brine in tanks T 1, 4, 3 and 2. Transfer brine as necessary.
7. IX valve switches in REMOTE control panel on AUTO position (Valves IV 21, 121, 22 122)
8. IX valves IV 23 and 123 in REMOTE control panel on OPEN position.
   VERIFY valves are OPEN.
9. Open manual valves IV 23m, 123m, 39m and 139m.
10. CW's 3 isolation valves open. (Note: CW4 will not be used during these tests).
11. Chlorine pipeline isolation valve into CW3 and CW4 open.
12. Cartridge filter isolation valves open.
13. Main circuit breakers for IX pumps to ON position.
    (Pumps IP 1, 5, 6, 7, 8 and 9.)
14. IX valve and pump switches in RO/IX office on AUTO position.
    (Except pumps IP 2 and 3 are to be OFF)
15. IX control program on Analog computer initiated.
16. AUTO button on Analog computer pressed in.
17. Adjust event durations according to current schedule.

Preparation complete.

Note: List is for 2 unit operation. Adjust list as necessary for single unit operation.