

## Appendix E

### Estimated O&M Cost Process Area Breakdown

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Client: **City of San Diego**  
 Project: **IPR/RA Demonstration Project AWP Facility**

Job No.: **2072-78220**

Computed By: **A.Goh**

4/9/2012

Checked By: **L. Voelz**

Date: **Updated 6/7/2012**

**Updated 11/5/2012**

Detail: **Full-Scale Facility O&M Costs - 15 mgd**

Date Checked: **6/7/2012**

Page No.:

**1 of 2**

**INPUT**

Power cost	0.12	\$/kWh
Hours of operation per day	24	hours
Days of operation per year	365	days
AWP Facility Online Factor	95%	
Annual Average Flow	15	mgd

**1) Equipment/Building Operations**

#	Load	HP	kW	# Operating	Demand	Annual Power (kWh/yr)	Annual Cost (\$/yr)
1	AWP Facility Influent Pumps	137	102	3	100%	2,548,536	\$305,824
2	MF System Automatic Strainers	0.5	0	6	100%	18,650	\$2,238
3	MF Backwash Pumps	30	22	2	22%	80,815	\$9,698
4	MF System Blowers	50	37	1	22%	67,346	\$8,081
5	MF System Air Compressors	15	11	1	100%	93,248	\$11,190
6	MF CIP Recirculation/Drain Pumps	20	15	2	3.6%	8,856	\$1,063
7	MF System CIP Tank Heaters	24	18	2	28%	85,363	\$10,244
8	RO Booster Pumps	149	111	3	100%	2,777,506	\$333,301
9	RO Feed Pumps	572	427	3	100%	10,665,622	\$1,279,875
10	RO Energy Recovery (accounted for in RO Feed Pumps)				100%		
11	RO Flush Pumps	60	45	2	0.20%	1,480	\$178
12	RO System CIP Recirculation Pumps	40	30	2	0.27%	1,363	\$164
13	RO System CIP Tank Heaters	24	18	2	1.5%	4,378	\$525
14	UV	116	86	3	71%	1,540,759	\$184,891
15	Sodium Hypochlorite Feed Pump	0.5	0.37	3	100%	9,325	\$1,119
16	Ammonium Hydroxide Feed pump	0.5	0.37	3	100%	9,325	\$1,119
17	Sulfuric Acid Feed Pump	0.5	0.37	3	100%	9,325	\$1,119
18	Antiscalant Feed Pump	0.5	0.37	3	100%	9,325	\$1,119
19	Hydrogen Peroxide Feed Pump	0.5	0.37	3	100%	9,325	\$1,119
20	Calcium Chloride Feed Pump	0.5	0.37	2	100%	6,294	\$755
21	Caustic Soda Feed Pump	0.5	0.37	2	100%	6,294	\$755
22	Sodium Hypochlorite Feed Pump MF MC	0.5	0.37	1	14%	421	\$51
23	Sodium Hypochlorite Feed Pump MF CIP	0.5	0.37	1	0.9%	28	\$3
24	Sodium Bisulfite Feed Pump MF CIP	0.5	0.37	1	0.9%	28	\$3
25	Citric Acid Feed Pump for MF CIP	0.5	0.37	1	0.9%	28	\$3
26	Caustic Soda Feed Pump MF CIP	0.5	0.37	1	0.9%	28	\$3
27	Citric Acid Feed Pump RO CIP	0.5	0.37	1	0.09%	3	\$0
28	Caustic Soda Feed Pump RO CIP	0.5	0.37	1	0.09%	3	\$0
#	Load	Area (SF)	Unit Power (kW/SF)	Total Power (kW)	Demand	Annual Power (kWh/yr)	Annual Cost (\$/yr)
29	Multiple Buildings	50,700	0.01	482	100%	4,008,291	\$480,995
<b>Operations Subtotal</b>						<b>21,961,962</b>	<b>\$2,635,435</b>

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Client: **City of San Diego**  
 Project: **IPR Project/Reservoir Augmentation Demonstration**  
**Project AWP Project**  
 Detail: **Full-Scale Facility O&M Costs - 15 mgd**

