SEAWATER DESALINATION: OPPORTUNITIES AND CHALLENGES

WORKSHOP REPORT

Facilitated by:
National Water Research Institute

In cooperation with:
Metropolitan Water District of Southern California and Member Agencies

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California Polytechnic University, Pomona
Pomona, California

FOREWORD

The apparent enthusiasm for the use of desalination as a viable alternative to increase water-supply options for Southern California has occurred because of the rapid advancements in the area of membrane technology. Membranes performance has been greatly improved (e.g., increased rejection, lower pressure, reduced fouling, and increased energy recovery), at lower costs than ever before. Desalination is rapidly becoming a viable water-supply option and is considered by many as the "best available technology" for delivering a high-quality, reliable, and sustainable product. The real value of the product water is not necessarily associated with its price or cost, but what it does to enhance the environment, economy, and quality of life of the general population.

Nevertheless, a host of challenges remain to be addressed if Southern California water utilities are to optimize desalination as a viable option for expanding their portfolio of source waters. High-quality drinking water is one of many demands placed on source waters by expanding urban centers. The connection between water resources and the economy is not well recognized by the general population. This is especially true in the context of urban centers. The sustainability of a viable California economy is dependent upon the availability of a high-quality water supply.

The workshop was based on the Nominal Group Technique (NGT), which was developed by Andre Delbecq, Ph.D., at the University of Santa Clara. Since 1992, NWRI has used the NGT format as a process for identifying, prioritizing, and developing approaches to address critical local, state, and national water issues. The NGT process is rigorous and robust, and its protocol provides a controlled environment that allows every voice to be heard regardless of perspective. The ability of the workshop participants to focus on a single question allowed for the maximum use of time and energy. The participants attending were invited because of their expertise and credibility in their respective fields.

The origin of this workshop lies in the collaborative efforts between NWRI and the Metropolitan Water District of Southern California (MWD) and its member agencies currently involved in developing desalination projects, namely the San Diego Water Authority, West and Central Basin Municipal Water District, Long Beach Water Department, Los Angeles Department of Water and Power, and Municipal Water District of Orange County.

This report documents the results of the efforts of the 31 participants attending the workshop who provided their expertise to answer the question: *What are the most critical issues that water utilities will face when planning and implementing seawater desalination projects to supplement drinking-water supplies?*

This document comprises two parts. Part 1 (Working Group Reports) presents a more detailed version of the top 10 issues that were prioritized from the 19 consolidated issues generated during the NGT portion of the workshop. Participants were assigned to one of the 10 working groups and asked to digest and synthesize all of the individual issues consolidated under their particular overarching issue. The Power Point slides used by the working group during their presentations can be found in Appendix E.

Part 2 (NGT Workshop) reports the results of the issue identification and consolidation elements of the workshop. The participants identified 93 issues that were consolidated into 19 overarching themes. The fact that the participants were able to identify 93 issues demonstrates the significant need to address planning and implementation issues.

The success of any activity is due in great part to the participants and their enthusiasm for engagement in the process. The participants in this workshop are to be commended for their great enthusiasm! The MWD Planning Committee (Alvin Bautista, Mark Beuhler, Robert Cheng, Anatole Falagan, Andy Hui, Cesar Lopez, Matt Lyon, Rich Nagel, Paul Schoenberger, and Andy Sienkiewich) is singled out for providing the "glue" to the planning that made the workshop possible.

Thanks are also extended to the NWRI team that facilitated the workshop: Brian Brady, who so masterfully served as the Workshop Secretary and kept track of the issues to ensure their clarity, and to Tammy Russo, Workshop Coordinator; Patricia Linsky and Gina Melin, Editors; Barbara Close, Graphics Coordinator; Raymon Thomas, Graphics Assistant; Caroline Carpenter, Joyce Pease, and Rose Sota, Word Processors; and Teresa Taylor, Photographer.

Ronald B. Linsky
Executive Director
National Water Research Institute

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PRIORITY 1

Develop a Regulatory Framework for Large-Scale Seawater Desalination Projects

WORKING GROUP MEMBERS:

Bautista, Cheng, and Jensen

Issue Description:

A large-scale seawater desalination plant project will require numerous permits and approvals from a variety of local, state, and federal agencies before construction can commence and before the plant can be placed into operation. Obtaining these permits and approvals is critical in moving a project forward. It is important to develop a regulatory framework that is rational, consolidated, and streamlined to receive the necessary permit approvals.

A list of local, state, and federal agencies, and their associated permits, is provided below. This list is region specific and would vary depending on the locale and state in which the proposed project is to be located. The examples below are indicative of California's regulatory permitting requirements. Similar permitting requirements may be required for other states.

Federal Requirements

- National Environmental Protection Act (NEPA).
  - Environmental Impact Statement (EIS) for the entire project
    - potential to affect federal land or resources

- U.S. Army Corps of Engineers (COE).
  - Section 10 Permit under the River and Harbor Act
    - intake or outfall constructed in navigable waters of the United States
  - Section 404 Permit under the Clean Water Act
    - dredged or fill materials in United States waters
    - if wetlands habitat affected = greater compensation ratio

- U.S. Coast Guard.
  - Review of Section 10 permit

- U.S. Fish and Wildlife Service (USFWS).
  - Endangered Species Act
  - Fish and Wildlife Coordination Act
    - biological assessment
    - biological opinion

- National Oceanic and Atmospheric Administration (NOAA).
  - National Marine Fisheries Service
    - compliance with the Fish and Wildlife Coordination Act
    - evaluate the assessment of project impacts on marine, estuarine, and anadromous species
  - Sanctuaries and Reserves Division
    - compliance with the Marine Protection Reserves and Sanctuaries Act

- Advisory Council on Historic Preservation.
  - Section 106 compliance
    - Preserve the cultural resources of local, regional, or national significance on Federal lands

State Requirements

- Compliance with the California Environmental Quality Act (CEQA).
  - CEQA
    - Environmental Impact Report (EIR)

- California Coastal Commission (CCC).
  - Coastal Development Permit

- Bay Conservation and Development Commission.
  - applies to San Francisco
  - development permit

- Regional Water Quality Control Board (RWQCB).
  - National Pollutant Discharge Elimination System (NPDES) Permit
    - discharge of concentrate water, stormwater, or other liquids into surface waters
    - compliance with the Regional Water Quality Control Plan, California Ocean Plan (may not discharge into locations designated as Areas of Special Biological Significance, unless a waiver is obtained)
    - dispersion modeling of concentrate disposal

- State Lands Commission (SLC).
  - Land Use Lease
    - required for construction in lands owned by the State of California (intertidal and submerged lands under state ownership)

- California Department of Fish and Game (DFG).
  - Stream Alteration Agreement
    - construction affecting a stream

- California Department of Health Services (DHS), Office of Drinking Water.
  - Domestic Water Supply Permit
    - treated water from desalination plants must meet drinking-water standards

Local Requirements – County, City, Municipal and District Governments

- City or County Coastal Development Permit.
  - must be compliant with CCC's requirements

- City or County Conditional Use Permit.
  - zoning requirements in accordance with the General Plan of that city or county

- Local Agencies – County Health Department, Environmental Division, or Fire Department.
  - hazardous materials
  - Business Response Plan
  - Risk Management and Prevention Plan

- County and U.S. Environmental Protection Agency (USEPA).
  - generator of hazardous waste
    - storage of hazardous waste onsite

Other Permits – Project Specific

- Dredging permit from SLC.

- California Department of Transportation (CalTrans) – Encroachment and Transportation Permits.

- California Occupational Safety and Health Act (CalOSHA) – Trenching and Excavation Permit.

- Explosives permit from CalOSHA, if explosives are used.

- Explosives permit from DFG, if explosives are used.

Schedule for Permits

The total time to obtain permits for a project may be a minimum of 18 months. More than 18 months may be required for projects that are controversial or involve sensitive habitats, sanctuaries, and endangered species.

Importance:

Without the required permits, projects cannot proceed. An accepted regulatory permitting framework will fulfill the project proponent's fiduciary responsibility to address stakeholder concerns about the overall viability of the project. Such a framework will provide a level of assurance that the project will result in a minimum level of environmental impact. Furthermore, a streamlined framework will reduce the costs and time associated with obtaining the required permits for a project.

How Do You Propose Meeting or Complying with This Issue?

As project proponents, our objective should be: "To work within a regulatory framework for obtaining the required permits that is rational, consolidated, and streamlined." Ways to reach this objective include:

- Establishing a clearinghouse for permit review at the state and regional levels.
- Developing a comprehensive guidance document (include all applicable permitting data requirements).
- Encouraging enabling legislation.
- Inter-agency agreements.
- Stakeholder-based negotiations.
- Simplifying administrative procedures.
- Educating stakeholders.

Who Are the Individuals Best Able to Address, Illuminate, Refine, and Focus This Issue?

The project proponents should work collaboratively with the lead permitting agencies from local, state, and federal governments, and political leadership at both the state and federal levels to establish the regulatory framework. Technical experts/groups in the field should provide the necessary support to develop the regulatory framework. Such technical experts/groups include the National Water Research Institute, American Membrane Technology Association, American Water Works Association (AWWA), and Water Environment Federation (WEF), among others.

Budget/Financial Considerations:

Specified amount of funds must be set aside for permitting review and consolidation activities, developing guidance documents, establishing a clearinghouse, and for collaborative meetings between the agencies involved. Lobbying and other education-based activities should also be budgeted. Based on the knowledge of similar consolidation of permit and clearinghouse processes for selected projects in Florida, the estimated budget to develop the guidance document and for stakeholder meetings would be in the range of $250,000 to $500,000.

Comments:

"Regulating agencies should be requested to adopt desalination regulatory procedures and expected requirements. Agencies include, at the least, RWCQBs, State Water Resources Control Board (SWRCB), DHS, and CCC." – ***Jerry Gilbert***

"Include the DHS as a key regulator. Consider a coordinated effort to inform key regulatory agency staff about desalination experience and facts *before* regulatory permit processes occur." – ***Darryl Miller***

"Would suggest the permitting framework recognize the need to involve regulatory agencies only in the planning process. This serves an educational function for new technologies and allows regulatory engineers to follow the project through planning and development. Builds confidence in the project and may help to cover evolving water-quality regulations. Setting deadlines for permits and comments requires adequate resources to be present in the regulatory agencies. Under current budget constraints, many state agencies are not able to hire to fill staffing vacancies and may be looking at staff reduction." – ***Rick Sakaji***


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Robert Reiss

PRIORITY 2

Seawater Desalination Concentrate Management Options and Issues

WORKING GROUP MEMBERS:

Filteau, Lyons, and Reiss

Issue Description:

The management of concentrate from seawater desalination systems requires balancing numerous factors, including adequately addressing environmental issues, permitting requirements, cost considerations, concentrate quality, receiving water body quality, practical engineering issues, public perception, volume considerations, and site-specific issues. The combination of these factors can have a profound impact on the suitability and costs associated with a given site or desalination treatment process. In certain instances, concentrate management issues may render a given site unsuitable for further consideration; therefore, concentrate management must be a principal consideration early in the planning and implementation of any seawater desalination project.

These include specific issues as follows:

- Desalination concentrate is currently classified by the USEPA – and, therefore, the state of California – as Industrial Waste. This classification is a default category for concentrate and is not a reflection of a constituent-specific determination. Permitting can be complicated due to this classification. In addition, this classification can cause increased public concerns.

- Detailed information regarding the concentrate management alternatives currently being used by existing facilities are not readily available for consideration in site-specific planning efforts. The experience of these projects would be of significant value when screening and selecting a concentrate management alternative for implementation.

- Information regarding the environmental effects associated with existing facilities are not readily available. The absence of this information makes it difficult to present seawater desalination in an appropriate and accurate light when communicating with the public, regulators, and other affected parties, as well as determining the appropriate concentrate management method for implementation.

- Seawater desalination facilities discharging to surface waters must obtain an NPDES permit. RWQCBs issue the permits and operate independent of each other, yet review a variety of projects that have common discharge issues. Some form of uniform NPDES permitting model is needed.

- While the selected concentrate management alternative may be technically sound, gaining consensus with other stakeholders is critical. The failure to proactively address stakeholder concerns can result in increased costs, project delays, and other impacts.

- The implementation of a surface-water discharge requires mathematical modeling of concentrate dispersion. These modeling efforts are a part of determining environmental impact minimization, permitting, and addressing public concerns. However, stakeholders and permitting entities, in particular, may not agree with the selected model and methodology. This can impact costs, acceptance, and schedule.

- The addition of chemicals to the process train can adversely impact the ability to obtain a concentrate disposal permit due to the introduction of chemicals to the receiving water body.

- The regulatory limits for parameters are not always consistent with analytical quantification levels for demineralization projects and seawater projects, in particular. The limits of analytical equipment and techniques are such that laboratories cannot meet the Method Detection Limit/Practical Quantification Limit (MDL/PQL) sensitivity for some parameters for certain demineralization source waters and concentrate. For example, the PQL for a demineralization feed water or concentrate from a seawater facility may be higher than the regulatory limit established for that parameter due to matrix interferences.

Importance:

Appropriate concentrate management planning is necessary to ensure compliance with project objectives, including protection of the environment, accurate estimations of project costs and schedules, and other factors. In extreme cases, inadequate concentrate management planning could prevent project implementation.

How Do You Propose Meeting or Complying with This Issue?

- Recommend that the State of California reclassify concentrate as a "potable water byproduct" as other states have done (e.g., Florida). While this does not change the regulatory requirements associated with permitting, it mitigates unnecessary public perception issues. In addition, it is recommended that the Industrial Waste regulatory criteria be evaluated relative to the constituents in seawater desalination concentrate. For criteria that appear misapplied to this stream, it is recommended that a regulatory reform effort be initiated.

- Ensure that all possible concentrate management alternatives are considered early in the planning process. This may include surface-water discharge (including blending with power plant cooling water, dispersed discharge to the ocean, and/or introduction into a regional brine collector system), deep-well injection (including considering the use of abandoned oil and gas wells), blending with municipal wastewater effluent, and shallow-well injection/dispersion (i.e., beach wells with a "Rainey collector"-type of apparatus).

- Collect data from existing facilities with regard to the concentrate management method, design of concentrate outfall structures or other infrastructure associated with concentrate management, and other pertinent information, such as a literature search to support an understanding of current management practices.

- Conduct additional research to fill information gaps, such as the efficiency of shallow-beach well and/or deep-well injection.

- Address environmental impacts considerations and public perceptions issues, in part, through the collection of data related to existing desalination facilities. Much of the controversy of applying seawater desalination relates to the perception of environmental impacts from concentrate disposal. Significant existing data from the hundreds of medium- and large-scale seawater desalination plants throughout the world may be available. This information should be assimilated and utilized to support the site-specific environmental evaluation, permitting, and addressing public concerns. This may include presenting information via a website and providing literature for the public. Assimilation of the data requires identifying data fields.

- Recommend an effort to develop a statewide policy on the discharge of saline waters to mitigate the issue of RWQCBs operating independently on projects with commonality and issuing differing requirements for common situations. Some form of an NPDES permitting model is needed. Coordination with DHS would ensure proper regulatory policies, reduce the time for review, and avoid project delays. The SWRCB could develop this policy.

- Bring stakeholders into the planning process in the early stages of the project to ensure broad-based stakeholder support for the project and the proposed concentrate management alternative in particular. Concentrate management can be one of the most important stakeholder issues. Due to the importance of this issue, a public relations firm should be party to this effort.

- Ensure acceptance of dispersion modeling results through the following recommended actions: work closely with regulators and other affected parties early in the evaluation of concentrate disposal (i.e., prior to a permit application); explore and present the relative applicability of dispersion models, and select a model and a methodology that all parties agree with that would be appropriate for the duration of the project; and concentrate on upfront planning to minimize the cost and schedule deviations and minimize objections to the results.

- Consider during the process design the selection and/or minimization of chemical additives to limit the resulting difficulties that may be encountered in the concentrate permitting process.

- Establish early in a project the ability to meet MDL/PQL requirements through meetings between the selected laboratory, consultant, municipality, and regulators. The inability to meet pre-established MDL/PQLs should be identified and resolved as soon as possible.

Who Are the Individuals Best Able to Address, Illuminate, Refine, and Focus This Issue?

The Metropolitan Water District of Southern California (MWD), U.S. Department of Interior, Bureau of Reclamation (USBR), and other similar agencies may be appropriate for implementing the two data collection projects defined above due to the more global value these projects would provide. MWD should lead the effort to have concentrate reclassified by the state as a potable water byproduct, as well as a review of permitting criteria with regulatory changes implemented, as appropriate. The utilities wishing to permit these facilities should take the lead on the remaining items.

Budget/Financial Considerations:

For the collection and presentation of information from existing seawater desalination facilities, as defined in the two data collection topics above, a preliminary effort may cost on the order of $40,000. To fully implement the projects, as defined, and to fill information gaps through additional research, it may be on the order of $250,000 or more. Costs for a preliminary assessment of the Industrial Waste classification are estimated to be on the order of $100,000.

Comments:

"Analytic methods need to be carefully evaluated and selected for sensitivity and applicability. Further, the regulators need to be a stakeholder in establishing the specific permit conditions and need to report and evaluate compliance with applicable standards." – ***Neil Callahan***

"Use a national group to coordinate the implementation of the activities in order to learn from each other and ensure it is not just a Southern California product that is only applicable here (i.e., look at Florida and Texas issues as well)." – ***Lisa Henthorne***

"Better and agreed-upon analysis methods for concentrate need to be established. Current analysis methods produce varying results and many have MDLs and PQLs significantly higher than regulatory levels." – ***Chris Kuzler***

"Attention should be given to the wealth of data and information regarding the outfall of publicly owned treatment works to the marine and coastal environments. Significant work has been done over the years on dispersion modeling that could be relevant to concentrate disposal." – ***Ron Linsky***

"Are there real-world studies in other countries that can be sourced instead of re-inventing the wheel?" – ***John MacHarg***

"I suggest a dispersion model, such as the existing Scripps Institute model used for the Carlsbad site, be adopted by regulator agencies so that regulators and proponents have a common point of reference." – ***Darryl Miller***

"A concentrated research effort is underway with the WateReuse Foundation, Water Environment Research foundation (WERF), American Water Works Association Research Foundation (AWWARF), and USBR. While much of the emphasis has been on inland concentrate issues, the effort includes seawater concentrate issues." – ***Kevin Price***

"In last year's Florida legislative session, a comprehensive permitting approach was proposed by Senator Paul for desalination projects. It did not make it to the floor due to lack of support. MWD may have an interest in reviewing this proposed legislation. – ***Robert Reiss***

"Analysis in concentrates poses a challenge due to the dilution of sample matrices. Method detection limits and practical quantification limits will not change, but the minimum concentration detectable will be higher than in an undiluted sample. It may not be appropriate to just specify drinking-water methods because the actual detectable minimum concentration in the sample will be higher than the MDL or PQL." – ***Rick Sakaji***


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PRIORITY 3

Regional Planning: How Should an Agency Select Ocean Water Desalination As a Water Supply Source?

WORKING GROUP MEMBERS:

Gagliardo, Lindeman, and Wilf

Issue Description:

The state of California is experiencing a prolonged period of below-average precipitation. In addition, there are pressures on the water supply from the State Water Project and the Colorado River. California must live within its Colorado River allotment of 4.4 million acre feet per year. Water from the San Francisco Bay – Sacramento River Delta has to be allocated between agriculture, environmental, and urban water demands. This demand pressure on a limited water supply is causing a shortfall in water available to urban areas of Southern California.

Southern California water agencies in the last few years have been engaged in water resources planning efforts. It has become apparent due to these efforts that new water supplies must be developed. These water supply resources include demand management, groundwater development, farm-to-urban water transfers, water recycling, and ocean water desalination. It is also important to continue to develop and implement an aggressive conservation program as part of the planning effort.

An important question that regional water agencies must answer is: Which new water supply source is right for us? The ocean water desalination option must be analyzed in context with other, more conventional, water supply options. Issues such as life cycle cost, environmental impacts, ability to permit, ability to site a facility and the proximity of the facility to sufficient water conveyance pipelines, water quality impacts, supply reliability, quality-of-life impacts, and regional economic impacts all must be considered in the planning process. Not only must individual agencies pursue a planning effort, but also the planning efforts must be coordinated to ensure that regional supplies and demands are balanced.

Ocean water desalination could be a significant new part of the region's water supply portfolio. The water supply planning efforts must analyze the ocean water desalination option using the same set of criteria as other more conventional water supply options. The planning efforts must include the usual set of stakeholders as well as those that have a specific interest in ocean water issues. In addition, the planning efforts must take into account the changing face of desalination technology. The planned timing of an ocean water desalination facility will be a key to the

success of such a project. All new water supply projects should be coordinated on a regional basis to ensure that adequate water is available to support sustainable economic development and maintain high quality of life in the region.

The planning exercises should be comprehensive and integrated efforts. All affected stakeholders should be included in the open public policy process. Not only should the issue of what new supply source is the most appropriate one, or ones, to select, but also the method of executing the project program needs to also be discussed in an open public policy forum.

Importance:

Regional planning is important in that the local agencies responsible for reliable and safe water supply must be in control of their own destiny. These planning efforts must take into account, but not be subservient to, State and federal planning efforts. Planning should occur from both ends of the government hierarchy spectrum, but since the ultimate customer has to live with the consequences of any actions, the local perspective should have overriding control.

Identifying the concerns about creating a new supply source is critical to successful implementation of a desalination plant. It is critical to the long-term success of the project that everyone involved in the process be educated on what concerns exist and the potential solutions available to relieve those concerns. For the effective analysis of various options, issues of importance are:

- Investment cost.
- Operating cost.
- Power consumption.
- Implementation period.
- Availability of affordable financing.
- Permitting.
- Environmental effect.
- Source availability.
- Sustainability.
- Flexibility of capacity.
- Siting options.

- Water-quality integration.

- Public involvement.

Regional planners need evaluation tools or definite information on all the above aspects of the seawater desalination supply option, as well as traditional supplies to develop a clear and comparable assessment of desalination versus conventional alternatives. The method of evaluation of the economics of seawater desalination projects data is quite straightforward but what is critically required is a database of relevant input parameters. Environmental effect and water quality integration issues are complex, and basic information and evaluation models have to be developed.

How Do You Propose Meeting or Complying with This Issue?

Providing information to the public, staff, and politicians is critical to resolving the issue. The regional utility is essential in identifying and evaluating the potential supply sources for the region. The regional utility should work with the individual municipalities to identify all possible supply sources that could be developed in an area. No source can be too large or too small to be considered initially.

