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**BEFORE THE PUBLIC UTILITIES COMMISSION  
OF THE STATE OF CALIFORNIA**

In the Matter of the Application of California-  
American Water Company (U 210 W) for a  
Certificate of Public Convenience and  
Necessity to Construct and Operate its Coastal  
Water Project to Resolve the Long-Term Water  
Supply Deficit in its Monterey District and to  
Recover All Present and Future Costs in  
Connection Therewith in Rates.

Application 04-09-019  
(Filed September 20, 2004;  
Amended July 14, 2005)

**REBUTTAL TESTIMONY OF R. RHODES TRUSSELL, Ph.D., P.E.  
ON BEHALF OF MARINA COAST WATER DISTRICT**

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**BEFORE THE PUBLIC UTILITIES COMMISSION  
OF THE STATE OF CALIFORNIA**

In the Matter of the Application of California-American Water Company (U 210 W) for a Certificate of Public Convenience and Necessity to Construct and Operate its Coastal Water Project to Resolve the Long-Term Water Supply Deficit in its Monterey District and to Recover All Present and Future Costs in Connection Therewith in Rates.

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**REBUTTAL TESTIMONY OF R. RHODES TRUSSELL, Ph.D., P.E.  
ON BEHALF OF MARINA COAST WATER DISTRICT**

Q1. What is your name and employer?

A1. My name is R. Rhodes Trussell, Ph.D., P.E. I am the president of Trussell Technologies, Inc., Pasadena, California.

Q2. What is your role on the project?

A2. I am the Technical Director for the portion of the work conducted by Trussell Technologies, Inc. Trussell Technologies, Inc. is a subconsultant to RMC Water and Environment, (RMC). The Marina Coast Water District (MCWD) hired RMC to provide engineering services for the Groundwater Desalination plant and the Salinas River Surface Water Treatment plant projects. Trussell Technologies, Inc.'s role on the projects is to assist RMC with predesign tasks and to work with the California Department of Public Health regarding permitting.

Q3. Are you the same R. Rhodes Trussell, Ph.D., P.E. whose Direct Testimony was served on the parties in this proceeding on June 24, 2009.

1 A3. Yes, I am.

2  
3 Q4. Do you stand by the testimony you gave on that day?

4 A4. Yes, I do, but I would like to clarify my answer to question 11.

5  
6 Q5. And what is this clarification, Dr. Trussell?

7 A5. The question was “is this level of boron safe?” This question was asked in  
8 reference to my answer to Question 10 in which I said, “The anticipated boron  
9 concentration in the permeate water from a SWRO system ranges between 0.6 and  
10 1.6 ppm, but concentrations just at, below, or just above 1.0 ppm are common.”  
11 The following is a restatement of my answer:

12  
13 From the standpoint of public health, more or less. From the standpoint of the local  
14 plant life, no. The CDPH Notification Level (NL) of 1 ppm<sup>1</sup> has only one  
15 significant figure, so boron levels as high as 1.44 ppm technically meet this public  
16 health requirement. So on this basis, the typical concentrations of just under 1.0  
17 ppm that I cited would comply. On the other hand conversations with CDPH  
18 indicate that one measurement above 1 ppm would trigger the notification  
19 requirement. As a result, if a facility is built whose boron levels are just above 1.0  
20 ppm and range as high as 1.6 ppm, both MCWD and Cal Am would risk having to  
21 notify their customers that the boron in the water they provide is at levels that may  
22 represent a risk to public health.

23  
24 Finally, many common plants are even more sensitive to boron than people. Thus  
25 these levels of boron may also result in unacceptable appearance for much of the  
26 plant life important to the local community. Thus, a primary issue with boron  
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<sup>1</sup> 1 part per million (ppm) equals 1 milligram per liter (mg/L). The standards are the same.

1 removal in this application is the potential for adverse impact to residential and  
2 public landscaping and to commercial and retail nurseries.

3  
4 Q6. Would you like to comment on the “Bureau of Reclamation Review Comments on  
5 Coastal Water Project and alternatives, Monterey, CA, prepared for the Division of  
6 Ratepayers Advocates (DRA), California Public Utilities Commission (CPUC)”?

7 A6. Yes, I would.

8  
9 Q7. On page 11, the Bureau’s recommendation is, “Abandon the concept of a second  
10 pass for the RO system as it is not necessary to meet existing CDPH notification  
11 level for Boron and secondary standards for sodium and chloride”. Do you agree  
12 with this recommendation?

13 A7. No, I do not. Virtually every large-scale seawater desalination system in the world  
14 today that produces water for domestic use, employs a full or partial second pass,  
15 and they do so for good reason. The Bureau is advocating a project that would  
16 barely meet minimum standards for potable water and which would produce water  
17 that is of unacceptable quality with respect to agricultural uses or for irrigation of  
18 private homes and yards. For that matter eliminating the second pass would put  
19 users of the project water dangerously close to a real risk that they may not meet  
20 CDPH notification levels in the future.