Job No.: **2072-78220**

Computed By: **A.Goh**

Checked By: **L. Voelz**

Date: **4/9/2012**

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**1 of 2**

2) Chemical Usage Costs							
#	Chemical	Dose (mg/L)	Usage (gal/day)	Usage (gal/yr)	Demand	Unit Cost (\$/gal)	Annual Cost (\$)
	<b>Pre-/Post-Treatment</b>						
1	Sodium Hypochlorite (Pre-treatment)	5.0	632	230,835	100%	0.66	\$144,734
2	Ammonium Hydroxide	1.5	163	59,426	100%	1.39	\$78,240
3	Sulfuric Acid	60.0	619	225,817	100%	1.39	\$298,191
4	Antiscalant	4.0	59	21,468	100%	6.49	\$132,359
5	Hydrogen Peroxide	5.0	126	46,002	100%	4.94	\$215,893
6	Calcium Chloride	20.0	640	233,718	100%	0.53	\$118,118
7	Caustic Soda	15.0	294	107,338	100%	2.35	\$239,641
8	Sodium Hypochlorite (Membrane Cleaning)	1000.0		1,441		0.66	\$951
9	Caustic Soda (Membrane Cleaning)	Varies		2,946		2.35	\$6,923
10	Citric Acid (Membrane Cleaning)	Varies		8,974		10.55	\$94,659
	<b>Chemical Usage Subtotal</b>						<b>\$1,329,710</b>

\*MF/RO CIP chemicals not included

3) Major Equipment Replacement Costs							
#	Equipment	Units/Modules	Unit Cost (\$/unit)	Replacement (#/year)			Annual Cost (\$)
1	MF Membrane Replacement <sup>(1)</sup>	1,084	\$ 3,000.00	0.14			\$441,167
2	Cartridge Filter Replacement <sup>(2)</sup>	6					\$72,818
3	RO Element Replacement <sup>(2)</sup>	3					\$245,759
4	UV Lamp Replacement <sup>(3)</sup>	1,296	\$268.00	0.7			\$225,474
5	UV Ballast Replacement <sup>(4)</sup>	648	\$636.00	0.14			\$55,932
	<b>Major Equipment Replacement Subtotal</b>						<b>\$1,041,149</b>

(1) Assumes replacement every 7 years. Unit cost provided by MF manufacturer (Pall).

(2) Based on information from similar sized AWP.

(3) Assumes 8200 hours of lamp operation per year. Per vendor (Trojan): 12,000 hours life per lamp. Unit cost provided UV manufacturer (Trojan)

(4) Assumes replacement every 7 years. Unit cost provided by UV manufacturer (Trojan).

4) Maintenance Cost							
#	Item	Percentage	Equipment Cost				Annual Cost (\$)
1	Maintenance Cost	1.7%	\$82,883,273				\$1,409,016
	<b>Maintenance Cost Subtotal</b>						<b>\$1,409,016</b>

5) Other Costs							
#	Item						Annual Cost (\$)
1	Compliance Testing						\$150,000
2	Security						\$160,000
	<b>Other Costs Subtotal</b>						<b>\$310,000</b>

6) Labor Costs							
#	Personnel	#				Full Labor Cost (\$)	Annual Labor Cost (\$)
1	Associate Civil Engineer	0.5				\$173,384.60	\$86,692
2	Water Plant Operator	3				\$136,749.18	\$410,248
3	Water Operations Supervisor	2				\$141,935.48	\$283,871
4	Water Production Superintendent	0.5				\$171,983.84	\$85,992
5	Water Systems Technician II	2				\$78,581.88	\$157,164
6	Electrician	2				\$104,177.17	\$208,354
7	Laboratory Technician	0.5				\$85,522.93	\$42,761
8	Assistant Chemist	0.5				\$110,646.90	\$55,323
9	Clerical II/Receptionist	1				\$62,865.50	\$62,866
10	Outside Lab Sample/Special Testing Allowance	-				-	\$25,000
	<b>Labor Subtotal</b>	12.00					<b>\$1,418,271</b>

	<b>Phase 1 Total Annual O&amp;M Cost</b>						<b>\$8,143,581</b>
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Client: City of San Diego  
 Project: IPR/RA Demonstration Project AWP Facility  
 Detail: Full-Scale Facility Electrical Load List - 15 mgd

Job No.: 2072-78220  
 Checked By: L. Voelz  
 Date Checked: 4/9/2012

Computed By: A.Goh  
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 Page No.: 1 of 1