Once all the potential supply sources have been identified, they should be compared for selection and implementation strategies. This can be accomplished by developing a "whole-systems" approach and method of comparing desalination supply with other supply options. This could include full life-cycle cost/benefit analysis, transportation cost, water quality (including the potential for multiple uses through reuse), whole-system energy comparisons, environmental benefits as well as impacts (including avoided extraction of water from natural systems), water system reliability (including analysis of reliability and shortage issues with existing systems), and other factors.

Development of a whole systems approach for comparative purposes helps build the foundation on which future supply decisions can be based. Providing a level playing field to select projects for further feasibility and design minimizes the guesswork for all parties involved. Incorporation of this approach with a considerable public information program allows for the public to provide input throughout all stages of development. By providing multiple points of input to the public during the selection process you are better able to address concerns of those worried about government not being up front in their supply selection process.

Renewal of the development plan on a 5-year cycle keeps the identified projects up to date and allows an organization the flexibility to modify the development plans to meet the ever changing needs of the region.

Who Are the Individuals Best Able to Address, Illuminate, Refine and Focus the Issue?

- Regional wholesale water agencies.
- Local retail water agencies.
- Regional and local groundwater agencies.
- Local government agencies.
- Local land-use agencies.
- Environmental groups.
- Industries.
- Agriculture.
- Local citizen groups.
- Regional planning agencies.
- Regional and local Chambers of Commerce.
- Taxpayers associations.
- Water-related advocacy groups.
- Water-related organizations.

Budget/Financial Considerations:

It is estimated that in order to do an effective job, it would be necessary to set a planning budget of $2,000,000.

Comments:

"Power generation community needs to be recognized as a stakeholder. A lesson we have learned in Texas is that regional water planning and state water have to be closely integrated. Otherwise, serious, costly inefficiencies are perpetuated." – ***Jorge Arroyo***

"I suggest the value of alternative water resources be a key decision criteria rather than just cost." – ***Darryl Miller***

"Need to emphasize that the planning process needs to be driven concurrently from the local agencies up and from the regional agencies down – ultimately clear communication of expectations, assignment of responsibility for future reliability, and monitoring of performance need to occur." – ***Karl Seckel***

"How can local/regional planning encourage projects that are not just environmentally benign, but create net environmental benefits?" – ***Gary Wolff***


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PRIORITY 4

Public Information and Outreach of Seawater Desalination

WORKING GROUP MEMBERS:

Henthorne, Rohe, and Wildermuth

Issue Description:

Marketing principles can successfully be used to gain public support for desalination projects, as part of a successful public information and outreach program. The program must take a long-range approach that maintains support through drought and flood cycles. If we properly inform stakeholders (public) on the benefits of desalinating seawater, the projects will more likely be accepted. Desalination projects should begin by getting community leaders to agree that desalination is the "new" water source of choice or a key component of an overall water supply plan before going to the general public and asking for their support.

Many water projects begin as decide, announce, and defend (DAD), which provides a more significant challenge in gaining public support than projects that have the initial support of community leaders before it is taken public.

If we are not careful, we can get the cart before the horse in desalination outreach. Frequently, agencies decide we need new water; we decide how to get it – most of the time without public support, understanding, or even knowledge. This is a losing outreach strategy.

Without public support for desalination projects, the projects can be halted, delayed, or stopped altogether by special interests or political groups or misunderstood issues. Building public support is difficult, but just as necessary as the design of the project. Building trust in the project and agency through effective communication is key to successful project understanding and implementation. The fact that some people will view desalination as an open door to unlimited growth must be addressed. The unique coastal location for project siting also exasperates outreach efforts. Environmental sensitivities related to coastal location, and potential environmental impacts from concentrate disposal and/or the seawater intake must be fully addressed in desalination outreach programs. Cost and water quality considerations associated with desalination are the final significant issues that the program should include. Comparative analyses with alternative new water resources will be a principal illustrative mechanism to inform the public regarding the benefit and value of desalination. Be prepared to dedicate people to do full-time outreach and fund them properly, including outreach innovations such as paid advertising.

A visitor center focused on water supply and desalination, accompanied by a small demonstration-scale treatment plant, will greatly accentuate the effectiveness of the program. The center will function to meet educational needs of a wide age range and professional diversity.

Importance:

Without public support, desalination projects can be stopped or delayed, incurring claims by an interrupted contractor, or in the very worse case, the project may be built and not be able to operate. Today's water projects cannot be done in a vacuum. There is less trust in public and private water agencies today than in the past. In fact, the public is more active and more distrusting of public water projects now than ever before.

Why worry about public support? The public can and has stopped other water projects. One public participation researcher posits that one individual can stop a project. The closer a water project is to human contact or use, the harder it is to communicate and build trust and support for the project. Historically, desalination projects have been DAD projects. DAD projects are more difficult projects in which to build public support than projects that involve and incorporate key stakeholders from the beginning of project planning. DAD projects do not have the benefit of the community leaders being involved and agreeing on the selection of desalination as the water supply project of choice. As a result, community stakeholders must be convinced after the fact that seawater desalination is the best choice for that community and that it offers the most benefits considering all alternatives. This after-the-fact notification can cause distrust and project opposition.

Because desalination produces drinking water, and that water is essential to human life and there is no substitute, there will be great public interest and scrutiny in future desalination projects. The best-engineered project with significant public opposition will fail. Conflict and opposition must be expected and dealt with in public projects. More and more stakeholders want to have a say in public projects – we still live in a democracy that breeds and encourages full disclosure, public debate, and both support and opposition. The more people feel they are being ignored the more likely their opposition. Peter Drucker has noted that utility managers fostering projects need to bring in the perspective on many other disciplines besides engineering, including public outreach.

How Do You Propose Meeting or Complying with This Issue?

The optimal beginning to a desalination project is to engage the stakeholders from the beginning of the project planning process when clear, convincing rationale for the project has been developed. At this point the agency can gain agreement that desalination is the best way to obtain future water supplies. By providing business, environmental, political, educational, religious, and other community leaders with the same analysis that the utility developed, and if the rationale is sound, it is very likely that they will agree that desalination is the best option.

Armed with community leader support and project agreement, the utility can now plan and carry out an active communication program to gain acceptance by the remaining stakeholder audiences. Done properly, community leaders that support the project can positively influence other opinion leaders and make desalination projects more likely to be accepted.

There is no magic formula to build public support for a project. It is as much art as it is science. There are procedures and methods that come from practice and research that can guide outreach efforts.

There is a four-step process used in communications taught by the Public Relations Society of America (PRSA), including:

- Research.
- Planning.
- Communication.
- Evaluation.

This is the basis for an effective public outreach program to support a desalination project. The PRSA planning system involves formally researching the stakeholder's opinions and attitudes; based on that research develop specific messages for each audience; then develop a communication plan to determine the communication vehicles required to reach each audience; and finally conduct periodic research to ensure your communication activities are achieving their goals.

Another key part of building successful project outreach is building and maintaining a trusting relationship with key stakeholders for both the agency and the project. The project must be solving a legitimate community problem. The community must be better off when the project is done, and stakeholders must believe that to be a fact. The benefits of the project must be clearly communicated. The project must also engage any opposition and move them from opposing to tolerating your project.

Guiding principles for effective outreach according to a recent water communication reuse study that applies to seawater desalination include:

- Managing information going to all audiences.
- Maintaining organizational and staff commitment to outreach.
- Promoting communication and public dialogue in as many channels or communication vehicles as possible.

- Ensuring a fair, open, and sound decision process for the project.
- Building and maintaining trust in your project and your agency.

Key issues that must be dealt with in a desalination project include:

- The "true" cost of desalinated water.
- Again, trust in the project and agency.
- Awareness of water problems that justify the project.
- Protection of the environment.
- Simultaneous support of conservation in addition to new water development.
- Potential for a new unlimited water supply, which could be considered growth-enhancing.
- An explanation of all alternatives considered.
- Protection of public health and confidence in safety of treatment process.

Successful strategies should include:

- Make sure you create the perception of enhancement for the community.
- Clearly articulate the legitimacy of the community problem that desalination is solving.
- Establish the need for the new water supply without using the term "growth."
- Express costs in terms stakeholders can easily understand (relate cost to the average home water bill).
- It is best if the agency providing the water is part of the community using the water.
- Demonstrate, if possible with independent experts, the safe, high quality of product water.
- Inform; do not educate audiences.
- Constantly communicate and listen (have many community feedback systems incorporated in all communication products and listen to and act upon this feedback).
- Plan on having a communications team dedicated solely to the project to communicate before, during, and after the project is a reality.

A local public relations firm should be retained in order to coordinate and execute a comprehensive public information and outreach program. This firm will work closely with the consortium of public water utilities and their respective public relations and technical staff (and consultants, if needed) to direct the firm as to the specific informational details of the program. A survey should be considered to determine which entities and professions are considerable "most credible" in order to obtain their independent, third-party endorsement.

Who Are the Individuals Best Able to Address, Illuminate and Focus This Issue:

Additional Outreach and Information Studies that have been conducted for water reuse projects can also be drawn upon for outreach for seawater desalination projects:

- WERF Framework for Public Perception and Participation in Non-Potable and Potable Water Reuse Initiatives Project OO-PUM-1 under the leadership of WERF's Bonnie Bailey.

- WateReuse Foundation's "Best Practices for Developing Potable Reuse Projects, Phase I" is currently in draft and should be available soon. This study is developing a list of 25 marketing-based practices that can apply to water reuse and desalination projects.

- The California Department of Water Resources (DWR) is also in the process of developing a similar study of reuse outreach that will be of benefit to desalination information programs.

- Several water agencies are engaged in community outreach programs for various water projects and could be a source for additional information: West and Central Basin in Los Angeles, California; Long Beach City Water Department Long Beach, California; Orange County Water District (OCWD), Fountain Valley, California; and Tampa Bay Water, Tampa, Florida.

- Other experts/references include: Hans Bleiker's Public Participation Handbook, and Dr. Peter Sandman's writing on Risk Management and Outrage Prevention.

Budget/Financial Considerations:

As mentioned, several water projects have been halted due to public, political, and environmental groups. This has occurred in various stages of projects. As communications become more important and the public becomes more involved in future projects, the importance and cost of communications programs will increase. Agencies will have to dedicate personnel specifically to the desalination project outreach, in addition to the regular staff who is conducting the day-to-day agency information program. This personnel augmentation can be done by use of outside consultants or temporary staff for the duration of the project from inception to one or two years after the project comes on line.

A recent water reuse project involving converting sewer water to drinking water to recharge a groundwater basin required funding for outside consultant teams that included research,

advertising, as well as an extension of the agency staff. The cost of this outreach was $900,000 per year for four years. Similar expenditures of funding are anticipated for an additional four years until the $450 million dollar reuse project is online and operating. The major cost for this reuse outreach program is for advertising on cable television three times a year and three direct mail pieces to every household in the affected area of the project.

Additionally, a visitor center, similar in scope to that recently established in Singapore for NeWater project, should be included in the scope of this program, at an estimated cost of $3-5 million. This cost would include a small demonstration desalination facility for public, technical, and school tours and VIP visits.

Comments:

"The Barbados desalination facility has incorporated a visitor center with window access into the facility. The resulting public acceptance and use of the facility have been fantastic from kindergarten tours to high school science projects. Public relations is an ongoing process." – ***John Kiernan***

"Giving tours of your drinking water plant may be a problem in time of security issues." – ***Matt Lyons***

PRIORITY 5

Optimize Seawater Desalination Plant Design and Operating Concepts for Power Management and Consumption

WORKING GROUP MEMBERS:

Callahan, Kuzler, MacHarg, and Morisset

Issue Description:

Power (electricity) is the single largest operating cost in a reverse osmosis (RO) seawater desalination project. Power is a significant factor in the projected delivered water cost of any desalination project. Optimizing the supply relationship between the power supplier and the water producer and optimizing the facilities design and operating procedures to manage power in the most efficient manner possible could greatly reduce the cost of seawater desalination.

This power supply and consumption optimization issue has both an immediate near-term and long-term component. The near-term potential lies in the fact that forcing the seawater desalination plant designers paradigm to include evaluating possible commercial and physical relationships with a power supplier as a fundamental tenant at the conceptual design stage for a desalination facility can produce the next significant increment of savings for desalination projects in the United States. The long-term component includes research and development needs in power/desalination public policy and regulatory issues, efficient design and operating practices, and power conservation technologies.

Consequently, the working group recommends that agencies and designers developing the design concept for a desalination plant should initially undertake an evaluation of project-specific "outside-the-fence" power supply relationship options and "within-the-fence" power management and consumption reduction best practices. This also includes knowledge of currently available technologies and process control considerations to provide a cost-effective facility. Since power consumption represents the highest cost in operating a desalination plant, reducing power consumption can provide the highest return when attempting to reduce operating costs.

Historically, the primary design approach for seawater desalination plants has been to assume that a facility will produce a base load of product water for delivery to water transmission systems. The primary means of securing electric power for desalination projects has been purchasing power at a retail rate. Optimizing the design for power management would include integrating the power supplier's generation load, transmission characteristics and rate structures,

and optimizing the level of installed desalination processing equipment and capacity of product water storage. In many cases, if the desalination facility's daily/weekly/monthly production cycle could better match off peak operating periods of the power generator, it could lead to reductions of operations and maintenance (O&M) costs by 10 to 30 percent, or more.

An example of the above would be where a desalination plant power distribution system, supervisory control and data acquisition (SCADA), control systems, the RO system's level of redundancy (i.e., installed production capacity above the plant's average design capacity), and plant's product water storage capacity were designed to allow the RO plant to shut down during the several power supplier weekday "on-peak" demand hours while still meeting the water supplier's system water demand objectives. The object for the desalination plant designer would be to minimize, or eliminate, peak power usage and maximize off-peak power usage to provide the best financial return to the owner.

Extending the concept of optimizing power management up the supply chain can lead to the development of more sophisticated relationships with power suppliers and opportunities for creating new joint ventures, contract relationships, or tariff possibilities between the power and water suppliers.

It may even be possible for some agencies to significantly expand the concept of power performance optimization by considering designing and implementing a desalination project with both a power generation component and desalination plant component. These two components need not necessarily be on the same site or owned by the same parties.

Electrical energy procurement options should be structured to achieve the most cost-efficient use of existing infrastructure. Large power requirements typically associated with RO trains can place considerable burden on already overtaxed infrastructure. Including and understanding these potential limitations in the original design concept can offer immediate benefits in the overall use of existing power generation equipment and utility infrastructure. For example, operating during off-peak hours has the potential to reduce power cost by as much as 40 percent when compared to operating during electrical on-peak hours.

Designing water plants to run at capacity during these times and shut down or run at some limited capacity during peak hours can result in significant savings in power costs. In addition, this concept will make the water system more compatible and in symbiotic relationship with the existing power generators. The RO plants that could be run heavily at night allow generators to sell excess off-peak generating capacity that typically would not be used.

It is also important to ensure that the plant is designed for maximum efficiency in terms of power consumption at every step in the process, from the seawater intake to high-pressure pump control. For example, some large systems are still being designed and built with high-pressure control valves on the outlet of the main high-pressure pump to control RO feed pressure. The differences in power consumption can be significant. Large state-of-the-art plants are being designed and built by smart operators at 2,800 kWh/acre-ft (2.3 kWh/m^3). However, many plants are still being designed with power consumption requirements as high as 4,000 kWh/acre-

ft (3.3 kWh/m^3). In a 25-MGD plant, this difference between best practices and older designs is approximately $2-million per year at $0.06/kWh.

Finally, to address the long-term component of power management and consumption reduction issues, it is necessary to assess new technological developments in this area. New technologies are constantly being conceived, developed, tested, and piloted to further optimize and maximize the efficiencies of existing processes. Technology is advancing at a rapid pace with new highly efficient energy recovery devices, membrane technologies and power-driven options being proposed nearly every day. Research efforts are needed to evaluate these new technologies for their suitability and associated readiness for the market place.

Further, there are some power consumption and use issues in California relating to the power consumption of existing comparable water supply options that need to be identified to ensure availability of accurate public information on the sensitivity of all California water supplies to power use and cost. One specific recommendation in this area has been to develop an evaluation of the pros and cons of co-location.

Importance:

For water-supply agencies to be able to consider seawater desalination as a "conventional" option for planning and delivering water supply, the cost of delivered desalinated water will need to be comparable to the next increment of a feasible water supply. Reducing the cost of desalinated water by optimizing electrical power management will facilitate the quickest possible consideration of seawater desalination plants for implementation. The simplest metric for policy makers and the public to understand is delivered water cost in terms such as dollars per acre-foot, which is essentially a life-cycle cost analysis result. Power management optimization will reduce costs to consumers and, consequently, will facilitate public acceptance of the project.

Presently, there are several energy industry policies and benefits that will be derived by managing desalination plants to be able to base load power generation facilities.

How Do You Propose Meeting or Complying with This Issue?

Conducting a case study analysis on a proposed project to evaluate the relationships between power supply and generation options, financially model the desalination plant control systems, plant processing equipment, and plant storage capacity to prepare a pro forma projection of optimized financial project performance under several scenarios.

A future phase could be to conduct a value engineering exercise on an actual project design.

It is not within the area of experience of the work group members to propose an approach for research and development into power optimization technologies and plant configuration possibilities.

Who Are the Individuals Best Able to Address, Illuminate, Refine, and Focus This Issue?

Water suppliers, power suppliers/generators, experienced desalination plant designers, and infrastructure project modelers.

Budget/Financial Considerations:

$200,000 for case study analysis.

Comments:

"Energy recovery is an important component to reduce system O&M costs. Water agencies should look into special rate incentives offered by power providers to further reduce energy costs. This is an important issue." – ***Alvin Bautista***

PRIORITY 6

Policy on Public and Private Roles and Development of New Project Delivery Process to Minimize Costs and Maximize Performance

WORKING GROUP MEMBERS:

Cline, Gilbert, and Kiernan

Issue Description:

Every utility that intends to build a desalination facility should develop a policy, with adequate stakeholder participation, that employs the most advantageous features of the public sector and private enterprise. In the initial stages of project development, each agency should consider a full range of options in such areas as financing, design, process, ownership, permitting, and long-term operation. For example, public financing has clear advantages over private-funding mechanisms.

Such early considerations provide a basis for an acceptable strategy for public/private partnerships in the delivery of desalination projects. Priority should be given to a single source of responsibility for primary project functions, such as design, construction, and operations.

Importance:

MWD is presently evaluating the prospect of giving financial assistance for the construction of five separate desalination projects within the district in the near future. These projects are expected to produce over 120,000 acre-feet per year of potable water. This is the initial phase of a broader program to supplement Southern California's water supplies. It is imperative that projects be delivered efficiently and reliably at the lowest life-cycle costs. This objective can best be achieved when each agency implements a transparent, competitive process. This could be facilitated by the development of a model procurement policy that assures the district's constituency of a product quality compatible with MWD's present high standards. Such a model should emphasize the importance of fully qualified and experienced project teams and address performance risk to prevent cost escalation and operational inefficiencies

Considering the developing capabilities of the environmental, engineering, and desalination industries and dramatic cost savings in recent design-build-operate (DBO) projects (e.g., Seattle, Washington, and elsewhere), it is important to develop an optimal public/private partnership strategy for Southern California's desalination projects. A broad spectrum of public/private

project structures is available as models to consider, including DBO; build-own-operate (BOO); build-own-operate-transfer (BOOT); and others.

How Do You Propose Meeting or Complying with This Issue?

Two efforts should be undertaken:

- Provide guidance for the development of a public/private project management strategy.

- Create a flexible adaptive model to serve as a framework for local contracting. Both efforts should begin with the review of successful strategies, contracting procedures, and procurement policies that have been implemented for drinking-water plants (including desalting facilities) and should be improved and adapted to Southern California circumstances.

Who Are the Individuals Best Able to Address, Illuminate, Refine, and Focus This Issue?

This effort should be undertaken by MWD, in cooperation with the five member agencies. It should take advantage of existing professional expertise in the legal and contractual fields regarding public/private procurement.

Budget/Financial Considerations:

Estimates to hire professional assistance and to develop a public/private model for the procurement of the desalination projects would fall in the $500,000 range. Based upon the combined capital costs of the five projects (in excess of $400 million), this investment can be easily justified.

Comments:

"Does your approach consider a recommended evaluation of the risk transfer/benefit relationship of alternate project delivery methods and the fundamental risk appetite or tolerance level of the sponsor organization?" – ***Neil Callahan***

"Seeking a 'standardized' approach would focus on a process by which MWD's member agencies would choose a project delivery method that best suits their project-specific needs." – ***Anatole Falagan***

"Many proponents/stakeholders have limited experience with different project delivery methods and may influence their comfort level of using design-bid-build (DBB); DBO; or design-build-own-operate-transfer (DBOOT) project delivery methods. Therefore, an education process

describing the benefits and risks typically associated with each project delivery method may be necessary." –***Jim Jensen***

"Please change the word 'standardization.' It is not appropriate. Emphasize the importance of public agency involvement in order to ensure that public sector procurement requirements are included in implementing a project, such as: fair and open engineering, procurement, and construction (no sole sourcing) to encourage competition, potentially driving cost down." – ***Cesar Lopez, Jr.***

"There needs to be a comprehensive review of successful and failed projects: public only, public-private, and private only." – ***Matt Lyons***

"The concept presented was for a 'standardized' approach towards procuring an ocean desalination facility within the MWD service area for all five plants being pursued. Flexibility needs to be provided for the local agency options. The educational aspect of this effort is very important to outline and communicate how to blend the best aspects of both the public and private sectors." – ***Karl Seckel***

"Include a standard contract for such procurements, with options. Enforcement, dispute resolution, maintenance requirements, etc. are *not* trivial, and some language has proven to work far better than others, to date." – ***Gary Wolff***


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PRIORITY 7

Source Water Issues and Options Analysis

WORKING GROUP MEMBERS:

Falagan, Geever, and Kartinen

Issue Description:

Different source water delivery options offer different performance characteristics and advantages, and include integrating intakes with existing power plant cooling water, developing beach well systems, and dedicating intake/outfall pipelines for seawater desalination plants.

Besides performance issues related to these options, the impingement and entrainment of marine life is a critical issue in the analysis and choice of source water options. As difficult as it is to document threats of extinction to marine life, several species are either listed or are being considered for listing as threatened or endangered. Furthermore, numerous fisheries are being dramatically curtailed in response to population declines. Finally, marine ecosystems are being dramatically impacted by numerous human activities.

The USEPA is currently drafting regulations to significantly reduce cooling water intakes. Initially, the revised regulations will affect new power plant construction, with a subsequent phase of drafting regulations to apply to existing power plants.