21  
22 First of all, as pointed out by the Bureau on the second paragraph on page 10 of its  
23 report, “the boron concentration in seawater can vary significantly”. As RO  
24 removes a certain fraction of the boron in water, when the boron in the seawater  
25 goes up, the boron in the RO permeate will go up as well. The Bureau points out  
26 that the pilot project at Moss Landing indicates that the boron in the product water  
27 tends to be about 1 mg/L, ranging between 0.8 and 1.2 mg/L. In fact, the results  
28

1 from pilot studies cannot be directly extrapolated to assess full-scale performance.  
2 For example, the pilot did not include energy recovery devices and it employed  
3 new membranes. The most modern energy recovery devices introduce a small  
4 amount of concentrate into the upstream side of the RO, making full-scale boron  
5 levels a bit worse than those experienced at pilot level. Moreover, the RO  
6 membranes themselves deteriorate over time and, as a result the salinity and boron  
7 concentrations of the permeate they produce gradually increase as well. Most  
8 design manuals for SWRO recommend an allowance be made for an annual  
9 deterioration in permeate quality of 5 to 15 percent. Assuming a 3 percent increase  
10 in influent boron due to energy recovery and a 10 percent increase in boron passage  
11 each year, a membrane that produces a boron level of 0.8 to 1.2 mg/L during pilot  
12 testing might be expected to produce between 1.3 and 1.7 mg/L during its 5th year  
13 of full-scale operation. On days when the level of boron in seawater is higher,  
14 performance would be even worse.

15  
16 Second, an allowance must be made for the levels at which a water utility can  
17 comfortably operate and for the provisions that must be made in a design to ensure  
18 that the performance sought is the performance achieved. It is normal practice for  
19 water utilities to design and operate their facilities to operate at levels that provide  
20 a safety factor below regulatory levels. The magnitude of this safety factor varies  
21 from one utility to the next, but it is generally about 0.5 (0.5 x regulatory limit) and  
22 rarely more than 0.8 (0.8 x regulatory limit). On this basis, if a limit of 1 ppm is to  
23 be met, the operating/design goal would be between 0.5 ppm and 0.8 ppm.

24 Allowance must also be made in the design. As shown in the results of the Moss  
25 Landing testing and associated modeling, performance in boron removal varies a  
26 great deal from one membrane to another and manufacturer's models often  
27 overestimate performance. In public works projects, where competitive  
28

1 procurement is typical practice, it is important to incorporate conservatism in  
2 design to protect against a bid won by membranes that give performance that is  
3 below average and or below what their design models predict.  
4

5 Finally, a design with no second pass would not meet the standards of practice that  
6 the municipal water supply industry is expected to meet, namely water that is safe,  
7 appealing and wholesome, as opposed to water that barely meets CDPH limits. On  
8 page 11, the Bureau’s document indicates that, “the concentration limits of 100  
9 mg/L for sodium and chloride are excessively strict for drinking water.” The Bureau  
10 points out that there is only a secondary standard of 250 mg/L for chloride and no  
11 formal standard for sodium. Allowing for an increase from 54 and 69 mg/L to 100  
12 mg/L “is weak justification for a substantial cost increase.” These comments  
13 should be put in perspective. Sodium and chloride levels at 100 mg/L would put the  
14 desalinated supply at higher levels than 90% of the terrestrial waters available  
15 (JMM, 1985, Water Treatment, Wiley, page 2.).  
16

17 The Contra Costa Water District, which has long struggled with high chloride  
18 levels in its water supply, has set a goal not to exceed chloride levels of 65 mg/L  
19 and is considering membrane treatment to reduce chloride when it is above that  
20 level. High levels of chloride derived from seawater are also known to come with  
21 high levels of bromide as well and bromide is known to result in increased levels of  
22 disinfection byproducts and poor stability of chlorine residuals. The secondary  
23 standards for chloride are not offered by CDPH as a goal water utilities should seek  
24 to achieve good water, they are offered as guidance for when a supply should be  
25 considered unacceptable.  
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Q8. On page 10, DRA states that “the WHO has raised their guideline on boron in drinking water from 1 mg/L to 2.4 mg/L”. Would you like to comment on this statement?

A8. Yes, I think this statement is misleading. The WHO guidelines are not relevant to this project. WHO guidelines for drinking water are not applied anywhere in the United States. The California Department of Health (CDPH) has primacy for drinking water regulation in state of California and CDPH has its own contaminant limits and notification levels. The CDPH notification level for boron is 1 mg/L and there is no indication CDPH plans to change it.