INPUT

#	Load	Phase 1											Current	VFD		
		Volts	Phase	HP	KVA	kW	Loads									
							Total #	Operating	Standby	Operating Frequency	Demand					
<b>Major Process Equipment</b>																
1	AWP Facility Influent Pumps	480	3	137		102	4	3	1	Continuous	100%			Yes		
2	MF System Automatic Strainers	480	3	0.5		0.37	7	6	1	Continuous	100%			No		
3	MF Backwash Pumps	480	3	30		22	3	2	1	1x30sec/30min/skid	22%			Yes		
4	MF System Blowers	480	3	50		37	2	1	1	1x30sec/30min/skid	22%			Yes		
5	MF System Air Compressors	480	3	15.0		11	2	1	1	Continuous	100%			No		
6	MF CIP Recirculation/Drain Pumps	480	3	20		15	4	2	2	1x2hr/mo/skid	3.6%			Yes		
7	MF System CIP Tank Heaters	480	3	24		18	3	2	1	1x16hr/mo/skid	28%			No		
8	RO Booster Pumps	480	3	149		111	4	3	1	Continuous	100%			Yes		
9	RO Feed Pumps	480	3	572		427	4	3	1	Continuous	100%			Yes		
10	RO Energy Recovery	480	3	0		0	1	1	0	Continuous	100%			Yes		
11	RO Flush Pumps	480	3	60		45	3	2	1	1 x 5min/wk/train	0.20%			Yes		
12	RO System CIP Recirculation Pumps	480	3	40		30	3	2	1	2 x 3hr/yr/train	0.27%			Yes		
13	RO System CIP Tank Heaters	480	3	24		18	3	2	1	2 x 16hr/yr/train	1.5%			No		
14	UV	480	3	116		86	3	3	0	Continuous	100%			No		
15	Finished Water Pumps					0				Continuous	100%			Yes		
<b>Influent Pre-treatment Chemicals</b>																
16	Sodium Hypochlorite Feed Pumps	115	1	0.5		0.37	4	3	1	Continuous	100%			Integral to Pump		
17	Ammonium Hydroxide Feed Pumps	115	1	0.5		0.37	4	3	1	Continuous	100%			Integral to Pump		
<b>RO Pre-treatment Chemicals</b>																
18	Sulfuric Acid Feed Pumps	115	1	0.5		0.37	4	3	1	Continuous	100%			Integral to Pump		
19	Antiscalant Feed Pumps	115	1	0.5		0.37	4	3	1	Continuous	100%			Integral to Pump		
<b>AOP Chemicals</b>																
21	Hydrogen Peroxide Feed Pumps	115	1	0.5		0.37	4	3	1	Continuous	100%			Integral to Pump		
<b>Product Water Post-treatment Chemicals</b>																
22	Calcium Chloride Feed Pumps	115	1	0.5		0.37	3	2	1	Continuous	100%			Integral to Pump		
23	Caustic Soda Feed Pumps	115	1	0.5		0.37	3	2	1	Continuous	100%			Integral to Pump		
<b>MF MC Chemicals</b>																
25	Sodium Hypochlorite Feed Pumps for MF MC	115	1	0.5		0.37	1	1	0	1 x 15min/day/skid	14%			Integral to Pump		
<b>MF CIP and Neutralization Chemicals</b>																
26	Sodium Hypochlorite Feed Pumps for MF CIP	115	1	0.5		0.37	2	1	1	1 x 30min/mo/skid	0.9%			Integral to Pump		
27	Sodium Bisulfite Feed Pumps for MF CIP Neutralization	115	1	0.5		0.37	2	1	1	1 x 30min/mo/skid	0.9%			Integral to Pump		
28	Citric Acid Feed Pumps for MF CIP	115	1	0.5		0.37	2	1	1	1 x 30min/mo/skid	0.9%			Integral to Pump		
29	Caustic Soda Feed Pumps for MF CIP Neutralization	115	1	0.5		0.37	2	1	1	1 x 30min/mo/skid	0.9%			Integral to Pump		
<b>RO CIP and Neutralization Chemicals</b>																
30	Citric Acid Feed Pumps for RO CIP/Neutralization	115	1	0.5		0.37	2	1	1	2 x 1hr/yr/train	0.09%			Integral to Pump		
31	Caustic Soda Feed Pumps for RO CIP/Neutralization	115	1	0.5		0.37	2	1	1	2 x 1hr/yr/train	0.09%			Integral to Pump		
<b>TOTAL</b>						<b>4,545</b>										
						<b>3,395</b>										

Volts - Typically 120, 208, 240 or 480

Phase - 1 or 3 (Usually 3 phase for motors except for 120 V chemical metering pumps)

HP, KVA, KW - Only one of these columns would be filled out (typically HP for motors, KVA for transformers, KW for heaters)

Total # - Total number of that particular load (EG. 3 RO Feed Pumps)

Operating - Total number of that particular load that runs during normal operations (EG. 1 RO Feed Pump runs during normal operations)

Standby - The additional number of that particular load that can run during emergency operations (EG. 1 additional RO Feed Pump runs during emergency operations)

Demand (HP loads) - The amount of time a load runs. If a pump runs continuously, the number will be 100%. If a pump runs occasionally then the % of the day the pump will run.

Demand (kVA loads) - The percent loaded a transformer is based on panel schedules.

Current - This column will be filled out by the electrical engineer based on the data in the other columns.

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