Additionally, each project site will have site-specific issues related to the quality of source waters, including potential influences from urban runoff, sewage treatment plants, etc. Accurately characterizing the source waters for a seawater desalination plant will have to account for variability due to influences.

Importance:

Finding common ground solutions that at the same time answer some of the technological requirements and solve some of the environmental issues are critical to successfully planning and implementing seawater desalination plants within California's environmental regulations. If incorrectly planned, poor decisions could lead to lengthy permit processes for these plants.

Therefore, it is important for agencies developing seawater desalination projects to have access to a variety of well-understood, proven site-specific options for source water collection and pretreatment. These options would include:

- Intake off of the return water of a power plant.
- Intake off of the incoming water to a power plant.
- Beach or Ranney (horizontal collector) wells tailored to smaller plants.
- Beach collection galleries.
- Separate intake for the seawater desalination plant.

Researching these options for Southern California project sites is critical to developing a base of knowledge that would allow project proponents to weigh the advantages and disadvantages of these options as they apply to their particular sites significantly. This research would aid in deciding which source water delivery option best suits a specific project site.

How Do You Propose Meeting or Complying with This Issue?

Deciding on which option to pursue could be based on some research efforts, such as:

- Design of collection and filtration systems, which address impingement issues and mitigate the mortality of aquatic life in the water column.
- Cost trade-offs between total life-cycle costs for systems that focus on accessing existing seawater intakes versus new construction designed specifically to consider environmental impacts on marine life.

Project developers will have to cooperatively work with regulatory agencies to establish the framework within which source waters will be characterized to properly permit a seawater desalination plant.

Who Are the Individuals Best Able to Address, Illuminate, Refine, and Focus This Issue?

- Public water utilities and consultants who would work cooperatively with institutions, such as Scripps Oceanographic Institute, to research collection and filtration systems.
- The USEPA, which could work with public water utilities to draft regulations that are flexible enough to facilitate the implementation of a full range of options for collection systems.

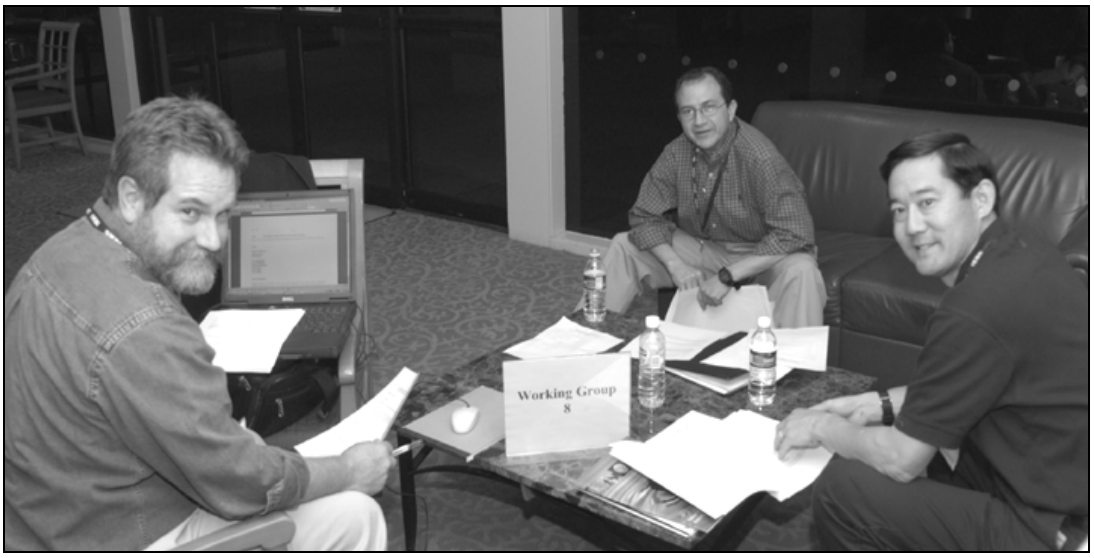
- State permitting agencies, which could allow for the cumulative permitting of decentralized seawater desalination plants that seek to take advantage of beach collection systems.

Budget/Financial Considerations:

Because of the multiple beneficiaries of these efforts, cooperative joint funding may be the best approach to undertaking each of the efforts mentioned above.

Comments:

"There is a need to have regulatory agencies recognize that marine life mortality is an issue that may not always be applicable to seawater desalination plants that use existing power plant cooling water discharges." – ***Chris Kuzler***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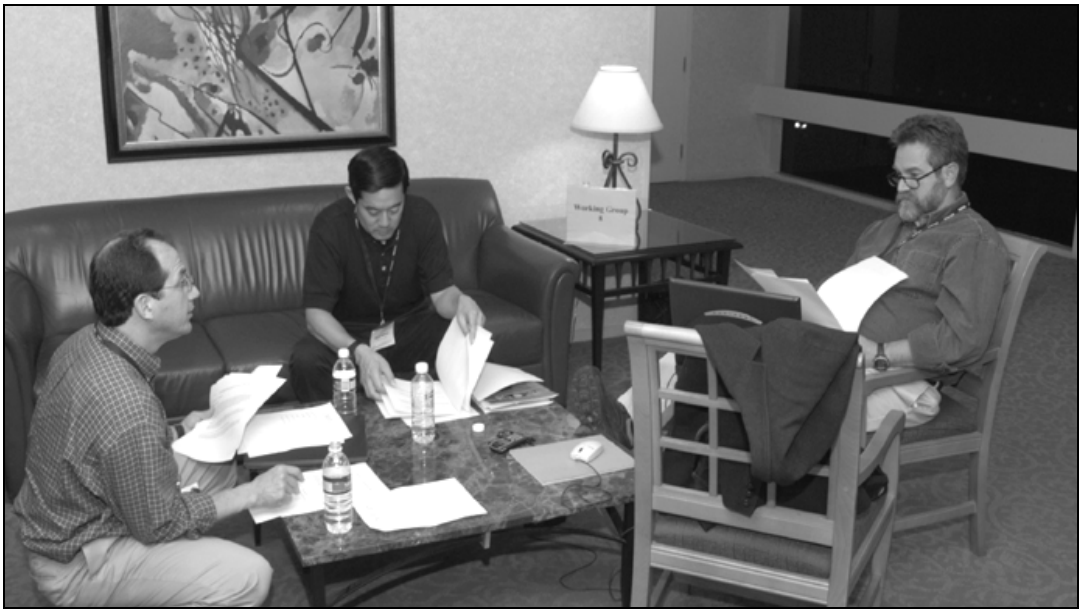

PRIORITY 8

What Value Does State Water Resource Planning Add to Desalination?

WORKING GROUP MEMBERS:

Arroyo, Sakaji, and Wilkinson

Issue Description:

Desalination holds considerable promise for enhancing the quantity and quality of the state's water supplies. There is a legitimate and critical role for the state to play in facilitating the consideration and eventual development of desalination. What *methodology* is most appropriate to facilitate an assessment of the prospects for, and total benefits available from, desalination options?

Issues for the state to address include:

- How do we properly recognize and value the reliability of water from desalination when compared to other water-supply sources?

- What support and assistance does the state provide to facilitate the development of desalination systems?

- How should the state water planning process recognize the potential environmental benefits of desalination, such as improving in-stream flows and other water-related benefits through replacing extractions with desalinated water?

- How can a state facilitate basin-wide and watershed-based planning that incorporates desalination?

States need to provide assistance and facilitation to develop regional water management strategies that incorporate desalination. With limited water resources, comprehensive basin-wide planning is required to ensure the lowest cost projects and lowest environmental impact, and to equalize water costs between users. Leadership is critically needed to coordinate the development and financing of these projects. Permits, cost, water quality, politics, and public involvement are growing issues for municipalities in the development of new water supplies.

In most cases, cost evaluations of water-supply alternatives consider only "local" costs. We should evaluate costs on a regional, statewide, interstate, or even a national basis. Costs

considered should include more than just easily quantifiable costs, such as construction, O&M, etc. It would be difficult to quantify costs, such as the environmental, sociological, and quality-of-life cost impacts on communities that are remote from the water purveyor considering developing a new water source or increasing the use of an existing water supply. But, these costs, too, should be identified and considered.

Total energy requirements for water systems need to be compared on an "apples-to-apples" basis, including equivalence in final product water quality. State strategies need to account for subsidies and waste in the system. Resulting comparisons of water supply strategies must be done on an equitable basis.

As a representative of all stakeholders, the state is a risk manager. In that capacity, the state can facilitate the development of solutions to manage unique water-supply problems. Solutions may vary from site to site – but the state can develop a risk-benefit framework that can be used to develop equitable solutions to water-supply problems that incorporates desalination.

Importance:

Improving the economics of desalination by government involvement will expedite an improvement of existing technologies and help develop new desalination methods. It is important, in a policy context, to understand the potential role and benefits, as well as costs and issues with the implementation of desalination options.

Decision-making is an extremely complex process that the public may not fully appreciate, yet the manner in which decisions are made is important to building confidence in the decision and the success of the project.

Projects need to be crafted in a manner that regional partnerships are explored to maximize water trade-offs. Due to local water rights issues, state agencies, with the proper authority and adequate resources, can facilitate water transfers to affect equitable cost sharing solutions to water-supply problems. It must be pointed out that the state can only facilitate or mediate these transfers and that solutions will have to be worked out based on existing water law. This will remain the case until water is valued and managed as a resource and not a property right.

How Do You Propose Meeting or Complying with This Issue?

There is a recognized need to develop a "whole-systems" approach and method of comparing desalination with other options. States can provide assistance and facilitate the development of cost-effective, reliable, and resilient regional water management strategies that incorporate desalination.

This may involve assembling a national and regional planning/leadership commission for desalination. A formal group needs to be created to capitalize on the efficiencies gained when common desalination issues are solved. While an informal group may currently exist in some

form, there is a tendency for each group member to compete against the other. This group needs to be able to provide unbiased information to the users as well as to decision makers and groups within and outside the region. However, leadership objectives will not change without education.

The education of the public, staff, and politicians is critical to resolving many water-supply issues. This can be accomplished by supply development planning, through public involvement, and by working with professional organizations to educate technical individuals to be better able to answer the questions posed during development and implementation.

At present, no formal framework for policy decisions exists, and none should be imposed on risk managers. However, the state can create a decision-making framework that can be used in a variety of situations so that the public understands and comprehends the elements of the decision-making process.

Who Are the Individuals Best Able to Address, Illuminate, Refine, and Focus This Issue?

The National Water Research Institute (NWRI) can play a key role in fostering creativity and community of the type needed.

Other organizations and institutions include:

- California Governor's Desalination Task Force.
- Texas Water Development Board (TWDB).
- DWR.
- SWRCB.
- University of California system.
- Regional water providers.

State Example:

Texas has a recognizable wealth of brackish groundwater. The current emphasis on ocean water is seen as a troublesome goal by many of the water users in view of the wealth and relatively wide availability of brackish groundwater. There are miles and miles of Texas, and a relatively scanty regional water distribution network. This restricts the ability of project developers to have a greater regional scope and, perhaps, limits the opportunity for accomplishing greater economies of scale. The Texas regional and state water planning methodologies offer an effective forum for public analysis of these issues and for the development of solutions with a broader support base.

Budget/Financial Considerations:

State support would be helpful to:

- Facilitate stakeholder input.
- Strengthen capabilities of state agencies to participate and facilitate.
- Continue to provide information and facilitate networking with stakeholders.
- Support research to look at regional environmental issues.

Comments:

"Southern California is planning to develop large-scale seawater desalination projects to maintain the sustainability of the region's water supplies. The reliability of imported supplies from Northern California, Eastern Sierra Nevada, and the Colorado River remains of critical importance to Southern California's long-term water resources plan. Continued significant investments in conservation will be made to demonstrate the region's commitment to sound water management." – ***Alvin Bautista***

PRIORITY 9

Develop a Portfolio Approach with Customers to Make Water Management Decisions

WORKING GROUP MEMBERS:

Lopez, Price, and Wolff

Issue Description:

New water sources are more expensive than current sources. Water utilities are also facing increasing risks and uncertainties. Consequently, water utilities are beginning to think about risks and uncertainties in more sophisticated ways than in the past and are placing more emphasis on the mix of projects ("the portfolio"). An ideal portfolio would include a diverse group of projects, some with higher costs but lower risks, and others with lower costs but higher risks. The ideal portfolio will vary from location to location depending on conditions and the willingness of customers to take on risks or to pay to avoid risks.

But customers are skeptical, with good reason, about relatively high-cost projects proposed by utilities, whether public or private. For example, seawater desalination usually has higher financial costs than other options for new water "supply" (including investments in conservation, efficiency, and water recycling). Customers need to consider whether the high quality and reliability of seawater desalination justifies the relatively high financial cost, and whether it is reasonable to spend the proposed amount and percentage of new investments on seawater desalination projects. Customers might be willing to pay for some amount of relatively expensive "blue chip" water "supplies" in their portfolio.

Importance:

If customers oppose seawater desalination projects as boondoggles promoted by engineers and contractors who are primarily interested in "playing with their favorite toys" while feeding from the public trough, the projects either will either not happen or will be delayed significantly. The Tampa Bay project was not moved forward quickly because of concerns about cost in comparison with the cost of traditional supply sources. In many cases, seawater desalination has been perceived as the supply source of last resort for cost reasons. Desalination projects must not follow a DAD pattern that increases the challenge in obtaining public support.

How Do You Propose Addressing This Issue?

Commissioning studies that "prove" that desalination is cost-effective or cost-beneficial will not address this issue. The studies need to be developed with customer involvement from the beginning. Many types of customers need to agree that the cost evaluation method seems reasonable to them, before analysis is done, because social cost is a social decision. Also, there needs to be broad agreement, especially that of the water utility, that the decisions have not been made in advance. Effective customer involvement processes are led but not controlled by the water utility. Each water utility should commit itself to such processes.

Developing a portfolio approach would involve four steps:

- Identify the costs, multiple benefits, and risks that go along with water management choices. Some management choices not only benefit customers, for example, by meeting their water needs, but also by increasing water quality and reliability.

- Quantify anticipated costs, benefits, and risks to the extent possible. This would include working with industry and government experts to arrive at better cost estimation models. As more seawater desalination facilities are commissioned in the United States, better cost estimating methods will be developed.

- Quantify the willingness of customers to take on risks or to pay for various benefits. Customers are willing to pay something or take other actions to reduce their risk exposure. This is what insurance is: you pay a premium in order to avoid a risk. In this step, customer "focus groups" and participation in workshops, etc., would lead to quantifying the risk aversion of customers in a particular service area to specific risks they might face.

- Modify the water utility decision framework to incorporate the portfolio approach. Managers of money funds routinely use the portfolio approach.

All four steps should include some amount of customer, outside expert, and water utility staff participation. What is important is that the outcomes be credible and accepted by all groups.

This effort is *not* a rate-design or rate-setting exercise. It would not include public hearings or discussions about actual decisions. Instead, the effort seeks to develop methods and procedures that customers participate in and support from the beginning, so that later decisions based on the methods or procedures have the best chance of success.

Who Is Best Able to Address, Illuminate, Refine, and Focus This Issue?

Water utilities or agencies can individually perform these four steps. Organizations like NWRI can also develop background information, methods, and guidelines for quantifying particular cost issues like the value of reliability or the value of higher quality water. Again, multiple parties should work together in a professionally facilitated way to develop such materials. Simply hiring an expert consultant who prepares a guidance manual is not enough.

Budget/Financial Consideration:

It is difficult to assess the cost of implementing our proposal. Several hundred-thousand dollars would probably be required, at minimum. However, the project concept should probably be developed in greater detail first. Fifty-thousand dollars of seed money would probably pay for concept development.


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PRIORITY 10

Providing Funding for Ocean Water Desalination Plants

WORKING GROUP MEMBERS:

Krishna, Miller, and Seckel

Issue Description:

Ocean water desalination plants are expensive to build, and many coastal utilities may need additional external funding to build such plants. Currently, costs for potable water supplies vary greatly from region to region. Ocean desalination costs also vary from site to site. Conventional water supplies range from 25 percent to 50 percent lower than estimates for desalinated ocean water. This translates to a funding gap of about $250, or more, per acre-foot. It is anticipated that this trend will continue during the rest of this decade. Water utilities are unlikely to charge the ratepayers the additional premium. The cost for desalinated ocean supplies could increase due to regulatory/permitting issues, an unstable power industry, and required environmental mitigation.

Importance

Without resolution of this issue, utilities might delay the implementation of ocean desalination projects until such time as the related issues are cleared up. This could lead to a reduced capability for providing the water supplies needed to meet future water demands.

How Do You Propose Meeting or Complying with This Issue?

Several approaches could be taken, such as:

- State supported funding or subsidies to assist the development of ocean water desalination projects.

- Federal funds from agencies such as the USBR, USEPA, Department of Defense (DOD), Natural Resources Conservation Service of the Department of Agriculture, and possibly other Federal sources to assist the development of ocean water desalination projects.

- The U. S. Desalination Coalition (a non-profit organization) has been formed to pursue Federal funding for brackish and ocean water desalination in the United States.

- The State could assist in the development of "cooperative" power plants where developers of water projects could provide funding towards one or more power plants and transmit the energy to the project location at a reduced cost for power and to ensure the long-term stability.

- Regional agencies could provide funding towards development of ocean desalination plants, where available.

Who Are the Individuals Best Able to Address, Illuminate, Refine, and Focus This Issue?

Those individuals who are in key decision-making positions, including:

- State Governor.

- State Legislators.

- U.S. Senators and Congressmen.

- Administrative Heads of State Agencies.

- Administrative Heads of Federal Agencies.

- Governing Boards of Utilities.

Budget/Financial Considerations:

Several regions of the United States can benefit from support of ocean water desalination projects. Approximately 50 percent of the United States population lives within 50 miles of the coastline. The required funding assistance may be of the order of $ 1-2 billion over the next 10 years.

Comments:

"Remember that willingness to pay (WTP) is not cast in stone. It changes as perceptions and information change. So, we need to focus on increasing WTP (whether actual payments is via taxes or rates), rather that taking WTP as an absolute, fixed constraint. " –***Gary Wolff***

PART 2

NGT WORKSHOP


RACKISH GROUNDWATER
64.
GROWTH AND MEETING THE
REQUIREMENTS OF THE CLEAN
WATER ACT
65.

PRIORITY 1

Regulatory Permitting Issues Associated with Seawater Desalination

Originators:

Bautista on behalf of himself, Cheng, Falagan, Gilbert, Jensen, and Rohe

The following issues were consolidated under the above title:

Title: **Regulatory Permitting Issues Associated with Seawater Desalination**

Originator: **Bautista**

Issue Description:

This involves the ability of project sponsors to secure regulatory permits, particularly those related to the discharge of concentrated brine through ocean outfalls, and to develop foolproof mechanisms to ensure that adequate measures are in place to minimize the introduction of contaminated water into the distribution system in case the process malfunctions. This is critical towards the development of consumer confidence in desalination and eventual public acceptance issues.

Importance:

Without permits, projects cannot proceed. Without public acceptance, projects cannot proceed. Public opinion is very important, particularly in emerging projects that have public health implications. These public opinions can also shape the regulatory process.

How Do You Propose Meeting or Complying with This Issue?

- Work with regulators to develop a reasonable set of criteria that is scientifically based and can be used to develop permit guidelines.

- Work with experts with proven experience in the desalination field to understand and utilize the most reliable treatment processes.

- Educate the public on seawater desalination.

Title: **A Cohesive Plan of Information Sharing Related to the Permitting, Design, Construction, and Operation of Seawater Desalination Membrane Processes**

Originator: **Bautista**

Issue Description:

In Southern California, the seawater RO process is an emerging water treatment option. Southern California water agencies are embarking on a regional approach and will benefit from information derived through those agencies that are in advanced stages of RO production. Open sharing of information is important to further the implementation of seawater desalination projects. This can be done directly between agencies, through workshops, and/or through other venues that carry responsibility in this arena.

Importance:

Knowledge and experience gained from others are valuable in assisting those water suppliers who are in the early stages of implementation.

How Do You Propose Meeting or Complying with This Issue?

- Continue forums such as this NGT workshop.

- NWRI, DWR, USBR, and CCC are organizations that can assist in this area.

Title: **How Does an Agency Identify All Relevant Water-Quality Issues for Integration into the Treatment Process?**

Originator: **Cheng**

Issue Description:

Similar to other treatment techniques, water produced from seawater desalination must meet all applicable drinking-water standards. However, a major difference in the use of seawater as a source is the unique water-quality conditions that other waters may not have. For example, in addition to containing elevated levels of calcium, magnesium, sodium, and chloride, seawater contains elevated levels of bromide and boron. It is important to be able to identify these parameters and emerging contaminants, including personal care products and endocrine disruptors, to be able to determine the effectiveness of the treatment. Other events include algal toxins that may be produced during red-tide events.

Importance:

Although distillation and membrane treatment are available for seawater desalination, the seawater desalination projects being discussed within the United States primarily incorporate membrane treatment. Although membranes have widely been regarded as an "absolute barrier," recent treatment study data suggest that the levels of bromide, boron, and endocrine disruptors may not be low enough to meet future regulations. As such, it is important to be able to systematically identify these water-quality parameters and the effectiveness of treatment. If membrane treatment is not effective, then other technologies must be incorporated into the overall treatment scheme to meet current and anticipated water-quality regulations.

How Do You Propose Meeting or Complying with This Issue?

Discuss this issue with federal and state regulatory authorities, and engage in discussions with risk analysis experts.

Title: **Develop a Permitting Plan for California's Regulatory Framework**

Originator: **Falagan**

Issue Description:

- What will be the plan for negotiating through California's regulatory maze to acquire the permits required to put a seawater desalination plant in operation?

- What will be the data requirements, and can some of those requirements be satisfied with the same data and analysis?

Importance:

Having a defined plan for acquiring the necessary permits will be critical for agencies who are under contractual commitments to complete projects and start producing water by a certain date or suffer financial impacts.

How Do You Propose Meeting or Complying with This Issue?

Work with California's regulatory agencies to cooperatively define the permitting framework that will be required for building and operating seawater desalination plants in Southern California.

Title: **Create New Statewide Policy on the Discharge of Saline Waters**

Originator: **Gilbert**

Issue Description:

Regional boards are operating independently to review a variety of projects that have common discharge issues. Some form of NPDES permitting model is needed. Coordination with the DHS would assure proper regulatory policies, reduce the time for review, and avoid project delays.

Importance:

Resolving uncertainties regarding permit conditions and timing would cut costs and improve project planning.