Q9. On page 10, DRA states that “for the Carlsbad desalination plant, CDPH has suggested two (boron) samples per year.” Does this correspond to your current understanding of the Carlsbad project?

A9. No, it does not. I am currently under contract with the City of Carlsbad and I have been advising them on water quality issues in connection with desalinated water for the past 5 or 6 years. The current water purchase agreement between Poseidon and the City of Carlsbad specifies a boron monitoring frequency of one sample per week and CDPH has informed us that any weekly sample which exceeds the Notification Level of 1 ppm will require timely notification of the local governing bodies and CDPH will recommend that the utility inform its customers about the presence of the chemical and about the health concerns associated with exposure to it.

Q10. Would you like to comment on additional information DRA received from the Bureau of Reclamation that supplements DRA’s prior response to MCWRA’s Data Request #1?

A10. Yes, I would.

1 Q11. In DRA’s response to MCWRA’s Data Request #1, question 90, DRA includes the  
2 following statement “the capital cost of the RO equipment for the two-pass plant  
3 would be approximately one third greater than for a one-pass plant.” Do you agree  
4 with this statement?

5 A11. I think this statement is very misleading. First, the cost of equipment at the  
6 treatment plant is only 17% of the total project cost. Thus, even if the equipment  
7 cost were to increase by one third, the increase in project cost would be much less.  
8 But the increase is much less than that.

9  
10 Second, the statement seems to contemplate the second pass as an all-or-nothing  
11 decision (either all the water goes through a second RO pass or none of it does).  
12 Quite the contrary is true. The fraction of the water that must be treated in a  
13 second pass varies from one project to the next. In our design, we determined that  
14 only 40% of the first-pass permeate would have to be treated through a second pass  
15 for this project. Our cost estimate shows that the 40% second pass only contributes  
16 to 3% of the total project cost.

17  
18 Q12. In DRA’s response to question 90, DRA includes the following statement “a  
19 properly run one-pass reverse osmosis system will reduce the usual concentration  
20 of 4.3 mg/L boron to 1 mg/L.” Do you agree with this statement?

21 A12. No, I do not. First, we have established that the CDPH notification requirement is  
22 based on the maximum boron level, not the average or typical level. The  
23 maximum influent concentration of boron in the ocean observed in the ocean in  
24 Moss Landing and Santa Cruz is significantly higher than 4.3 mg/L. Moreover, I  
25 do not believe that the maximum boron level exiting a single pass RO will be  
26 consistently below 1 mg/L. See my response to Question 7 above.  
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Q13. Would you like to comment on groundwater contamination issues raised in the Comments on Settlement by Monterey Peninsula Water Management District?

A13. Yes.

Q14. On Page 10 of the Comments, MPWMD states that MCWD's existing groundwater wells in the northern portion of the former Fort Ord are subject to contamination. Have you any experience with removal of solvents like trichloroethylene (TCE) and perchloroethylene (PCE) from groundwater?

A14. Yes.

Q15. When did you first encounter the TCE issue in a groundwater being used for domestic water supply?

A15. I can't give a precise date, but it would be in the San Gabriel Valley, approximately 1980. The well had both PCE and TCE that were thought to have originated from a Department of Defense contractor nearby.

Q16. Does a groundwater well that has been contaminated with solvents like TCE or PCE have to be removed from service?

A16. No. A treatment process can be used to remove the contaminant and the well can remain in service.

Q17. What methods are commonly used to remove TCE from groundwater?

A17. A15. TCE can be removed with air stripping, activated carbon adsorption or by advanced oxidation. It can also be removed insitu through bioremediation in anoxic environments. Air stripping and activated carbon adsorption, using granular activated carbon (GAC), are the most common.

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Q18. Can any of these processes be used at the wellhead?

A18. Air stripping, activated carbon adsorption and advanced oxidation have all been used for wellhead treatment. Which alternative is most cost effective depends on the specifics of the particular application, such things as the nature of the surrounding neighborhood, the hydraulics of the well and the water system, the degree of contamination and how long it is expected to remain and so on.

Q19. Is wellhead treatment for TCE removal common?

A19. Today, wellhead treatment for TCE removal is one of the most common forms of wellhead treatment. Such systems exist in virtually every state and every county.

Q20. MPWMD Testimony suggests that TCE contamination may need to be addressed prior to distributing groundwater to MCWD customers. At what level of TCE concentration would treatment be?

A20. In California the Maximum Contaminant Level for TCE is 5 ppb. Water cannot be served to the consumer if TCE exceeds this level. Often, however, when concentrations are not too far above the MCL, CDPH will allow dilution to acceptable levels with uncontaminated water from other wells. These decisions are made by CDPH on a case-by-case basis, considering other factors, such as the potential for the well to become an impaired supply.

Q21. Does this complete your testimony?

A21. Yes, it does.