How Do You Propose Meeting or Complying with This Issue?

Request the SWRCB to develop this policy.

Title: **Determine a Rational Basis for Approving an NPDES Permit for the Discharge of Seawater Concentrate**

Originator: **Jensen**

Issue Description:

An NPDES permit must be issued before the seawater concentrate from a seawater desalination facility can be discharged to the receiving seawater. The permit must satisfy the requirements of the federal Clean Water Act, California Water Code, California Ocean Plan, and the Comprehensive Water Quality Control Plan (Basin Plan) for the San Diego region, none of which anticipated the impact of the discharge and mixing of seawater concentrate with ocean waters.

Importance:

There is presently no clear guidance in any regulation to determine the effect of seawater concentrate or dilution thereof on the aquatic environment. We do not know whether technology-based effluent limits, such as dilution ratio, and distance-based effluent limits will be acceptable, or whether more stringent water-quality based effluent limits are required using surrogate marine species, etc.

How Do You Propose Meeting or Complying with This Issue?

The RWQCBs and the agency responsible for the Ocean Plan criteria should be encouraged to review available studies and information and conduct new studies, if necessary, to adopt uniform and reasonable criteria for obtaining an NPDES permit for the discharge of seawater concentrate from desalination plants.

Title: **Cost and Time to Obtain Environmental and Construction Permits and Approvals for the Construction of Large Seawater Desalination Plants**

Originator: **Rohe**

Issue Description:

A major seawater desalination plant project will need to obtain numerous permits and approvals from a variety of local, state, and federal agencies before construction can commence and before the plant can be placed into operation. Obtaining these permits and approvals will be costly and time consuming.

A list of local, state, and federal agencies, and their associated permits, is provided below:

Federal Requirements

- National Environmental Protection Act (NEPA).
  - Environmental Impact Report (EIR) for the entire project

- U.S. Army Corps of Engineers (COE).
  - Section 10 Permit under the River and Harbor Act
    - intake or outfall constructed in navigable waters of the United States
  - Section 404 Permit under the Clean Water Act
    - dredged or fill materials in United States waters
    - if wetlands habitat affected = greater compensation ratio

- U.S. Coast Guard.
  - Review of Section 10 permit

- U.S. Fish and Wildlife Service (USFWS).
  - Endangered Species Act
  - Fish and Wildlife Coordination Act
    - biological assessment
    - biological opinion

- National Oceanic and Atmospheric Administration (NOAA).
  - National Marine Fisheries Service
    - compliance with the Fish and Wildlife Coordination Act
    - evaluate the assessment of project impacts on marine, estuarine, and anadromous species
  - Sanctuaries and Reserves Division
    - compliance with the Marine Protection Reserves and Sanctuaries Act

- Advisory Council on Historic Preservation.
  - Section 106 compliance
    - Preserve the cultural resources of local, regional, or national significance on Federal lands

State Requirements

- Compliance with the California Environmental Quality Act (CEQA).
  - CEQA
    - Environmental Impact Report (EIR)

- California Coastal Commission (CCC).
  - Coastal Development Permit (CDP)

- Bay Conservation and Development Commission (BCDC).
  - applies to San Francisco
  - development permit

- Regional Water Quality Control Board (RWQCB).
  - National Pollutant Discharge Elimination System (NPDES) Permit
    - discharge of concentrate water, stormwater, or other liquids into surface waters
    - compliance with the regional Water Quality Control Plan, California Ocean Plan (may not discharge into locations designated as Areas of Special Biological Significance, unless a waiver is obtained)
    - dispersion modeling of concentrate disposal

- State Lands Commission (SLC).
  - Land Use Lease
    - required for construction in lands owned by the State of California (intertidal and submerged lands under state ownership)

- California Department of Fish and Game (DFG).
  - Stream Alteration Agreement
    - construction affecting a stream

- California Department of Health Services (DHS), Office of Drinking Water.
  - Domestic Water Supply Permit
    - treated water from desalination plants must meet drinking-water standards

Local Requirements – County, City, Municipal and District Governments

- City or County Coastal Development Permit.
  - must be compliant with CCC's requirements

- City or County Conditional Use Permit.
  - zoning requirements in accordance with the General Plan of that city or county

- Local Agencies – County Health Department, Environmental Division, or Fire Department.
  - hazardous materials
  - Business Response Plan
  - Risk Management and Prevention Plan

- County and U.S. Environmental Protection Agency (USEPA).
  - generator of hazardous waste
    - storage of hazardous waste onsite

Other Permits – Project Specific

- Dredging permit from SLC.

- California Department of Transportation (CalTrans) – Encroachment and Transportation Permits.

- California Occupational Safety and Health Act (CalOSHA) – Trenching and Excavation Permit.

- Explosives permit from CalOSHA, if explosives are used.

- Explosives permit from DFG, if explosives are used.

Schedule for Permits

The total time to obtain permits for a project may be a minimum of 18 months. More than 18 months may be required for projects that are controversial or involve sensitive habitats, sanctuaries, and endangered species.

Importance:

This issue is important because these permits and approvals are costly and time-consuming steps during project planning and implementation.

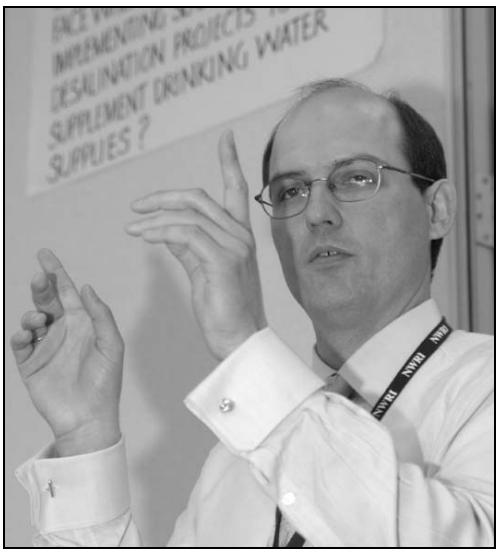
How Do You Propose Meeting or Complying with This Issue?

- Consolidate and streamline the permitting process.

- For emergency water supply projects, get a commitment from the Governor's Office that the permit applications will be processed in a timely manner after receipt.

- Similar to the Federal government's "Paperwork Reduction Office," establish a State "Permitting Streamlining Office."


IMPLEMENTING
DESALINATION PROJECTS TO
SUPPLEMENT DRINKING WATER
SUPPLIES ?


DESALINATION PROJECTS
SUPPLEMENT DRINKING WATER
SUPPLIES ?


SUPPLIES ?


FACE WHEN PLANNING
IMPLEMENTING SEAWATER

PRIORITY 2

Concentrate Issues and Options Analyses

Originators:

Lyons on behalf of himself, Gilbert, Henthorne, Krishna, Linsky, Reiss, and Wilkinson

The following issues were consolidated under the above title:

Title: **Concentrate Issues and Options Analyses**

Originator: **Lyons**

Issue Description:

Concentrate disposal options may include dilution with cooling water, reclaimed water, brackish water, as well as direct disposal, and beach-well and deep-well injection.

Importance:

This is important in relation to cost and environmental issues.

How Do You Propose Meeting or Complying with This Issue?

Identify the options and do comparative analyses.

Title: **Create New Statewide Policy on the Discharge of Saline Waters**

Originator: **Gilbert**

Issue Description:

Regional boards are operating independently to review a variety of projects that have common discharge issues. Some form of NPDES permitting model is needed. Coordination with the DHS would assure proper regulatory policies, reduce the time for review, and avoid project delays.

Importance:

Resolving uncertainties regarding permit conditions and timing would cut costs and improve project planning.

How Do You Propose Meeting or Complying with This Issue?

Request the SWRCB to develop this policy.

Title: **Comprehensive Assimilation of the True Environmental Impacts of Seawater Desalination**

Originator: **Henthorne**

Issue Description:

Much of the controversy of applying seawater desalination relates to the perception of environmental impacts from concentrate disposal. Significant existing data from the hundreds of medium- and large-scale seawater desalination plants throughout the world are available. This information should be assimilated and presented via the website and literature for the public, on a basis they can understand.

Importance:

Poor understanding of the environmental issues, particularly those associated with concentrate disposal, lead to public opposition to seawater desalination, which can slow down or prevent permitting.

How Do You Propose Meeting or Complying with This Issue?

Assimilate the existing information into a format that the public can understand related to their environmental system.

Title: **Explore Alternatives for Concentrate Disposal, Such As Injection into Abandoned Oil and Gas Wells**

Originator: **Krishna**

Issue Description:

Currently, brine disposal may be permitted into Class I injection wells, which is a time-consuming and expensive process.

Importance:

Less expensive alternatives need to be identified for concentrate disposal. It could be applicable to both seawater and brackish groundwater when they are co-located with or in the proximity of abandoned oil wells.

How Do You Propose Meeting or Complying with This Issue?

Through possible research, federal guidance from overseas experience, or regulatory amendments.

Title: **Scaling Down Versus Scaling Up**

Originator: **Linsky**

Issue Description:

Historical thinking is to scale up, as if it were the only way! Decentralization is a reality that is rapidly becoming an issue in complex urban centers.

Importance:

Space is limited, and often leads to management issues regarding a reasonable footprint within environmentally sensitive ideas.

How Do You Propose Meeting or Complying with This Issue?

Think decentralization!

Title: **Identify a Concentrate Dispersion Modeling Method That Will Meet Project Requirements through the Course of Implementation**

Originator: **Reiss**

Issue Description:

There can be significant costs, public perception, permitting issues, and other impacts to a project based on the selection and use of various dispersion models for evaluating concentrate discharges. The most sophisticated three-dimensional computational fluid dynamics (CFD) models are state-of-the-art, but require significant calibration and data. Less sophisticated two-dimensional models may be overly conservative in an effort to overcome their limitations in modeling the natural environment. Regulators may not be familiar with your proposed modeling approach.

Importance:

Dispersion modeling is costly and time consuming. Results must be appropriate, accurate, and acceptable to all parties involved. Failure to provide appropriate models and modeling methodologies can result in a failure to receive concentrate permit approval, a project delay, or increased costs.

How Do You Propose Meeting or Complying with This Issue?

- Work closely with regulators and other affected parties early in the evaluation of concentrate disposal (i.e., prior to a permit application).
- Explore and present the relative applicability of dispersion models; select a model and a methodology that all parties agree with that would be appropriate for the duration of the project.
- Concentrate on upfront planning to minimize the cost and schedule deviations and minimize objections to the results.

Title: **Options of Scale in Desalination Technology: Centralized Versus Decentralized Applications**

Originator: **Wilkinson**

Issue Description:

Desalination technology can be applied at different scales, from small, decentralized systems to large centralized ones. What are the pros and cons of each? In the electric utility industry, there is a trend toward decentralized generation based on various factors, including capital cost, lead time, environmental attributes, decision-making processes, efficiencies of specific technology applications, resilience, etc. Is there a similar dimension to desalination technology applications? If so, what might we want to consider as we plan infrastructure, siting, etc.?

Importance:

Some decisions relating to infrastructure will be hard to change later. It is important to understand our options and possible futures for technology development and applications.

How Do You Propose Meeting or Complying with This Issue?

Map out the options from small to large, decentralized to centralized, and begin to identify the attributes, issues, and concerns that might influence or guide decisions.

A scenario exercise may then be a useful approach to inform our thinking on possible futures and the pluses and minuses with each approach.

PRIORITY 3

Regional Planning: When Do You Build a Desalination Plant As a Supply Source?

Originators:

Lindeman on behalf of himself, Arroyo, Gagliardo, Henthorne, Kartinen, Price, Seckel, Wilf, and Wilkinson

The following issues were consolidated under the above title:

Title: **When Do You Build a Desalination Plant As a Supply When It Is Not a Source People Are Used To?**

Originator: **Lindeman**

Issue Description:

Permits, costs, water quality, politics, and public involvement are growing issues for municipalities in the development of new water supplies. When organizations need to expand their water supply sources, they may first look to expand existing sources. This is usually done because organizations are familiar with those sources and know how to develop them through all aspects of implementation. Seawater desalination is not a supply source commonly used in the United States. Although many technical people are comfortable with the use of desalination, this may not necessarily be the case for the people in the position to make decisions.

Importance:

Identifying the concerns about building a new supply source is critical to successful implementation of a desalination plant. It is critical to the long-term success of the project that everyone involved in the process be educated on what concerns exist and the potential solutions available to relieve those concerns.

How Do You Propose Meeting or Complying with This Issue?

The education of the public, staff, and politicians is critical to resolving the issue. This can be accomplished by supply development planning, through public involvement, and by working with professional organizations to educate technical individuals to be better able to answer the questions posed during development and implementation.

Title: **Recognize the Value of Drought-Proofing Water Sources in the Regional Water Planning Process**

Originator: **Arroyo**

Issue Description:

The Texas regional water planning process seeks to examine water demands and water availability on a drought-of-record basis. What constitutes a drought of record has become, somehow, a bit of a shifting target when you look at it in terms of what your needs are. You do not need a drought of record to have a water-supply crisis. The drought reliability of the source should be adequately recognized in our decision-making process.

Importance:

Adding drought-proof alternatives to your mix of water sources increases the overall reliability of your water supply.

How Do You Propose Meeting or Complying with This Issue?

The regional water planning process needs to ensure that drought proofing of the regional water supply is adequately recognized.

Title: **Siting**

Originator: **Gagliardo**

Issue Description:

Where are we going to put these facilities? The siting of desalination facilities is an issue due to the difficulty in locating industrial facilities at or near the ocean. These facilities must also then be located near an adequate transmission/conveyance system. To ensure a cost-effective system, the logistics of a desalination system is key.

Importance:

This issue is the foundation of any successful project.

How Do You Propose Meeting or Complying with This Issue?

There should be state or local land-use guidelines to encourage the siting of these facilities. The State of California can, during the renegotiation of power contracts, include a requirement that power plants must work with local water agencies to co-locate desalination facilities on these sites. This would be part of the value that the power companies owe the citizens of the state.

Title: **Basin-Wide Water Resource Planning and Leadership Relative to Desalination**

Originator: **Henthorne**

Issue Description:

With limited water resources, comprehensive basin-wide planning is required to ensure the lowest cost projects, lowest environmental impact, and equalize water costs between users. Leadership is critically needed to coordinate the development and financing of these projects. This issue is an extension of the present U.S. Desalination Coalition. The focus should be on who can desalinate in the cheapest and most environmentally friendly manner.

Importance:

Lots of small, medium, and large desalination plants can pop up (e.g., Monterey, California). It is critical to coordinate these projects on a regional/basin-wide area. Also, why should inland communities have to desalinate and face concentrate disposal? Coastal communities should desalinate and distribute the cost.

How Do You Propose Meeting or Complying with This Issue?

Put together a national and regional planning/leadership commission for desalination.

Title: **Wide Area Cost Evaluation of Alternative Water Supplies**

Originator: **Kartinen**

Issue Description:

In most cases, cost evaluations of water supply alternatives consider only "local" costs. We should evaluate costs on a regional, statewide, interstate, or even national bases. Costs considered should include more than just easily quantifiable costs, such as construction, O&M, etc. It would be difficult to quantify costs, such as the environmental, sociological, and quality-of-life impacts on communities that are remote from the water purveyor developing a new water source or increasing the use of an existing water supply. But, these costs, too, should be identified and considered.

Importance:

The least expensive water supply option for a local water purveyor may be the most expensive option when all cost impacts on all affected areas are considered.

How Do You Propose Meeting or Complying with This Issue?

- Regional, state, and federal agencies.
- AWWA.

Title: **Regional Review Process**

Originator: **Price**

Issue Description:

Many organizations are rapidly moving into desalination but have varying levels of expertise. This can lead to poor decisions by being too risk adverse or taking unwarranted risks.

Importance:

Opportunities exist to incorporate new ideas into desalination plants that may appear to be too high a risk. Individual organizations need the assistance of their peers and external experts. A regional review process would work to reduce costs due to over-conservatism, as well as supporting innovative efforts. This process would provide the independent credibility to take worthwhile risks.

How Do You Propose Meeting or Complying with This Issue?

A formal group needs to be created to capitalize on the efficiencies gained when common desalination issues are solved. While an informal group may currently exist in some form, there is a tendency for each group member to compete against the other. This group needs to be able to provide unbiased information to the users, as well as to decision-makers and groups within and outside the region.

Title: **Need and Timing for Ocean Desalination Supplies in Southern California**

Originator: **Seckel**

Issue Description:

MWD's Integrated Resources Plan (IRP) and the recently released Water Supply Assessment outline the needs for supplemental supplies to be developed by MWD to meet the region's reliability needs. The analysis was done assuming a certain level of supplies is developed locally

within the region, including desalinated ocean supplies. Confusion can be created with the presentation of these reports regarding the necessary timing for projects.

MWD's projects are within their control to a certain degree but can also suffer setbacks, such as the current Colorado River supply situation (i.e., timing and exact impacts of this situation are currently unknown).

Projects being implemented by local agencies are equally important. The timing for these projects is generally under the control of the local agencies but may be delayed due to budget, staffing, or other issues. There does not currently exist a process to monitor and report on the performance of the combined efforts to bring additional projects on-line, and there is no clear assignment of responsibility.

Importance:

The issue is important so that the party responsible for a project understands the need and timing for bringing the project on-line and so that there is a reporting process that evaluates the likelihood of projects coming on-line by a certain date. If the projects are not brought on-line when needed, the underlying regional reliability can be diminished.

How Do You Propose Meeting or Complying with This Issue?

MWD has proposed including a "planning buffer" in its IRP to account for the implementation risk of projects. This will help to a certain extent. A more explicit communication is needed between MWD and its member agencies to clearly assign responsibility for project allocations to meet the overall reliability of the region. One solution is that MWD could include an explicit list of projects expected to be developed within each of its member agencies. This would help to "assign the responsibility" for project development.

The Urban Water Management Plan updates for 2005 may help to resolve this issue if they are approached in a coordinated manner. This issue is further complicated by the policy question of who should pay and in what proportion (i.e., local supply benefits versus regional supply benefits). As can be seen in the recent scurry for Proposition 50 funding, many of the local projects will ultimately require regional funding to proceed. An analysis of the regional funding needs should be made. The policy issue of who pays and what benefits are received should also be addressed.

Title: **Develop State-Wide Policy of Water Supply, Including Desalination**

Originator: **Wilf**

Issue Description:

Desalination is the only way of providing "new" water of potable quality. Desalination in California helps to create new jobs in a variety of industries. It is also an export-oriented industry. Desalination addresses environmental concerns by reducing overpumping of natural water sources.

Importance:

Improving the economics of desalination by government involvement will expedite an improvement of existing technologies and help develop new desalination methods.

How Do You Propose Meeting or Complying with This Issue?

Lobbying by the desalination community to establish state or federal programs to allocate a budget for developing desalination technology and providing credit for conservation of natural resources.

Title: **Desalination in the Context of State Water Planning**

Originator: **Wilkinson**

Issue Description:

Desalination may hold considerable promise in providing water supply and quality in important parts of the state. What *methodology* is most appropriate to facilitate an assessment of the prospects for, and total benefits available from, desalination options?

Importance:

It is important, in a policy context, to understand the potential role and benefits, as well as costs and issues, with the implementation of desalination options.

How Do You Propose Meeting or Complying with This Issue?

We need to develop a "whole-systems" approach and method of comparing desalination with other options. This would include full life-cycle cost/benefit analysis, water quality (including the potential for multiple uses through reuse), whole-system energy comparisons, *environmental benefits* as well as impacts (including avoided extraction of water from natural systems) water system reliability (including analysis of reliability and shortage issues with existing systems), and other factors.





PRIORITY 4

Public Information and Outreach of Seawater Desalination

Originators:

Henthorne on behalf of herself, Filteau, Kartinen, Lopez, MacHarg, Rohe, and Wildermuth

The following issues were consolidated under the above title:

Title: **Public Education and Acceptance of Seawater Desalination**

Originator: **Henthorne**

Issue Description:

Desalination can be controversial due to cost, environmental concerns, and the potential for uninhibited growth. A comprehensive public relations/public education program must be initiated (e.g., Singapore) to answer the following:

- How much will it cost relative to other alternatives for new supplies?
- What are the benefits and value associated with these costs?
- What are the environmental concerns and how will they be addressed?
- Does desalination promote uncontrolled growth?

Importance:

Without public acceptance, the projects can be road-blocked and never reach implementation.

How Do You Propose Meeting or Complying with This Issue?

- Initiate public relations/public education.
- Develop an extensive public relations/public education program (municipal water district, state-wide, or national).
- Develop appropriate materials to get accurate information out to the public.
- Hold public forums.
- Develop a visitor center like Singapore's.

Title: **Comprehensive Assimilation of the True Environmental Impacts of Seawater Desalination**

Originator: **Henthorne**

Issue Description:

Much of the controversy of applying seawater desalination relates to the perception of environmental impacts from concentrate disposal. Significant existing data from the hundreds of medium- and large-scale seawater desalination plants throughout the world are available. This information should be assimilated and presented via the website and literature for the public, on a basis they can understand.

Importance:

Poor understanding of the environmental issues, particularly those associated with concentrate disposal, lead to public opposition to seawater desalination, which can slow down or prevent permitting.

How Do You Propose Meeting or Complying with This Issue?

Assimilate the existing information into a format that the public can understand related to their environmental system.

Title: **Maintain a Rational and Measured Approach to Planning and Implementing in the Presence of "Desal Fever"**

Originator: **Filteau**

Issue Description:

As seawater desalination approaches economic viability for some locations in the United States, a "dot com" popularity to the technology may develop that could result in rushed or forced implementation at individual locations. An incomplete or poorly planned project would be unhealthy for the water industry's efforts in desalination.

Importance:

Less than successful performance (either technically or economically) of the first desalination projects in the United States could hinder the long-term progress of others to follow.

How Do You Propose Meeting or Complying with This Issue?

This issue can be minimized by greater public dialog and education of the utilities regarding the status of all aspects of seawater desalination development.

Title: **Educate the Public to Accept the "True Cost" of Seawater Desalting**

Originator: **Kartinen**

Issue Description:

Most people view seawater desalting as too expensive. But, water rates in the United States are among the lowest in the world, and the United States is the richest nation in the world. Considering the value of water, it is substantially "undervalued" by most people. This view is "encouraged" by many potential desalted seawater purveyors.

Importance:

The "true cost" of seawater desalting is not recognized (or spoken of) in many cases. Until the public is educated as to the true cost (and value) of desalted seawater, there will be resistance to seawater desalting.

How Do You Propose Meeting or Complying with This Issue?

Should be addressed locally, regionally, statewide, and nationally by, for example, MWD, Association of California Water Agencies (ACWA), and AWWA.

Title: **Develop an Ideal Public Outreach Program; Avoid Extreme Situations of Doing It Too Early, Too Late, Too Little, or Too Much**

Originator: **Lopez**

Issue Description:

Failures in some of the large water projects recently proposed have been blamed on inappropriate public outreach efforts.

Importance:

Failure to inform the public in a timely manner could easily create public outrage, which could lead to the demise of a project. Most of the projects we have seen involved meetings with stakeholder, community leaders, etc. Projects proceed smoothly until an uninformed citizen(s) raises the issue in a public hearing and brings it to the public arena, where it becomes ugly from there.

How Do You Propose Meeting or Complying with This Issue?

Develop a customized public outreach program that is sensitive to the timely feeding of information to various sectors of the community.

Title: **How Do We Market and Leverage the Advantages of Seawater Desalination?**

Originator: **MacHarg**

Issue Description:

There are tremendous advantages to seawater RO, including reliability, water quality, security, and many environmental benefits, such as being able to give back water to areas that have been damaged due to water diversion actions.

Importance:

There will be no seawater desalination projects in California without sufficient public and political support.

How Do You Propose Meeting or Complying with This Issue?

The advantages of seawater RO need to be talked about and publicized by us. As it has been expressed before in this meeting by Ron Wildermuth, public relation programs should be implemented to highlight the numerous benefits of this technology, including how widely it has already been applied elsewhere in the world, and to give people an appreciation for how it works (as Lisa Henthorne mentioned), etc.

Title: **Break the "Hydro-Illogical Cycle": Develop a Long-Range Communication and Implementation Plant That Spans the Drought-Flood Cycle**

Originator: **Rohe**

Issue Description:

The "Hydro-Illogical Cycle" (see Appendix F) is the change in public opinion towards potential seawater desalination projects over the cycle from drought to normal rainfall periods and back to drought conditions.

Hydro-Illogical Cycle

- Drought starts:
  - awareness of drought starts
  - "wait and see" attitude occurs

- Drought worsens:
  - momentum of concern builds within the public and water agencies to take action
  - planning starts for the implementation of seawater desalination project

- Some rainfall occurs:
  - interest in seawater desalination declines

- Apathy toward drought protection ensues:
  - back to square one

Importance:

Since it may take up to 2 to 3 years to get through the federal, state, and local environmental and construction permitting, a long-range public communication plan that spans the "Hydro-Illogical Cycle" is therefore needed to keep a project "alive."

How Do You Propose Meeting or Complying with This Issue?

A proposed seawater desalination project needs to have a comprehensive public communication plan that ensures positive public opinion is maintained throughout the project planning and implementation phases.

Title: **Need to Begin Desalination Outreach Efforts Correctly**

Originator: **Wildermuth**

Issue Description:

We begin desalination outreach projects incorrectly. Desalination projects are growth and drinking water projects. We should begin by getting support from key community leaders *before* proposing desalination projects to the public, and we should be prepared to spend money to build trust, support, and acceptance.

Most desalination projects are DAD projects. This makes outreach most difficult and puts you on the path toward outreach failure rather than success.

Importance:

Without public support, desalination projects can be delayed, stopped, or halted after construction.

How Do You Propose Meeting or Complying with This Issue?

- Meet with business, political, environmental, and other key community leaders and demonstrate that desalination is the best choice of all new water alternatives before you go *public* with the project.
- Get their buy-in and then be prepared for a costly and difficult outreach effort due to "growth" and water-quality issues.
- Be prepared to have dedicated outreach staff, to pay for advertising, and to have other innovative public outreach methods.
- Emphasize the benefits of desalination.

Title: **Overcome Ignorance and Apathy over New Water Sources**

Originator: **Wildermuth**

Issue Description:

Even in arid regions, we provide all the water people need, destroying our own credibility. The public is apathetic toward water, even in water-short areas. People are ignorant of issues resulting in the erosion of public support and leaves projects vulnerable to political erosion.

Importance:

A water-informed electorate could do the opposite and force politicians to other issues. People need to be mobilized for future water, instead of being leery of it.

How Do You Propose Meeting or Complying with This Issue?

- Institute a paid national or regional public information campaign by water-short states using professional advertising on television, radio, and newspapers.
- Leverage the looming global water crisis.
- Address water apathy and ignorance on a massive scale to save funds on individual outreach efforts for all local water projects.
- Increase political, business, and community leadership support through a water-informed public.
- Military did it successfully to convert to All Volunteer Force.
- A paid public information campaign makes all future water projects more easily accepted.
- Advertising is the only way to get through today's communication "clutter."
- Use a fraction of dues from national water organizations.
- Initiate a "Got Water?" campaign similar to "Got Milk."
- Could also be used for water quality issues and may be the only way we get back our 2-percent market share of water lost to bottled water.





PRIORITY 5

Push the Boundaries: Evaluate New and Alternate Integrated Technologies for Optimizing Seawater Desalination Plant Design and Operating Concepts

Originators:

Callahan on behalf of himself, Kuzler, Lopez, MacHarg, Morisset, Rohe, and Wilkinson

The following issues were consolidated under the above title:

Title: **Pushing the Boundaries: Integrating the Power Generation and Seawater Desalination Plant Design Concepts**

Originator: **Callahan**

Issue Description:

Delivered water cost is a life-cycle cost function. Typically, O&M costs dominate the life-cycle cost analyses by a 70/30 to 60/40 ratio. Power represents 50 to 60 percent of the direct O&M expenses. If using a design approach, including power generation fully integrated with a highly redundant desalination plant, could reduce O&M costs by 20 to 30 percent, it would vastly benefit the customer.

Importance:

Reduce the delivered cost of desalinated seawater by 20 to 30 percent on a life cycle cost basis. Another consideration in the cost analysis would be to drought-proof the water supply cost premium value.

How Do You Propose Meeting or Complying with This Issue?

San Diego County Water Authority (SDCWA) and R.W. Beck. Research technology limitations; combine power generation and seawater desalination plant costs to develop a cost model validation of the concepts.

Title: **What Technology Should Be Used for a Seawater Desalination Plant?**

Originator: **Kuzler**

Issue Description:

Several technologies are available to desalinate seawater. These include RO, electrodialysis, and thermal distillation. Each technology has its pros and cons. Although RO has become the technology of choice, conditions specific to a given project may support one of the other technologies. Available technologies should be evaluated and compared as part of the initial feasibility study for a desalination facility.

Importance:

This issue is important for the justification, financial soundness, and defense of a desalination project.

How Do You Propose Meeting or Complying with This Issue?

Available technologies should be evaluated and compared as part of the initial feasibility study for a desalination facility.

Title: **Address the Potential Constraints That May Outweigh the Benefits of Co-Locating a Seawater Desalination Facility with a Coastal Power Plant**

Originator: **Lopez**

Issue Description:

The major benefits of co-locating a seawater desalination facility with a power plant are the ability to use existing intake and discharge structures, heated feed water, piggy-backing with existing permits, and easy access to power, etc. However, potential constraints in this type of set-up do exist, such as:

- Perceived support to the long-term viability of the power plant (environmentalist's concern).
- Questionable useful life of the power plant (i.e., time for repowering or phasing out).
- Power plant ownership stability (e.g., the power plant company may go bankrupt).
- Environmental and permitting factors (e.g., power plant permit facing major constraints).
- Questionable stability in the cost of power/fuel.

Importance:

Identifying and addressing these issues will help to strategize the implementation of a project that is co-located with a power plant.

How Do You Propose Meeting or Complying with This Issue?

- Thoroughly review and evaluate the constraints versus benefit.
- Strategize early and adopt a carefully crafted decision-making process.

Title: **Optimize System Efficiency**

Originator: **MacHarg**

Issue Description:

From seawater intake design to high-pressure pump control, it is easy to waste small and large amounts of power at every step. For example, large systems are still being designed and built with high-pressure control valves on the outlet of the main high-pressure pump to control the RO feed pressure. For the RO process portion of the system, it is possible to produce fresh water from seawater at 1.9 kilowatt-hour per cubic meter (kWh/m^3) (7kWh/1,000 gallons). Plants are currently being designed at 2.8 to 3.2 kWh/m^3 (10.6 to 12.1 kWh/m^3).

Importance:

Energy consumption is still the largest single cost in any given seawater RO plant. Even small losses add up to big numbers in large plants. For example, a 15-pounds per square inch (psi) loss in the feed system of a 25-million gallons per day (MGD) plant at $0.06/kWh will burn approximately $150,000.00 per year. The 1 kWh/m^3 (3.8/1,000 gallons) potential savings mentioned above adds up to approximately $2 million per year in the same 25-MGD plant at $0.06/kWh.

How Do You Propose Meeting or Complying with This Issue?

If the bid tender is written on a BOOT basis and states that the qualified consortium bidder who has the lowest unit price for water will be awarded the contract, then the 99-percent best design will win. There are also experienced operators around the world who know and are learning how to design and operate an efficient plant.

Title: **Energy: Procurement, Delivery, and Use**

Originator: **Morisset**

Issue Description:

Energy will be the single largest ongoing expense to operate a desalination facility. A thoughtful, forward-looking strategy can provide a balance between flexibility and stable costs.

- What type(s) of equipment should be installed to maximize flexibility and minimize operating costs?
- How can supply arrangements be structured for maximum flexibility, stability, and cost effectiveness?
- What current and future risks and opportunities do regulatory agency(s) and legislative bodies pose, and how can these risks be managed?
- What are the viable alternatives: Traditional utility service? Direct access? Distributed generation? Other?

Importance:

Today's turbulent energy market heightens the need for a thoughtful approach weighing available options, the reliability of supply, and long-term cost effectiveness. With the supply issues of 2000-2001 having left an indelible mark on an industry mostly taken for granted and analysts predicting that without reform, supply could again become the focus of our attention, the economic viability of these energy-intensive projects could hinge on today's decisions. Surrounded by uncertainty, should strategy be designed to mitigate risk or positioned to take advantage of opportunities that may lie ahead?

Each supply alternative offers advantages and disadvantages and generally comes complete with a full array of environmental, regulatory, or legal baggage. Focusing scarce resources on the right set of alternatives will demand a comprehensive understanding of the strengths and potential vulnerabilities of each. The thoughtful consideration of legal and regulatory issues, technology, and future innovation will assist project planning, design, and energy procurement flexibility.

How Do You Propose Meeting or Complying with This Issue?

Assuring full use of available resources will provide a start for scoping the issues. Resolution will require input from technical sources, state and federal regulatory agencies, and possibly the state legislature. Possible solutions should be posed to help in identifying the parties capable of providing assistance.

Title: **Desalination Power Requirements to Relieve Power Constrained/Congested Areas**

Originator: **Morisset**

Issue Description:

Distributed generation has been proposed as a possible alternative to relieving power congestion. Areas suffering from power congestion could benefit from the installation of a high-efficiency combined-cycle generating facility. Generated power under contract to desalination facilities would actually be consumed with the constrained area. Located in an area lacking congestion, the actual energy consumed by a desalination facility would be provided from other generating sources (displaced).

Importance:

Procurement options could be structured to satisfy other pressing public infrastructure needs. All utility services are vital to meet the growing public requirements. Regulatory agencies tend to look at one particular industry with little consideration as to how interrelated activities benefit the public as a whole. Benefits from a strategically located generation facility could be used to negotiate acceptable costs and regulatory policies that would enhance the long-term cost-effectiveness of desalination projects.

How Do You Propose Meeting or Complying with This Issue?

Successful implementation will require cooperation between multiple regulatory agencies and, most likely, guidance from legislative bodies.

Title: **Minimize Desalination Water Costs by Matching Seawater Desalination Plant Production with Water Demand: Base Load Operation Versus Meeting Peak Demands**

Originator: **Rohe**

Issue Description:

In Southern California, water demands are seasonal, with peak potable water demands typically occurring during the dry summers, and minimum demands occurring during the wet winters. With seawater desalination water typically costing more than other water sources, there is pressure to not operate the desalination plant when water demands are low. When the desalination plant is not operated at least at 90-percent on-line factor, the unit cost (e.g., $/acre-foot or $/1,000 gallon) of the water produced increases, thereby making seawater desalination appear to be even more costly.

Importance:

- Reducing the cost of desalinated water is of prime importance for seawater desalination plants to be considered for planning and implementation.
- Typically, operating a seawater desalination plant at a high on-line factor produces the least costly water ($/acre-foot or $/1,000 gallons).
- A high plant on-line factor has other benefits to RO membranes, such as avoiding extra membrane cleanings or removal, as well as the storage of RO-membrane elements.
- A high on-line factor also minimizes the unit cost for labor.

How Do You Propose Meeting or Complying with This Issue?

- Conduct comprehensive water supply and water demand studies and projections to find the optimum desalination plant capacity.
- Consider building smaller capacity seawater desalination plants but stay above a minimum capacity to take advantage of the economies of scale.

- Phase the construction of large seawater desalination plants.

- Perform a cost-sensitivity analysis for the project to find the optimum capacity, energy rate, number of plant operators, interest rate, and site features.

Title: **Net or "Embodied" Energy Analysis for Desalination**

Originator: **Wilkinson**

Issue Description:

Total energy requirements for water systems need to be compared on an "apples-to-apples" basis, including equivalence in final product water quality.

Importance:

To make good public-policy decisions and wise investments, we need to compare the full energy requirements of water-supply systems, with equivalence in water quality, as the basis for comparison.

How Do You Propose Meeting or Complying with This Issue?

- Conduct a comprehensive analysis of energy inputs and requirements for water-supply systems.

- Compare total energy intensity of options on an even basis, based on comparable water quality.

PRIORITY 6

Policy on Public and Private Roles and Development of a New Project Delivery Process to Minimize Costs and Maximize Performance

Originators:

Gilbert on behalf of himself, Callahan, Cline, Gagliardo, Kiernan, MacHarg, Miller, and Morisset

The following issues were consolidated under the above title:

Title: **Develop a New Competitive Project Delivery and Operation Process to Minimize Costs and Maximize Performance**

Originator: **Gilbert**

Issue Description:

Public agencies generally contract for services and projects through separate competitive selection processes. Most agencies will hire and train technicians to operate water treatment facilities. Recently, some public agencies have successfully experimented with what is referred to as design-build-operate contracting for new water treatment plants (Seattle, Washington, and Phoenix, Arizona). The RO-based desalination treatment facilities have unique characteristics that lend themselves to purchasing processes where RO units are designed and supplied by a single manufacturer. These units can be incorporated in a larger program operated by a single responsible contractor. Each local project has unique characteristics that could affect the design of the optimal project delivery program. The desalination generally would be aided by developing an optimized basic program that could be used by implementing utilities.

Importance:

The potential for cost reduction and the beneficial transfer of risk for future operations could be realized through an optimal project delivery process. By integrating project functions, economies can be achieved and designs optimized. Combining all costs into one package can reduce life-cycle costs. Providing the contract is for a sufficient length of time (10 to 20 years), the benefits of higher initial investments can be recovered by the contractor. Incentives can be

provided to enhance future performance, and contract provisions can protect assets. Incentives can also be provided for the use of new technology with shared benefits between the contractor and the owner. Finally, the environmental engineering marketplace in the United States has developed a number of teams that have the management, engineering, scientific, financial, and technical expertise to undertake this type of contracting.

How Do You Propose Meeting or Complying with This Issue?

A team of representatives of agencies now planning to construct projects could develop a standardized model for a contract that would achieve the above benefits.

Title: **Is There a Mutually Acceptable Model for Public-Private Partnerships in the Delivery of Desalination Plants?**

Originator: **Callahan**

Issue Description:

There are immature models for public-private partnerships in the United States in the water industry. Public agencies need transparency and are very concerned over private companies' internal rates of returns. Currently, a funding gap exists for public water infrastructure of tens to hundreds of billions of dollars. Bond cap limits on private activity bonds constrain private involvement.

Importance:

If an acceptable model for pursuing public-private partnerships in the desalination market can be developed and if state private activity bond caps for desalination projects are legislatively increased, then private market project delivery may be cost-effectively delivered via private-public partnerships.

How Do You Propose Meeting or Complying with This Issue?

Research.

Title: **Public Versus Private Development: Who Should Do It? Who Should Get Credit?**

Originator: **Cline**

Issue Description:

This is a policy issue that can readily emerge as a political matter in which the water utility will appear to favor a private enterprise but will quietly resist abdicating any control in the final process.

Importance:

An absence of true cooperation between private-public agencies can result in a feasibility quagmire.

How Do You Propose Meeting or Complying with This Issue?

The resolution of this issue can be addressed by developing clear guidance for the public policy regarding ultimate ownership and operation of future seawater desalting facilities.

Title: **Participative Public Policy**

Originator: **Gagliardo**

Issue Description:

What is the most appropriate public-policy position for water agencies to adopt regarding ownership and operation and financing of the assets? Who should be the owner of the goose that lays the golden egg?

Importance:

Critical issue related to the progression of any seawater desalination project.

How Do You Propose Meeting or Complying with This Issue?

Each agency that considers a project must have an open public-policy discussion to determine under what conditions is it acceptable for the agency to move forward.

Title: **Address Performance Risk to Prevent Cost Escalation and Operational Inefficiencies**

Originator: **Kiernan**

Issue Description:

The cost of delivering desalinated water to the public is determined by estimating the life of the equipment and the present value calculation of future O&M cost projections. Securing long-term guarantees of system performance is difficult if the engineering, procurement, and construction provider is a different entity to the long-term O&M provider. One can blame the other for system difficulties.

Importance:

If the life of the facility is less than the projected life, or if the production level is longer than expected, the entire basis for the justification of the project is miscalculated, and delivered costs need to be adjusted accordingly.

How Do You Propose Meeting or Complying with This Issue?

I believe the Santa Barbara Project first wrestled with this issue and found a successful way of dealing with it. I believe the Tampa Bay Water Project was intending to follow suit, but now finds itself the owner of a project that they had little input into until after the contract had been signed.

A preferred structure might be found halfway around the globe in Perth, Australia. There, the Water Authority interviewed a number of prequalified teams with the intention of selecting two companies to compete for the project. Each company was required to submit their development costs, which would be reimbursed by the government. The selected company was then required to enter into a 50/50 joint venture with the government. The joint venture was guaranteed to be profitable, and the private sector was offered a reduced return for a reduced risk.

Nambibia tried a similar approach, but insisted the government take half of the profits and none of the risks. That project died.

Title: **Specific Large-Scale Seawater RO Design and Operator Experience Is Essential**

Originator: **MacHarg**

Issue Description:

There is a lack of companies in the United States who have actual experience designing and operating large seawater RO systems. The lion's share of smart large-scale seawater RO companies resides outside the United States (e.g., Spain, France, Cyprus, Israel, etc.). Ionics is the exception, but one company is not enough.

Importance:

Operating experience is especially important to ensure that the plant design will work as advertised for 20 years.

How Do You Propose Meeting or Complying with This Issue?

Experience in designing and operating large seawater RO plants must be a fundamental requirement in qualifying commercial bidders. Consortiums should be established requiring one of the key members to be an experienced designer/operator.

To get the best price for water, the projects need to be put together on some kind of build, own, operate, and transfer (BOOT) basis with 10-to 20-year transfer terms.

Some top companies with design and operating experience include: Ionics (USA), Caramondoni Desalination Plants (Cyprus), Pridesa (Spain), Tedaugua (Spain), Cadaugua (Spain), and IDE (Israel).

Title: **Municipal Ownership and Development Rather Than Private Ownership and DBO Contracts**

Originator: **Miller**

Issue Description:

Municipalities have financial advantages and much higher public acceptance than private water developers.

Importance:

This issue is important for focusing on the least-costly approach to desalination development. This issue is also important in gaining public acceptance of desalination and public confidence in water resource planning.

How Do You Propose Meeting or Complying with This Issue?

Municipalities should approach private firms and team with them to provide an end solution that provides the benefits of public and private entities.

Title: **Create Public Policy to Encourage Coordinated Public and Private Investments in Utility Infrastructure**

Originator: **Morisset**

Issue Description:

Installing infrastructure to support population growth is essential, but generally unpopular (i.e., it results in the Not-In-My-Backyard [NIMBY] Syndrome). Developing coordinated public policies between regulatory agencies will be essential to getting infrastructure installed in a timeframe consistent with the needs of a growing population.

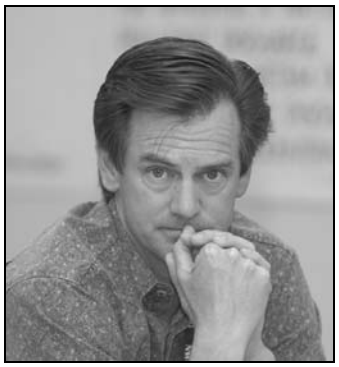
Importance:

Utility infrastructure must be available to support the needs of a growing population. Current regulatory policies do not encourage investments in infrastructure needs.

How Do You Propose Meeting or Complying with This Issue?

Coordinated public policies will require cooperation and a consolidated effort from all parties involved in the development of these sites (e.g., water and electric developers and distribution companies).









PRIORITY 7

Source-Water Issues and Options Analysis

Originators:

Lyons on behalf of himself, Falagan, Geever, Kuzler, Linsky, Miller, and Reiss

The following issues were consolidated under the above title:

Title: **Source-Water Issues and Options Analysis**

Originator: **Lyons**

Issue Description:

Source-water options include power plant cooling water, beach wells, beach galleries, near-shore pipelines, and offshore (long) pipelines. The chosen option can affect direct capital costs and O&M, pretreatment capital costs, the degree of source-water contamination, public "yuck factor" response, environmental impact/mitigation issues, source-water temperature, and public acceptance.

Importance:

This affects potential cost and fatal flaw issues (associated with water contaminants and "yuck" issues).

How Do You Propose Meeting or Complying with This Issue?

Identify and flush out the issues associated with major source-water options, creating a decision tree for use by water utilities.

Title: **Develop Beach Wells As a Pretreatment Option**

Originator: **Falagan**

Issue Description:

Currently, there are technical problems with beach wells as a pretreatment option for seawater desalination. Solving those problems or developing mitigating processes for those problems would create an additional pretreatment option that utilities could use to scale down the size of their plants and locate them strategically to optimize their integration into their distribution systems.

Importance:

Without an option for smaller scale seawater desalination plants, utilities may find themselves permanently linked to power plants due to infrastructure requirements, whether or not they are optimally located near their distribution systems' greatest needs.

How Do You Propose Meeting or Complying with This Issue?

Research the possible causes of failure in beach-well projects and develop possible solutions or mitigating processes that could be tested on a pilot basis.

Title: **Marine Life Mortality and Marine Ecosystem Disruption from Seawater Intake**

Originator: **Geever**

Issue Description:

The USEPA is currently drafting regulations to significantly reduce cooling water intakes. It is unclear how desalination projects that rely on coastal generator cooling water for seawater supply will cooperate in efforts to reduce or eliminate current cooling-water intakes.

Importance:

Cooling-water intakes impinge and entrain significant numbers of marine life. As difficult as it is to document threats of extinction to marine life, several species are either listed, or are being considered for listing, as threatened or endangered. Furthermore, numerous fisheries are being dramatically curtailed in response to population declines. Finally, marine ecosystems are being dramatically impacted by numerous human activities.

How Do You Propose Meeting or Complying with This Issue?

Cooperate with coastal generators to reduce or eliminate the need for seawater intakes. Also, cooperate in marine life research and habitat/population restoration.

Title: **Protect a Seawater Desalination Plant's Source Water from Accidental and/or Deliberate Contamination**

Originator: **Kuzler**

Issue Description:

Intake structures and source waters for seawater desalination plants should be protected from accidental or deliberate acts of contamination. This could be difficult because the intakes are typically submerged, draw from large areas, and are subject to stormwater runoff and wastewater treatment plant discharges.

Importance:

This issue could directly affect the health and safety of the public.

How Do You Propose Meeting or Complying with This Issue?

Seawater intake facilities should be monitored, and access should be limited. Additional consideration also needs to be given to developing technologies for testing source water for contaminants.

Title: **Collect Temperate Ocean Water Profiling Data Specific to Southern California**

Originator: **Linsky**

Issue Description:

Temperate ocean water characteristics are not adequately known in Southern California. A Southern California database of ocean water characteristics applicable to desalination would assist in the new projects.

Importance:

Determinations of temperate ocean water behaviors within desalination systems are an absolute must if the technology is to be successful.

How Do You Propose Meeting or Complying with This Issue?

Establish a MWD temperate ocean water database for use by all parties.

Title: **Siting Desalination Plants Near Treated Wastewater Ocean Discharge Outfalls: Wastewater/Stormwater Management**

Originator: **Miller**

Issue Description:

The public and regulators will be concerned with how well desalination membranes can treat constituents discharged by outfalls.

Importance:

This issue will be a key in the EIR.

How Do You Propose Meeting or Complying with This Issue?

Conduct membrane testing to evaluate the effectiveness of wastewater constituents.

Title: **Determine the Net Benefit of Warm- Versus Ambient-Temperature Feed Water on Water Treatment Plant Design and Life-Cycle Costs**

Originator: **Reiss**

Issue Description:

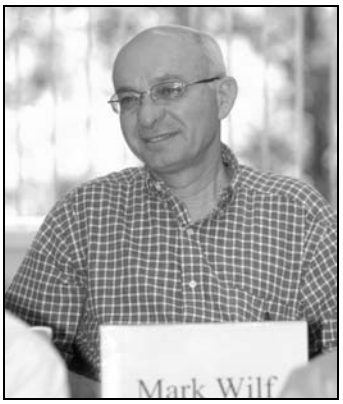
Given increasingly stringent water-quality standards for finished water, the benefit of warm, power plant cooling-water discharges is reduced. The rejection limits of membranes and increased salt passage associated with warm waters result in a need for a larger second pass or other design considerations to meet finished-water objectives. This erodes the benefit associated with warm-water feeds. There is an absence of information to support this decision without a detailed assessment and evaluation of the two feed-water alternatives.

Importance:

A facility's cost, operational stability, and quality of finished water may not meet project goals, if the relationship between feed-water temperature and compliance with project goals is not fully understood.

How Do You Propose Meeting or Complying With This Issue?

- Identify and collate the factors associated with feed-water temperature and project goals early on in a project.
- Conduct adequate engineering and cost analyses to know that you are making the right choice.
- Conduct pilot studies that accurately simulate the proposed facility, including seasonal affects.


Mark Wilf

PRIORITY 8

Desalination in the Context of State Water Planning

Originators:

Wilkinson on behalf of himself, Arroyo, Henthorne, Kartinen, Lindeman, Price, Sakaji, Wilf, and Wolff

The following issues were consolidated under the above title:

Title: **Desalination in the Context of State Water Planning**

Originator: **Wilkinson**

Issue Description:

Desalination may hold considerable promise in providing water supply and quality in important parts of the state. What *methodology* is most appropriate to facilitate an assessment of the prospects for, and total benefits available from, desalination options?

Importance:

It is important, in a policy context, to understand the potential role and benefits, as well as costs and issues, with the implementation of desalination options.

How Do You Propose Meeting or Complying with This Issue?

We need to develop a "whole-systems" approach and method of comparing desalination with other options. This would include full life-cycle cost/benefit analysis, water quality (including the potential for multiple uses through reuse), whole-system energy comparisons, *environmental benefits* as well as impacts (including avoided extraction of water from natural systems) water system reliability (including analysis of reliability and shortage issues with existing systems), and other factors.

Title: **Brackish Groundwater Versus Seawater Desalination**

Originator: **Arroyo**

Issue Description:

Texas has a recognizable wealth of brackish groundwater. The current emphasis on ocean water is seen as a troublesome goal by many of our water users in view of the wealth and relatively wide availability of brackish groundwater.

Importance:

Pursuing projects of potentially more questionable cost-effectiveness could result in some justifiable backlash from our water users.

How Do You Propose Meeting or Complying with This Issue?

Pursue good feasibility studies for our seawater projects; explore all possible ways to increase the cost-effectiveness; and equitably compare them with competing alternatives.

Title: **Ability to Market and Transport Water on a Regional Basis**

Originator: **Arroyo**

Issue Description:

There are miles and miles of Texas, and a relatively scanty regional water distribution network. This restricts the ability of project developers to have a greater regional scope and, perhaps, limits the opportunity for accomplishing greater economies of scale.

Importance:

If the regional transportation infrastructure is not in place, then it has to be factored in as an additional project cost.

How Do You Propose Meeting or Complying with This Issue?

Projects need to be crafted in a manner that regional partnerships are explored to maximize water trade-offs.

Title: **Recognize the Value of Drought-Proofing Water Sources in the Regional Water Planning Process**

Originator: **Arroyo**

Issue Description:

The Texas regional water planning process seeks to examine water demands and water availability on a drought-of-record basis. What constitutes a drought of record has become, somehow, a bit of a shifting target when you look at it in terms of what your needs are. You do not need a drought of record to have a water-supply crisis. The drought reliability of the source should be adequately recognized in our decision-making process.

Importance:

Adding drought-proof alternatives to your mix of water sources increases the overall reliability of your water supply.

How Do You Propose Meeting or Complying with This Issue?

The regional water planning process needs to ensure that drought proofing of the regional water supply is adequately recognized.

Title: **Basin-Wide Water Resource Planning and Leadership Relative to Desalination**

Originator: **Henthorne**

Issue Description:

With limited water resources, comprehensive basin-wide planning is required to ensure the lowest cost projects, lowest environmental impact, and equalize water costs between users. Leadership is critically needed to coordinate the development and financing of these projects. This issue is an extension of the present U.S. Desalination Coalition. The focus should be on who can desalinate in the cheapest and most environmentally friendly manner.

Importance:

Lots of small, medium, and large desalination plants can pop up (e.g., Monterey, California). It is critical to coordinate these projects on a regional/basin-wide area. Also, why should inland communities have to desalinate and face concentrate disposal? Coastal communities should desalinate and distribute the cost.

How Do You Propose Meeting or Complying with This Issue?

Put together a national and regional planning/leadership commission for desalination.

Title: **Wide Area Cost Evaluation of Alternative Water Supplies**

Originator: **Kartinen**

Issue Description:

In most cases, cost evaluations of water supply alternatives consider only "local" costs. We should evaluate costs on a regional, statewide, interstate, or even national bases. Costs considered should include more than just easily quantifiable costs, such as construction, O&M, etc. It would be difficult to quantify costs, such as the environmental, sociological, and quality-of-life impacts on communities that are remote from the water purveyor developing a new water

source or increasing the use of an existing water supply. But, these costs, too, should be identified and considered.

Importance:

The least expensive water supply option for a local water purveyor may be the most expensive option when all cost impacts on all affected areas are considered.

How Do You Propose Meeting or Complying with This Issue?

- Regional, state, and federal agencies.
- AWWA.

Title: **When Do You Build a Desalination Plant As a Supply When It Is Not a Source People Are Used To?**

Originator: **Lindeman**

Issue Description:

Permits, costs, water quality, politics, and public involvement are growing issues for municipalities in the development of new water supplies. When organizations need to expand their water supply sources, they may first look to expand existing sources. This is usually done because organizations are familiar with those sources and know how to develop them through all aspects of implementation. Seawater desalination is not a supply source commonly used in the United States. Although many technical people are comfortable with the use of desalination, this may not necessarily be the case for the people in the position to make decisions.

Importance:

Identifying the concerns about building a new supply source is critical to successful implementation of a desalination plant. It is critical to the long-term success of the project that everyone involved in the process be educated on what concerns exist and the potential solutions available to relieve those concerns.

How Do You Propose Meeting or Complying with This Issue?

The education of the public, staff, and politicians is critical to resolving the issue. This can be accomplished by supply development planning, through public involvement, and by working with professional organizations to educate technical individuals to be better able to answer the questions posed during development and implementation.

Title: **Regional Review Process**

Originator: **Price**

Issue Description:

Many organizations are rapidly moving into desalination but have varying levels of expertise. This can lead to poor decisions by being too risk adverse or taking unwarranted risks.

Importance:

Opportunities exist to incorporate new ideas into desalination plants that may appear to be too high a risk. Individual organizations need the assistance of their peers and external experts. A regional review process would work to reduce costs due to over-conservatism, as well as supporting innovative efforts. This process would provide the independent credibility to take worthwhile risks.

How Do You Propose Meeting or Complying with This Issue?

A formal group needs to be created to capitalize on the efficiencies gained when common desalination issues are solved. While an informal group may currently exist in some form, there is a tendency for each group member to compete against the other. This group needs to be able to provide unbiased information to the users, as well as to decision-makers and groups within and outside the region.

Title: **What Risk/Benefit/Cost Model Do Risk Managers Follow When Developing Public Policy or Moving Ahead with a Desalination Project?**

Originator: **Sakaji**

Issue Description:

Each stakeholder is a risk manager with a critical viewpoint upon which his or her decision is based.

Risk managers must come up with solutions to manage their unique water-supply problems. Solutions may vary from site to site – but can their risk-benefit points contain a common end point? Risk managers realize that we cannot provide a risk-free solution but can a common level of acceptable risk be defined?

Importance:

Decision-making is an extremely complex process that the public may not fully appreciate yet the manner in which decisions are made is important to building confidence in the decision and the success of the project. For example, how do public policy makers prioritize their objectives when trying to develop interagency agreements?

How Do You Propose Meeting or Complying with This Issue?

At present, no formal framework for policy decisions exists, and none should be imposed on risk managers. However, the manner in which they arrive at their decision should be sufficiently well laid out so the public understands and comprehends the elements of the decision-making process.

Title: **Develop State-Wide Policy of Water Supply, Including Desalination**

Originator: **Wilf**

Issue Description:

Desalination is the only way of providing "new" water of potable quality. Desalination in California helps to create new jobs in a variety of industries. It is also an export-oriented industry. Desalination addresses environmental concerns by reducing overpumping of natural water sources.

Importance:

Improving the economics of desalination by government involvement will expedite an improvement of existing technologies and help develop new desalination methods.

How Do You Propose Meeting or Complying with This Issue?

Lobbying by the desalination community to establish state or federal programs to allocate a budget for developing desalination technology and providing credit for conservation of natural resources.

Title: **Ensure That Desalination Projects Are Not Just Environmentally Benign but Enhance Environmental Quality**

Originator: **Wolff**

Issue Description:

Significant stakeholder groups in modern societies often have de facto veto power over publicly funded projects. If they cannot defeat a project outright, initially, they can delay it enough to make it less desirable or they can sabotage it later via court action or changes in political leadership. The environmental community is a significant stakeholder group in the water area and, historically, has viewed desalination as an energy intensive, environmentally inferior option compared with demand management, conjunctive use and subsurface storage, and water reuse.

That perception needs to be overcome – based on facts, not just a public relations campaign – if desalination projects are to be implemented.

Importance:

If not addressed head-on from the beginning, money and time will be wasted. As wastewater treatment plant staff sometimes say, remember the five "Ps": "Planning prevents piss poor performance."

How Do You Propose Meeting or Complying with This Issue?

Environmental issues need to be addressed during project design, not after the fact in an environmental review whose primary goal is to satisfy a law or regulation. Mitigating impacts is necessary and worthwhile. But can the project be designed from the beginning so that environmental benefits are created? For example, can more water be left in the environment at low cost by taking advantage of economies of scale? Can pollution from energy consumption embedded in water management be reduced rather than increased? Can a new water supply complement rather than undermine demand management programs and investments? Creativity is needed, including paid participation by community groups and non-profits. Why are consultants paid, but citizens and environmentalists expected to volunteer their time?

NWRI can play a key role in fostering creativity and community of the type needed. Workshops like this one, but with a leading environmental question, would be helpful.

PRIORITY 9

Work with Ratepayers to Find Particular Seawater Desalination Projects They Perceive As Reasonable to Fund, If Any

Originators:

Wolff on behalf of himself, Cheng, Jensen, Price, Sakaji, and Wilkinson

The following issues were consolidated under the above title:

Title: **Demonstrate to Ratepayers That Particular Seawater Desalination Projects Are Reasonable to Fund**

Originator: **Wolff**

Issue Description:

Ratepayers are skeptical, with good reason, about relatively high-cost projects proposed by utilities, whether public or private. Seawater desalination usually has higher financial costs than other options for new water "supply," including investments in water distribution and end-use efficiency. Ratepayers need to consider whether the high quality and reliability of seawater desalination justifies the relatively high financial cost, and whether it is reasonable to spend the proposed amount and percentage of new investments on seawater desalination projects. Ratepayers might want a relatively expensive "blue chip" water source in their portfolio.

Importance:

If ratepayers oppose the projects as boondoggles promoted by engineers and contractors who are primarily interested in "playing with their favorite toys" while feeding from the public trough, the projects either will not happen or will be delayed significantly.

How Do You Propose Meeting or Complying with This Issue?

"Reasonable to fund" is inherently subjective. I choose that phrase because it reflects the political nature of the decisions to be made. One of the "dirty little secrets" of the economics profession is that there is no such thing as the "true cost" or "real cost" of a project. There are

only financial costs and social costs not included in financial costs, where the second category depends on subjective judgments.

Commissioning studies that "prove" that desalination is cost-effective or cost-beneficial will not address this issue. The studies need to be developed with stakeholder involvement from the beginning. Many interest groups need to agree that the cost evaluation methodology seems reasonable to them, before analysis is done, because social cost is a social decision. Also, there needs to be broad agreement, especially that of the water utility, that the answers are not known in advance. Effective stakeholder processes are led, but not controlled, by the water utility. Each water utility should commit itself to such processes, and involve community and non-profit groups, including groups like the Pacific Institute and others, as well as technical consultants.

Also, organizations like NWRI can develop background information, methods, and guidelines for quantifying particular cost issues like the value of reliability or the value of higher quality water. Again, multiple parties should work together in a professionally facilitated way to develop such materials. Simply hiring an expert consultant who prepares a guidance manual is rarely enough.

Title: **How to Accurately Estimate Costs for Large-Scale Seawater Desalination Projects**

Originator: **Cheng**

Issue Description:

As compared to other regions in the world, there has been relatively little large-scale seawater desalination experience in the United States. As more agencies contemplate seawater desalination as an alternative water supply, a body of knowledge is needed to establish more reliable cost estimates.

Importance:

Cost is a major component in the decision-making process. As more information becomes available, agencies will have better and more reliable knowledge to make the decisions.

How Do You Propose Meeting or Complying with This Issue?

Work with industry and government experts to arrive at better cost estimation models. As more seawater desalination facilities are commissioned in the United States, a better body of knowledge may be gained. Additional pilot and demonstration-scale tests may provide needed information.

Title: **Risk Analysis/Risk Adverse Client: Who Has the Risk?**

Originator: **Jensen**

Issue Description:

Clients, such as utilities and other water wholesale agencies, are typically risk adverse; therefore, the client wants to put as many as possible risks on the desalination developer. A risk analysis will identify the risks, who has the risk, and the potential impact, in dollars and/or operational reliability of the project. The developer will charge for accepting the risk; therefore, there is a risk/benefit to be determined.

Importance:

A risk/benefit analysis needs to be conducted early in the procurement process to determine the risks, risk assignment, and potential impact on the project's cost and operations.

How Do You Propose Meeting or Complying with This Issue?

Conducting a risk/benefit analysis study will determine who has the risk and the impact of the risks on the operations and reliability of the desalination facility.

Title: **Water Portfolio Analysis**

Originator: **Price**

Issue Description:

Solving water management issues today is not as simple as "one solution fits all." Water managers need a tool to examine the local mix of water supplies and opportunities to determine the optimum fit for a given area.

Importance:

Depending on one source of water can easily be seen as a risk that can be reduced by developing additional sources. There is an analogy in the financial sector called "modern portfolio theory," whereby risks are reduced to maximize returns. For instance, in stock selection, it usually takes less than eight or nine stocks to minimize risk and maximize return. It is believed that the risks inherent in water-supply management are similar to risks in finance.

How Do You Propose Meeting or Complying with This Issue?

Create a group to support research in the development of a modern portfolio theory model for water managers.

Title: **What Risk/Benefit/Cost Model Do Risk Managers Follow When Developing Public Policy or Moving Ahead with a Desalination Project?**

Originator: **Sakaji**

Issue Description:

Each stakeholder is a risk manager with a critical viewpoint upon which his or her decision is based.

Risk managers must come up with solutions to manage their unique water-supply problems. Solutions may vary from site to site – but can their risk-benefit points contain a common end

point? Risk managers realize that we cannot provide a risk-free solution but can a common level of acceptable risk be defined?

Importance:

Decision-making is an extremely complex process that the public may not fully appreciate yet the manner in which decisions are made is important to building confidence in the decision and the success of the project. For example, how do public policy makers prioritize their objectives when trying to develop interagency agreements?

How Do You Propose Meeting or Complying with This Issue?

At present, no formal framework for policy decisions exists, and none should be imposed on risk managers. However, the manner in which they arrive at their decision should be sufficiently well laid out so the public understands and comprehends the elements of the decision-making process.

Title: **Fully Account for Multiple Benefits from Desalination for Water Management**

Originator: **Wilkinson**

Issue Description:

Desalination may provide economic and environmental benefits that are not being fully or properly accounted for. Examples include the improved potential for high-value water reuse applications (i.e., higher quality water available because of lower total dissolved solids is source water); reduced cost of "insurance policies" to secure supplies from highly variable (unreliable) import systems; and the reduced variability of water quality.

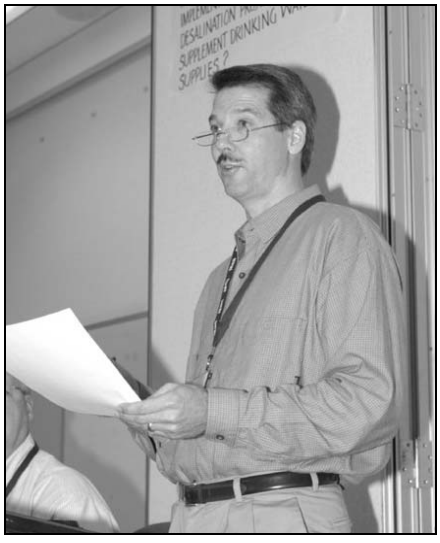
Importance:

A full accounting of multiple benefits is needed to provide a proper basis for public policy and for investing in public and private investments.

How Do You Propose Meeting or Complying with This Issue?

Fully account for multiple benefits.


IMPLEMENTING PROJECTS TO
DESALINATION
SUPPLEMENT DRINKING WATER
SUPPLIES ?


DESALINATION
SUPPLEMENT DRINKING
SUPPLIES ?

PRIORITY 10

Providing Funding for Seawater Desalination Plants

Originators:

Krishna on behalf of himself, Miller, and Seckel

The following issues were consolidated under the above title:

Title: **Providing Funding for Seawater Desalination Plants**

Originator: **Krishna**

Issue Description:

Seawater RO plants are expensive to build, and many coastal utilities may not have the funds to build such plants.

Importance:

Without adequate funding, it is very difficult to build large-scale seawater desalination plants. Funding is essential to initiate the planning, design, and construction of desalination plants.

How Do You Propose Meeting or Complying with This Issue?

Possible funding through private activity bonds or with support from state or regional agencies.

Title: **Funds for the 30-Percent Higher Cost of Seawater Desalination Need to Be Subsidized by the State or Federal Government**

Originator: **Miller**

Issue Description:

West Basin Municipal Water District's current cost of imported water is $479 per acre foot, and the projected cost of seawater desalination is $650 per acre foot (after MWD's $250 per acre foot investment).

Importance:

The public ratepayers will accept small increases for more reliability but will most likely not accept a 30-percent increase.

How Do You Propose Meeting or Complying with This Issue?

Pursue federal funding through the U.S. Desalination Coalition.

Title: **Ensure Costs for the Implementation of Ocean Desalination Supplies to the Local Agencies Are Competitive with Other Supplies**

Originator: **Seckel**

Issue Description:

The traditional benchmark for water supplies in the Southern California region is that of MWD. Currently, supplies from MWD are about $450 per acre-foot. MWD has Tier 2 water that is currently about $80 per acre-foot higher than their Tier 1 water. Current estimates of ocean desalinated water are about $1,000 per acre foot (with estimated energy costs of 6.2¢ per kilowatt-hour). MWD is offering a contribution of $250 per acre-foot. That leaves a current gap of about $300 per acre-foot. MWD rates will escalate over time. It is unknown what the out-year forecast is for capital and O&M costs associated with an ocean desalination facility (technology improvements versus regulations and energy uncertainties). Local agencies (at least in Orange County, California) are unlikely to willingly pay the additional premium *at this time*.

The cost for desalinated ocean supplies could increase due to regulatory/permitting issues, an unstable power industry, and required environmental mitigation. The issue may be complicated by two events at MWD:

- The use of bond funds from the State to reduce the cost of MWD supplies below where they otherwise would have been.

- An unknown of how MWD supplies will be allocated in times of drought.

These are both policy issues yet to be decided by MWD.

Importance:

Without resolution of this issue, a lack of local agency support may delay the implementation of ocean desalination projects until such time as the related issues are cleared up. A lack of performance on the implementation of local projects within the MWD service area could undermine the reliability of the region. With respect to the energy costs, for a plant located in Dana Point, California, it has been estimated that the energy costs (e.g., ocean intake, treatment, and 600-foot boost for system integration) will run about $77 per each 1¢ per kilowatt-hour of energy cost. An increase in energy from the estimated 6.2¢ up to the estimated grid cost of 10.3¢ adds about $316 per acre-foot to the estimated costs.

How Do You Propose Meeting or Complying with This Issue?

Several approaches could be taken, including:

- Develop state or federal funds to assist the development of projects.

- Receive additional contribution by MWD over and above the $250 per acre-foot.

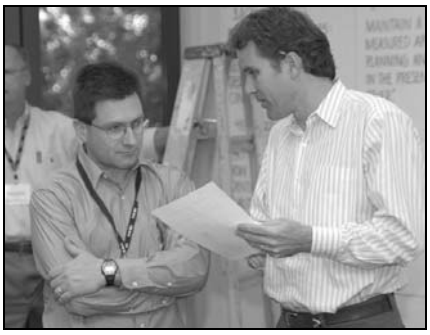
- Have MWD take over construction of the plants (i.e., to ensure improvement in regional reliability).

- Seek State assistance to develop "cooperative" power plants where developers of water projects could "buy-into" one or more power plants and wheel the energy to the project location to ensure the long-term stability of power.

- Conduct a study on the value of having a reliable water supply to demonstrate the "hidden" costs of not pursuing these types of projects.

- MWD could adopt a policy on not pursuing State bond funding and allow the funds to go to local agencies, thus resulting in a somewhat higher MWD rate and Southern California benchmark.

- MWD could adopt a policy of not reducing allocations to an area when they have invested in projects that cost more than the cost of MWD supplies (tricky policy issue).



PRIORITY 11

Total Cost of Seawater Desalination Includes a Relatively Large Number of Minor Cost Components That Must Be Identified, Optimized, and Controlled

Originators:

Filteau on behalf of himself, Cheng, Kiernan, Kuzler, MacHarg, Rohe, and Wilf

The following issues were consolidated under the above title:

Title: **Total Cost of Seawater Desalination Includes a Relatively Large Number of Minor Cost Components That Must Be Identified, Optimized, and Controlled**

Originator: **Filteau**

Issue Description:

It is necessary to achieve and maintain an acceptable cost of seawater desalination compared to that of alternative supplies. A critical issue is that the total cost of seawater desalination is made up of a relatively large number of cost components. Although energy is a major cost component, not just one or two major components will control a project's viability. Additionally, typical water utilities have little experience with many of the seawater desalination cost components.

Importance:

This cost complexity and experience level could make budgeting, cost control, and cost optimization more difficult and unreliable than many alternative supplies.

How Do You Propose Meeting or Complying with This Issue?

The utility must draw on resources that are experienced in seawater desalination and address a board range of implementation issues.

Title: **How to Accurately Estimate Costs for Large-Scale Seawater Desalination Projects**

Originator: **Cheng**

Issue Description:

As compared to other regions in the world, there has been relatively little large-scale seawater desalination experience in the United States. As more agencies contemplate seawater desalination as an alternative water supply, a body of knowledge is needed to establish more reliable cost estimates.

Importance:

Cost is a major component in the decision-making process. As more information becomes available, agencies will have better and more reliable knowledge to make the decisions.

How Do You Propose Meeting or Complying with This Issue?

Work with industry and government experts to arrive at better cost estimation models. As more seawater desalination facilities are commissioned in the United States, a better body of knowledge may be gained. Additional pilot and demonstration-scale tests may provide needed information.

Title: **Educate the Utility Staff to Understand the Criteria Necessary to Evaluate Potential Projects**

Originator: **Kiernan**

Issue Description:

Few of the commonplace perceptions about seawater desalting are universally correct. Perceptions include:

- Cost will go down significantly due to advancements in technology.
- Permitting is impossible, and the brine will kill everything.

- Co-location with a power plant is necessary.
- Using cooling-water discharge (warm water) reduces costs.
- Using the existing intake pumps and pretreatment will reduce costs.
- The cost of water is high.
- The independent power plant model is transferable to seawater desalting.
- The public will oppose seawater desalting.
- The taste of the water is a concern.
- Piloting is necessary.
- You can run the water directly into the pipeline and have the production fluctuate on an instantaneous basis.
- Private companies should not profit at the public's expense.

Importance:

Many of the above issues are correct for specific projects, but none are always true and several are just plain wrong. These perceptions are embedded into the psyche of the water utility boards and can create roadblocks into the selection process.

By educating the staff to the dynamics of siting/process/permitting, more options can be aired prior to forming selection criteria.

How Do You Propose Meeting or Complying with This Issue?

Hold seminars on a more regular basis.

Title: **Define an Appropriate Repair and Replacement Level of Funding for Desalination Plants**

Originator: **Kuzler**

Issue Description:

Seawater desalination plants operate in highly corrosive conditions when compared to traditional water treatment facilities. Because desalination is a relatively new approach to water treatment in the United States, plant operators and owners are not familiar with the equipment failure rates that can result. Materials of construction that can withstand seawater are available (i.e., super duplex or 6-moly stainless steels). However, the use of these materials does not negate the harsh environment imposed on the smaller, hidden, less-thought-of parts of equipment, such as bearings, seals, keyways, shafting, etc. Without a large amount of municipal desalination experience in the United States, how can the life cycle of equipment and proper repair and replacement funding be accurately determined?

Importance:

This issue is important because governments cannot afford to pay for large-scale repairs without having the money previously budgeted and designated for that use.

How Do You Propose Meeting or Complying with This Issue?

Seawater desalination plants have been operating in the other countries, private industries, and in the military for years. In addition, pilot plants have been and are currently being used to evaluate seawater desalination. Information from these facilities and from equipment suppliers can be compiled and evaluated to assist with determining the life cycle of various materials and pieces of equipment.

Title: **Optimize System Efficiency**

Originator: **MacHarg**

Issue Description:

From seawater intake design to high-pressure pump control, it is easy to waste small and large amounts of power at every step. For example, large systems are still being designed and built with high-pressure control valves on the outlet of the main high-pressure pump to control the RO feed pressure. For the RO process portion of the system, it is possible to produce fresh water from seawater at 1.9 kilowatt-hour per cubic meter (kWh/m^3) (7kWh/1,000 gallons). Plants are currently being designed at 2.8 to 3.2 kWh/m^3 (10.6 to 12.1 kWh/m^3).

Importance:

Energy consumption is still the largest single cost in any given seawater RO plant. Even small losses add up to big numbers in large plants. For example, a 15-pounds per square inch (psi) loss in the feed system of a 25-million gallons per day (MGD) plant at $0.06/kWh will burn approximately $150,000.00 per year. The 1 kWh/m^3 (3.8/1,000 gallons) potential savings mentioned above adds up to approximately $2 million per year in the same 25-MGD plant at $0.06/kWh.

How Do You Propose Meeting or Complying with This Issue?

If the bid tender is written on a BOOT basis and states that the qualified consortium bidder who has the lowest unit price for water will be awarded the contract, then the 99-percent best design will win. There are also experienced operators around the world who know and are learning how to design and operate an efficient plant.

Title: **Delivery of Seawater Desalination Plant Product Water to Customers; Cost and Quality Issues**

Originator: **Rohe**

Issue Description:

Typically, the desalinated water is produced at or near sea level; however, for coastal California, many of the customers and existing water storage and delivery infrastructures are some distance inland and at a higher elevation. The product-water transmission facilities and pumping energy required to integrate the desalination product water into the existing water system increase the costs of a proposed seawater desalination alternative.

Desalinated water is low in hardness and alkalinity and, therefore, needs to be post-treated to be suitable for transmission and delivery in standard water pipes (i.e., corrosion mitigation is needed). Studies need to be made to learn the effect of mixing the desalinated water with other water sources to ensure a blended quality that meets all drinking-water standards.

Importance:

If the delivery and post-treatment of desalinated water increases the desalination project's water cost, this increase may cause the project to be considered "uneconomic" and, therefore, may cause the project to not go forward.

How Do You Propose Meeting or Complying with This Issue?

- In the early planning stages, study the integration of the proposed seawater desalination plant and product-water delivery system into the overall Water Master Plan for the water agency to arrive at the most economical product-water delivery system.

- Consider multiple delivery points for the desalinated product water into the existing water system to reduce the distance and elevation for delivery.

- Build smaller desalination plants with good post-treatment that do not need to have large transmission pipelines and are able to deliver their product water directly into the local distribution system.

Title: **Corrosion in Seawater RO Systems**

Originator: **Wilf**

Issue Description:

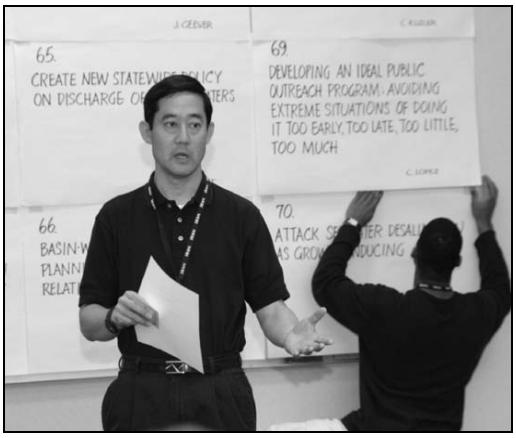
Equipment in RO seawater systems is exposed to the marine environment, which is highly corrosive. Pitting, crevice, and stress-cracking corrosion can be experienced. The severity of corrosion is site-specific as it depends on environmental conditions: salinity, temperature, pH, and flow conditions. By selecting proper construction materials, design configuration, and operation mode, the corrosion rate can be significantly reduced. Over the years, a number of solutions to marine corrosion problems have been developed.

Importance:

Corrosion damage of RO system equipment can result in significant expenses and efforts required to repair or replace affected equipment. In an improperly designed system, corrosion damage will intensify with time. In extreme cases, corrosion can result in higher operating costs or even shortening the useful life of the RO system.

How Do You Propose Meeting or Complying with This Issue?

A working comity on the corrosion subject should be formed to evaluate engineering practices applied in large RO systems and other equipment operating in seawater environments. Eventually, the comity should develop recommendations regarding design, materials selection, and maintenance procedures aimed to reduce corrosion in future local RO seawater systems.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DEVELOPING AN IDEAL PUBLIC OUTREACH PROGRAM: AVOIDING EXTREME SITUATIONS OF DOING IT TOO EARLY, TOO LATE, TOO LITTLE, TOO MUCH
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ISSUES THAT WATER
FACE WHEN PLANNING
IMPLEMENTING SEAWATER
DESALINATION PROJECTS TO
SUPPLEMENT DRINKING WATER
SUPPLIES ?

PRIORITY 12

Understand the Relationship between Finished-Water Quality Specifications and Plant Design/Costs

Originators:

Reiss on behalf of himself, Cheng, Rohe, and Sakaji

The following issues were consolidated under the above title:

Title: **Understand the Relationship between Finished-Water Quality Specifications and Plant Design/Costs**

Originator: **Reiss**

Issue Description:

Water-quality goals are becoming increasingly stringent. These include issues of bromide, boron, chloride, endocrine disruptors, and others. Regulatory, social, and political influences are resulting in an evaluation of alternative water-quality specifications. The impact to life-cycle costs is not clearly understood. Historical costs are becoming less and less pertinent as the bar is raised for finished-water quality.

Importance:

The ability to plan and implement seawater desalination projects is dependent upon understanding the cost/benefit ratio associated with finished-water quality goals. A final decision on costs must occur concurrently with the finalization of finished-water quality goals, otherwise, the ultimate cost may be more than budgeted, or the ultimate finished-water quality may be less than originally desired.

How Do You Propose Meeting or Complying with This Issue?

Develop a knowledge base that defines the relationship between water-quality goals and costs. While this may seem intuitive, more stringent water-quality goals render previous information obsolete. This knowledge base could be national in scope and could feed into individual projects. In the end, each project needs to integrate appropriate information into the planning process, and a site-specific analysis must be conducted. The purpose is to clearly understand the relationship between water-quality goals, costs, and the accurate implementation of the project, from design to budget procurement.

Title: **Disinfectant Residual Stability in High Bromide Waters**

Originator: **Reiss**

Issue Description:

Presence of bromide at levels common to desalinated seawaters will result in the formation of bromine following the addition of free chlorine. The decay of residual may be accelerated due to the presence of two strong oxidants (i.e., bromine and chlorine) in solution at the same time. In addition, for systems that chloraminate, bromamines will be formed as well as chloramines. Presence of these two groups of oxidants in solution can result in extremely fast declines in disinfectant residual and can result in a complete loss of residual in the distribution system. This is a violation of drinking-water standards.

Importance:

An unacceptable decline in disinfectant residuals will require adjustments to designs and increases in costs. It is important this effect is taken into account early in the planning/predesign stages to ensure that:

- Costs are accurately budgeted.
- The facility's operation is not compromised by after-the-fact discovery of this issue.

How Do You Propose Meeting or Complying with This Issue?

Perform adequate process engineering early on in a project to determine the chemistry of these reactions, design solutions, and cost impacts.

Title: **How to Design Facilities to Account for Future Changes in Technology and Water-Quality Regulations**

Originator: **Cheng**

Issue Description:

As changes in treatment technology and water quality occur, it is important to include flexibility in the design of the facility to account for these changes. As environmental laws and regulatory standards become more stringent, it is important to recognize that the currently designed facility may not be able to meet future regulations.

Importance:

It is important to design and incorporate flexibility in the facility to avoid obsolescence when equipment replacement is needed or when new water-quality regulations are proposed.

How Do You Propose Meeting or Complying with This Issue?

Standardize vendor equipment; include collecting as much water-quality information as possible during initial evaluations.

Title: **Delivery of Seawater Desalination Plant Product Water to Customers; Cost and Quality Issues**

Originator: **Rohe**

Issue Description:

Typically, the desalinated water is produced at or near sea level; however, for coastal California, many of the customers and existing water storage and delivery infrastructures are some distance inland and at a higher elevation. The product-water transmission facilities and pumping energy required to integrate the desalination product water into the existing water system increase the costs of a proposed seawater desalination alternative.

Desalinated water is low in hardness and alkalinity and, therefore, needs to be post-treated to be suitable for transmission and delivery in standard water pipes (i.e., corrosion mitigation is needed). Studies need to be made to learn the effect of mixing the desalinated water with other water sources to ensure a blended quality that meets all drinking-water standards.

Importance:

If the delivery and post-treatment of desalinated water increases the desalination project's water cost, this increase may cause the project to be considered "uneconomic" and, therefore, may cause the project to not go forward.

How Do You Propose Meeting or Complying with This Issue?

- In the early planning stages, study the integration of the proposed seawater desalination plant and product-water delivery system into the overall Water Master Plan for the water agency to arrive at the most economical product-water delivery system.
- Consider multiple delivery points for the desalinated product water into the existing water system to reduce the distance and elevation for delivery.
- Build smaller desalination plants with good post-treatment that do not need to have large transmission pipelines and are able to deliver their product water directly into the local distribution system.

Title: **Regulations May Not Be Sufficiently Robust to Deal with the Water-Quality Issues Surrounding the Permitting of a Desalination Facility**

Originator: **Sakaji**

Issue Description:

Can or should desalination plants be regulated as surface-water treatment plants? Do we have a sufficient understanding of water-quality issues in salt or brackish water? Concepts and framework to cover water-quality issues may exist, but regulatory limits may not be appropriate.

Present surface water regulations require source water characterization and source water monitoring as a condition of permitting. Current drinking-water standards method detection limits (MDL) and practical quantitation limits (PQL) are established for freshwater matrices. Diluting samples to ameliorate the impacts of a more complex matrix does not change the MDL or PQL of the method but changes the minimum detectable concentration in the sample.

Importance:

Source characterization is an important component of the permit application process. Knowing what is present in a source water is as important as knowing the product quality. If detection levels are too high (i.e., higher than primary drinking-water standards), how can the product quality be adequately defined?

The ability to monitor to the same concentration levels in source and product waters is important to building public confidence in the quality of the source water. Public confidence in the final product is an important component of public acceptance of the final product. Building regulatory confidence in the technology and regulatory acceptance is critical to permitting.

How Do You Propose Meeting or Complying with This Issue?

- Transfer existing information and knowledge to public policy-making agencies (critical to good risk management).

- Identify those analytical methods that might be impacted by the saltwater/brackish water matrix.

- Encourage project proponents to bring regulatory discussions to the forefront of projects (i.e., regulatory involvement during project planning and design).


SUPPLEMENT DRINKING WATER
SUPPLIES ?

PRIORITY 13

What Should Be the Federal Role in Desalination?

Originators:

Price on behalf of himself, Arroyo, Henthorne, Kartinen, Lindeman, Sakaji, Wilkinson, and Wolff

The following issues were consolidated under the above title:

Title: **What Should Be the Federal Role in Desalination?**

Originator: **Price**

Issue Description:

The federal government provides a portion of funding for water infrastructure projects. The discretionary federal budget is declining in real terms. What should be the federal focus in the era of limited budgets and aging infrastructure?

Importance:

Federal contributions to projects can speed the implementation of new technologies; improve public health and standards of living; protect against projected threats; and level the playing field between the states.

How Do You Propose Meeting or Complying with This Issue?

Broad consensus needs to be developed to justify rational investments of national financial resources.

Title: **Regional Review Process**

Originator: **Price**

Issue Description:

Many organizations are rapidly moving into desalination but have varying levels of expertise. This can lead to poor decisions by being too risk adverse or taking unwarranted risks.

Importance:

Opportunities exist to incorporate new ideas into desalination plants that may appear to be too high a risk. Individual organizations need the assistance of their peers and external experts. A regional review process would work to reduce costs due to over-conservatism, as well as supporting innovative efforts. This process would provide the independent credibility to take worthwhile risks.

How Do You Propose Meeting or Complying with This Issue?

A formal group needs to be created to capitalize on the efficiencies gained when common desalination issues are solved. While an informal group may currently exist in some form, there is a tendency for each group member to compete against the other. This group needs to be able to provide unbiased information to the users, as well as to decision-makers and groups within and outside the region.

Title: **Brackish Groundwater Versus Seawater Desalination**

Originator: **Arroyo**

Issue Description:

Texas has a recognizable wealth of brackish groundwater. The current emphasis on ocean water is seen as a troublesome goal by many of our water users in view of the wealth and relatively wide availability of brackish groundwater.

Importance:

Pursuing projects of potentially more questionable cost-effectiveness could result in some justifiable backlash from our water users.

How Do You Propose Meeting or Complying with This Issue?

Pursue good feasibility studies for our seawater projects; explore all possible ways to increase the cost-effectiveness; and equitably compare them with competing alternatives.

Title: **Ability to Market and Transport Water on a Regional Basis**

Originator: **Arroyo**

Issue Description:

There are miles and miles of Texas, and a relatively scanty regional water distribution network. This restricts the ability of project developers to have a greater regional scope and, perhaps, limits the opportunity for accomplishing greater economies of scale.

Importance:

If the regional transportation infrastructure is not in place, then it has to be factored in as an additional project cost.

How Do You Propose Meeting or Complying with This Issue?

Projects need to be crafted in a manner that regional partnerships are explored to maximize water trade-offs.

Title: **Recognize the Value of Drought-Proofing Water Sources in the Regional Water Planning Process**

Originator: **Arroyo**

Issue Description:

The Texas regional water planning process seeks to examine water demands and water availability on a drought-of-record basis. What constitutes a drought of record has become, somehow, a bit of a shifting target when you look at it in terms of what your needs are. You do not need a drought of record to have a water-supply crisis. The drought reliability of the source should be adequately recognized in our decision-making process.

Importance:

Adding drought-proof alternatives to your mix of water sources increases the overall reliability of your water supply.

How Do You Propose Meeting or Complying with This Issue?

The regional water planning process needs to ensure that drought proofing of the regional water supply is adequately recognized.

Title: **Basin-Wide Water Resource Planning and Leadership Relative to Desalination**

Originator: **Henthorne**

Issue Description:

With limited water resources, comprehensive basin-wide planning is required to ensure the lowest cost projects, lowest environmental impact, and equalize water costs between users. Leadership is critically needed to coordinate the development and financing of these projects. This issue is an extension of the present U.S. Desalination Coalition. The focus should be on who can desalinate in the cheapest and most environmentally friendly manner.

Importance:

Lots of small, medium, and large desalination plants can pop up (e.g., Monterey, California). It is critical to coordinate these projects on a regional/basin-wide area. Also, why should inland communities have to desalinate and face concentrate disposal? Coastal communities should desalinate and distribute the cost.

How Do You Propose Meeting or Complying with This Issue?

Put together a national and regional planning/leadership commission for desalination.

Title: **Wide Area Cost Evaluation of Alternative Water Supplies**

Originator: **Kartinen**

Issue Description:

In most cases, cost evaluations of water supply alternatives consider only "local" costs. We should evaluate costs on a regional, statewide, interstate, or even national bases. Costs considered should include more than just easily quantifiable costs, such as construction, O&M, etc. It would be difficult to quantify costs, such as the environmental, sociological, and quality-of-life impacts on communities that are remote from the water purveyor developing a new water source or increasing the use of an existing water supply. But, these costs, too, should be identified and considered.

Importance:

The least expensive water supply option for a local water purveyor may be the most expensive option when all cost impacts on all affected areas are considered.

How Do You Propose Meeting or Complying with This Issue?

- Regional, state, and federal agencies.
- AWWA.

Title: **When Do You Build a Desalination Plant As a Supply When It Is Not a Source People Are Used To?**

Originator: **Lindeman**

Issue Description:

Permits, costs, water quality, politics, and public involvement are growing issues for municipalities in the development of new water supplies. When organizations need to expand their water supply sources, they may first look to expand existing sources. This is usually done because organizations are familiar with those sources and know how to develop them through all aspects of implementation. Seawater desalination is not a supply source commonly used in the United States. Although many technical people are comfortable with the use of desalination, this may not necessarily be the case for the people in the position to make decisions.

Importance:

Identifying the concerns about building a new supply source is critical to successful implementation of a desalination plant. It is critical to the long-term success of the project that everyone involved in the process be educated on what concerns exist and the potential solutions available to relieve those concerns.

How Do You Propose Meeting or Complying with This Issue?

The education of the public, staff, and politicians is critical to resolving the issue. This can be accomplished by supply development planning, through public involvement, and by working with professional organizations to educate technical individuals to be better able to answer the questions posed during development and implementation.

Title: **What Risk/Benefit/Cost Model Do Risk Managers Follow When Developing Public Policy or Moving Ahead with a Desalination Project?**

Originator: **Sakaji**

Issue Description:

Each stakeholder is a risk manager with a critical viewpoint upon which his or her decision is based.

Risk managers must come up with solutions to manage their unique water-supply problems. Solutions may vary from site to site – but can their risk-benefit points contain a common end point? Risk managers realize that we cannot provide a risk-free solution but can a common level of acceptable risk be defined?

Importance:

Decision-making is an extremely complex process that the public may not fully appreciate, yet the manner in which decisions are made is important to building confidence in the decision and the success of the project. For example, how do public policy makers prioritize their objectives when trying to develop interagency agreements?

How Do You Propose Meeting or Complying with This Issue?

At present, no formal framework for policy decisions exists, and none should be imposed on risk managers. However, the manner in which they arrive at their decision should be sufficiently well laid out so the public understands and comprehends the elements of the decision-making process.

Title: **Desalination in the Context of State Water Planning**

Originator: **Wilkinson**

Issue Description:

Desalination may hold considerable promise in providing water supply and quality in important parts of the state. What *methodology* is most appropriate to facilitate an assessment of the prospects for, and total benefits available from, desalination options?

Importance:

It is important, in a policy context, to understand the potential role and benefits, as well as costs and issues, with the implementation of desalination options.

How Do You Propose Meeting or Complying with This Issue?

We need to develop a "whole-systems" approach and method of comparing desalination with other options. This would include full life-cycle cost/benefit analysis, water quality (including the potential for multiple uses through reuse), whole-system energy comparisons, *environmental benefits* as well as impacts (including avoided extraction of water from natural systems) water system reliability (including analysis of reliability and shortage issues with existing systems), and other factors.

Title: **Ensure That Desalination Projects Are Not Just Environmentally Benign but Enhance Environmental Quality**

Originator: **Wolff**

Issue Description:

Significant stakeholder groups in modern societies often have de facto veto power over publicly funded projects. If they cannot defeat a project outright, initially, they can delay it enough to make it less desirable or they can sabotage it later via court action or changes in political leadership. The environmental community is a significant stakeholder group in the water area

and, historically, has viewed desalination as an energy intensive, environmentally inferior option compared with demand management, conjunctive use and subsurface storage, and water reuse. That perception needs to be overcome – based on facts, not just a public relations campaign – if desalination projects are to be implemented.

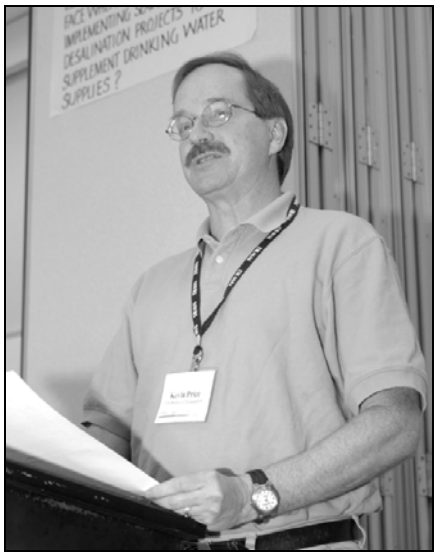
Importance:

If not addressed head-on from the beginning, money and time will be wasted. As wastewater treatment plant staff sometimes say, remember the five "Ps": "Planning prevents piss poor performance."

How Do You Propose Meeting or Complying with This Issue?

Environmental issues need to be addressed during project design, not after the fact in an environmental review whose primary goal is to satisfy a law or regulation. Mitigating impacts is necessary and worthwhile. But can the project be designed from the beginning so that environmental benefits are created? For example, can more water be left in the environment at low cost by taking advantage of economies of scale? Can pollution from energy consumption embedded in water management be reduced rather than increased? Can a new water supply complement rather than undermine demand management programs and investments? Creativity is needed, including paid participation by community groups and non-profits. Why are consultants paid, but citizens and environmentalists expected to volunteer their time?

NWRI can play a key role in fostering creativity and community of the type needed. Workshops like this one, but with a leading environmental question, would be helpful.



PRIORITY 14

Rapid Improvement in Technology Will Potentially Result in Significant Savings for a Seawater Desalination Project

Originators:

Lopez on behalf of himself, Gagliardo, Kuzler, Linsky, Price, Sakaji, and Wilkinson

The following issues were consolidated under the above title:

Title: **Rapid Improvement in Technology Will Potentially Result in Significant Savings for a Seawater Desalination Project**

Originator: **Lopez**

Issue Description:

Keeping up with rapidly changing and improving technologies in all aspects of a seawater desalination project is difficult. Know what and when to specify a new technology, such as:

- Pretreatment system (i.e., membranes - no track record, not a proven technology).
- Energy recovery – no good track record, not proven in large capacities.
- RO.
- Materials.
- Controls.

When to make the decision is critical. Most new technologies do not have good track records, and most of these new technologies and products are not yet proven for large-scale projects (e.g., 50-MGD facilities).

Risk must be taken into consideration when recommending a new technology, especially when one knows that the real problems may not be known until after the plant is operational.

Importance:

Tremendous savings could be achieved by using new and improved process components. However, without a good track record, risk is taken.

How Do You Propose Meeting or Complying with This Issue?

- Thoroughly investigate, research, and pilot-test new technologies well ahead of the design effort.
- Establish and incorporate criteria into the design process based on the results of pilot testing.
- Build flexibility into the design of new technologies that will allow designers, contractors, and/or operators to switch back to the old technology (if needed) during both construction and operation.

Title: **Technology Certification**

Originator: **Gagliardo**

Issue Description:

As membrane technology becomes more cost effective and as it becomes the technology of choice for seawater desalination facilities, membrane systems must be certified by the health department as adequate to meet surface-water treatment rules. This will necessitate the selection of a surrogate pathogen for seawater membrane disinfection efficiency testing.

Importance:

To ensure that the regulators and customers of desalinated seawater are confident in the quality of the product, adequate testing of equipment and the development of real-time monitoring systems must be deployed.

How Do You Propose Meeting or Complying with This Issue?

Require the testing of membrane systems under a standard testing protocol.

Title: **What Technology Should Be Used for a Seawater Desalination Plant?**

Originator: **Kuzler**

Issue Description:

Several technologies are available to desalinate seawater. These include RO, electrodialysis, and thermal distillation. Each technology has its pros and cons. Although RO has become the technology of choice, conditions specific to a given project may support one of the other technologies. Available technologies should be evaluated and compared as part of the initial feasibility study for a desalination facility.

Importance:

This issue is important for the justification, financial soundness, and defense of a desalination project.

How Do You Propose Meeting or Complying with This Issue?

Available technologies should be evaluated and compared as part of the initial feasibility study for a desalination facility.

Title: **Scaling Down Versus Scaling Up**

Originator: **Linsky**

Issue Description:

Historical thinking is to scale up, as if it were the only way! Decentralization is a reality that is rapidly becoming an issue in complex urban centers.

Importance:

Space is limited, and often leads to management issues regarding a reasonable footprint within environmentally sensitive ideas.

How Do You Propose Meeting or Complying with This Issue?

Think decentralization!

Title: **Reduce Capital and O&M Costs through Research**

Originator: **Price**

Issue Description:

Efficiencies in existing desalination processes will continue to be made. Also, as plant sizes increase, opportunities are created for better economies of scale.

Importance:

By increasing funding for research, desalination costs for new plants can be more rapidly decreased.

How Do You Propose Meeting or Complying with This Issue?

A prioritized research program needs to be developed to meet the specific needs of this region. Projects could include large-scale equipment, direct-energy conversion to pressure for RO (e.g., Brayton cycle engine, fuel cells), innovative pretreatment, etc.

Title: **Technology Acceptance**

Originator: **Sakaji**

Issue Description:

The performance of any technology is as critical as the conditions under which the technology will be used. At present, regulatory agencies will only accept performance data or credit performance under the conditions in which it was tested (includes pretreatment impacts).

Source-water quality is very different in co-located desalination plants. High temperature impacts on membranes are not well understood by regulatory engineers who must permit the facilities (e.g., thermal stressing/cycling of the membranes may affect performance).

Importance:

Regulatory agencies may use testing conditions to limit the application of a tested technology.

How Do You Propose Meeting or Complying with This Issue?

Manufacturers and those testing desalinating technologies should consider the conditions under which it will be used or applied.

Title: **Options of Scale in Desalination Technology: Centralized Versus Decentralized Applications**

Originator: **Wilkinson**

Issue Description:

Desalination technology can be applied at different scales, from small, decentralized systems to large centralized ones. What are the pros and cons of each? In the electric utility industry, there is a trend toward decentralized generation, based on various factors, including capital cost, lead time, environmental attributes, decision-making processes, efficiencies of specific technology applications, resilience, etc. Is there a similar dimension to desalination technology applications? If so, what might we want to consider as we plan infrastructure, siting, etc.?

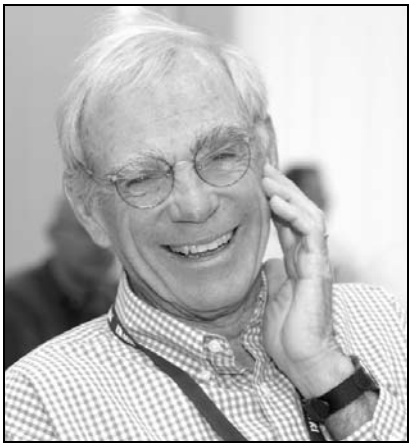
Importance:

Some decisions relating to infrastructure will be hard to change later. It is important to understand our options and possible futures for technology development and applications.

How Do You Propose Meeting or Complying with This Issue?

Map out the options from small to large, decentralized to centralized, and begin to identify the attributes, issues, and concerns that might influence or guide decisions.

A scenario exercise may then be a useful approach to inform our thinking on possible futures and the pluses and minuses with each approach.



PRIORITY 15

New Water Projects: Same questions, Good Answers—Perhaps

Originators:

Cline on behalf of himself, Geever, Linsky, Lyons, and Miller

The following issues were consolidated under the above title:

Title: **New Water Projects: Same Questions, Good Answers— Perhaps!**

Originator: **Cline**

Issue Description:

Proposed seawater desalting projects will face the same issues that all water projects encounter during the initial stages of project development:

- Cost.
- Environmental impacts.
- Growth inducement.

Costs and environmental matters can be evaluated based upon generally agreed principles, but the issue of analyzing growth inducements is not as easily quantified.

Water planners and environmental interests frequently have differing views of the role that available water supply plays in maintaining the overall welfare of the community.

This potentially fundamental difference can be a formidable hurdle for water utilities.

Importance:

If the utility is facing a critical water shortage, a seawater desalter may be a welcome solution. If there are varying opinions on the seriousness of the potential shortage, the desalter proponents

may face objections from those who wish to limit growth (and are not necessarily responsible for maintaining water supply for the community).

How Do You Propose Meeting or Complying with This Issue?

Because the coupling of water supply and growth is both a physical matter and a philosophical issue, there is no easy answer. The agencies that have had some success in this area have courageous Boards of Directors combined with aggressive public information programs.

Title: **Growth and Meeting the Requirements of the Clean Water Act**

Originator: **Geever**

Issue Description:

Can jurisdictions spend limited financial resources on creating water supplies prior to fully complying with their treatment facility permits, stormwater permits, and future total maximum daily load regulations? Furthermore, do new water supplies actually exacerbate the problems of water pollution?

Importance:

Compliance with the Clean Water Act is difficult and expensive. Some of the same jurisdictions that are operating under waivers to the Act, or have recently moved away from their waiver, are now considering new water supplies. More supply will likely lead to more instances of wastewater exceeding treatment capacity.

How Do You Propose Meeting or Complying with This Issue?

Consult with the RWQCB about the potential impact of additional water supply on existing treatment capacity. Also consult with the treatment facility about the impact of increased freshwater supply on capacity to handle storm drain diversion.

Title: **Desalination Is a Strategic Alternative to Support Sustainability Requirements**

Originator: **Linsky**

Issue Description:

Too often, growth is incorrectly associated with desalination. It would be advantageous if the concept of sustainability is introduced and addresses how it impacts the economic fabric of the population.

Importance:

For desalination to be accepted by policymakers and the public, it must clearly be viewed as having value that sustains the population (i.e., natural growth) and delivers economic goods and services.

How Do You Propose Meeting or Complying with This Issue?

Re-examine how desalination is presented in public, in private forums, in proposals, and to the media.

Title: **Attack Seawater Desalination As "Growth Inducing"**

Originator: **Lyons**

Issue Description:

Proponents of the theme that seawater desalination induces growth may make it much more difficult to finance and permit desalters by convincing funding agencies and regulators that the claim is true and that growth is a bad thing.

Importance:

Financing and regulatory approval is essential.

How Do You Propose Meeting or Complying with This Issue?

Educate the public, legislators, agency officials, and regulators that:

- Creating new water through seawater desalination is no different, from a supply availability perspective, than conservation, reclamation, or brackish-water desalination.
- New supplies do not "induce" (cause) growth. They prevent shortages when growth happens.
- New supplies in Southern California do not increase the region's supplies; they only make up some of the loss on the State Water Project, Colorado River Aqueduct, and Los Angeles aqueduct.
- Limiting growth by creating a water crisis is a gross violation of the public trust

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Title: **Dealing with Growth Issues Versus Good Water Resource Planning**

Originator: **Miller**

Issue Description:

Desalination is a "new" water source, and anti-growth advocates will discourage desalination development.

Importance:

The growth issue must be dealt with and resolved in the EIR process.

How Do You Propose Meeting or Complying with This Issue?

Regional planning and the water resource needs of California must be understood by the public and local land-use planning governance agencies.

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PRIORITY 16

Scaling Pilot Testing to Full-Scale Desalination Plant Design and Operations

Originators:

Jensen on behalf of himself, Cheng, Lindeman, Seckel, and Wilf

The following issues were consolidated under the above title:

Title: **Scaling Pilot Testing to Full-Scale Desalination Plant Design and Operations**

Originator: **Jensen**

Issue Description:

There are often problems associated with taking pretreatment, RO, and post-treatment pilot-scale plant results to full-scale RO facilities. The pilot-scale treatment systems need to be carefully designed and operated, and the results interpreted.

Past problems that have been identified from piloting need to be taken into account in designing pilot plants. Modeling needs to take into account the physical differences between pilot-and full-scale systems (lessons learned).

Importance:

Full-scale desalination facilities often experience operational problems that were not found during pilot tests. The problems often require design changes or upgrades to solve.

How Do You Propose Meeting or Complying with This Issue?

Pilot plants need to be designed to ensure the results are valid when full-size plants are designed. Past design problems that can be traced back to pilot testing need to be examined and a "fix" should be determined.

Title: **How to Accurately Estimate Costs for Large-Scale Seawater Desalination Projects**

Originator: **Cheng**

Issue Description:

As compared to other regions in the world, there has been relatively little large-scale seawater desalination experience in the United States. As more agencies contemplate seawater desalination as an alternative water supply, a body of knowledge is needed to establish more reliable cost estimates.

Importance:

Cost is a major component in the decision-making process. As more information becomes available, agencies will have better and more reliable knowledge to make the decisions.

How Do You Propose Meeting or Complying with This Issue?

Work with industry and government experts to arrive at better cost estimation models. As more seawater desalination facilities are commissioned in the United States, a better body of knowledge may be gained. Additional pilot and demonstration-scale tests may provide needed information.

Title: **Pilot-Plant Testing: Who Should Do It? How Much Is Enough?**

Originator: **Lindeman**

Issue Description:

The first question asks who should be in control of the pilot testing. The second question asks how long the pilot plant should be operated in order to accumulate enough data to be able to evaluate the needs of the municipality versus the needs of the developer to build a facility.

Importance:

It is necessary to gather enough information to allow an owner to determine what characteristics of a design are important to the owner. A developer may be looking at the characteristics that are important for them to turn a better profit, but the two concerns may not be the same.

You do not want to spend money on the piloting effort that could be better spent on construction.

How Do You Propose Meeting or Complying with This Issue?

Studies, such as the West Basin Municipal Water District and USBR projects, are critical for overarching issues, but it is important to build on this information with site-specific piloting.

Title: **Compatibility of Water Sources for Integration with Desalinated Ocean Product Water**

Originator: **Seckel**

Issue Description:

Ocean desalination along the coast of Southern California will undoubtedly involve the introduction of the product-water back into transmission and distribution systems that include waters of various sources. The sources and blend concentrations can change from day to day and month to month.

In Orange County, we have the potential to have a combination of Colorado River Water, State Project Water, groundwater from one location in North County, and water from a North County ocean desalination plant all coming together to blend into systems involving a second ocean desalination plant in South County, then into local systems that include groundwater from South County (a total of six sources).

Importance:

This issue is important to ensure that there are no unintended consequences once a plant begins operations. The damage done can be expensive from a liability standpoint, and considerable loss in public confidence could occur.

How Do You Propose Meeting or Complying with This Issue?

- Stabilize the water and conduct plenty of pilot work before the plant is brought on-line.
- Develop information from other areas that have already brought plants on-line that blend with various qualities of water.

Title: **Maintain Adequate and Consistent Quality of Feed Water to the RO Seawater Unit**

Originator: **Wilf**

Issue Description:

The quality of effluent produced by conventional pretreatment, based on sand filtration, strongly depends on the quality of raw seawater. The condition of seawater may fluctuate significantly, depending on seasonal conditions and the condition of the filtration equipment. Stormy weather may result in high seawater turbidity, in addition to the seasonal occurrence of algae blooms. In addition, the quality of media filter effluent may fluctuate during the filtration cycle, passing a higher concentration of suspended solids immediately following the filter's backwash.

The optimization of the operation of a pretreatment system is difficult due to the lack of well-defined indicators of feed-water quality. The common quality parameter, a silt density index (SDI), is not precise enough and only remotely related to the concentration of suspended solids in the feed water. The membrane industry relies on SDI values as an indicator of feed-water quality in lack of other, more accurate, indicators.

A pretreatment technology that can provide consistent, good-quality feed water is a membrane pretreatment (e.g., microfiltration or ultrafiltration). The effluent from a membrane pretreatment system is practically not affected by the fluctuation of the quality of raw seawater. The membrane pretreatment for seawater applications is a relatively new technology, and the equipment cost is higher than the cost of media filtration. Only limited field experience is available, mainly from pilot units or small systems operation.

Importance:

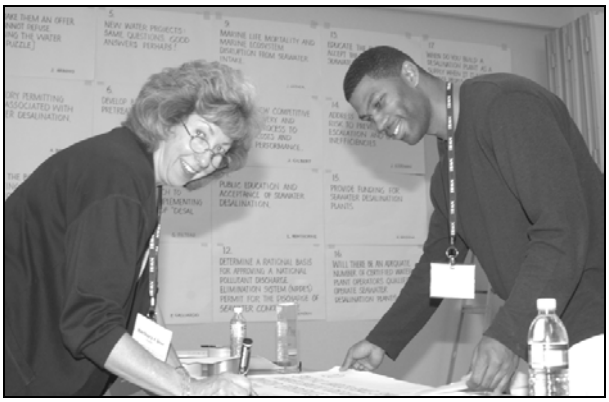
The quality of feed water to the RO membrane unit determines the performance and longevity of RO membranes. Poor feed-water quality may result in membrane fouling, which in turn will result in decreased system capacity, increased frequency of membrane cleaning, and higher than projected salt passage (i.e., increased permeate salinity).

The introduction of membrane pretreatment for seawater application can increase the reliability of operating seawater units by producing consistent RO feed that is practically free of suspended solids and bacteria. Better feed-water quality will reduce the fouling rate of RO membranes. An additional benefit is the elimination of pathogens that would otherwise be able to reach RO membranes.

Extensive field experience with membrane pretreatment operations is required to optimize this process for seawater applications. The objective is to reduce capital and operating costs.

How Do You Propose Meeting or Complying with This Issue?

A working comity on the membrane pretreatment subject should be formed to evaluate the economics and health aspects of using membrane pretreatment in seawater RO plants in California. Eventually, the comity should develop recommendations regarding the application of this technology as a pretreatment method for seawater systems.

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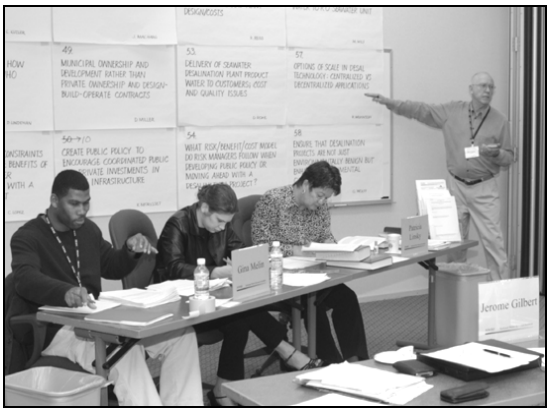

Jerome Gilbert

PRIORITY 17

Municipal Financing Should Be Allowed for Private Electrical Generator Stations That Favor the Development of Desalination

Originator:

Miller on behalf of himself

The following issues were consolidated under the above title:

Title: **Municipal Financing Should Be Allowed for Private Electrical Generator Stations That Favor the Development of Desalination**

Originator: **Miller**

Issue Description:

Exchanging lower public financing for discounted energy costs can reduce energy costs for desalination.

Importance:

The cost of energy for desalination is the most critical parameter for the all-end cost of desalination.

How Do You Propose Meeting or Complying with This Issue?

Change legislated rules for public financing.

Title: **No Wheeling Fee Should Be Applied to Ocean Desalinated Water**

Originator: **Miller**

Issue Description:

Desalinated water is a new source of water that should not be treated as a water transfer. The wheeling fee charged by MWD will increase the cost of desalination.

Importance:

In order to encourage desalination, MWD should not add cost to a new source of water by changing a "system access fee" to desalinated water introduced directly into MWD's distribution system.

How Do You Propose Meeting or Complying with This Issue?

Introduce and advocate this issue to MWD's Board of Directors.

PRIORITY 18

Will There Be an Adequate Number of Certified Water Plant Operators Qualified to Operate Seawater Desalination Plants?

Originators:

Kuzler on behalf of himself and Krishna

The following issues were consolidated under the above title:

Title: **Will There Be an Adequate Number of Certified Water Plant Operators Qualified to Operate Seawater Desalination Plants?**

Originator: **Kuzler**

Issue Description:

Currently, certified water treatment plant operators are in high demand. In many areas, there is a shortage of operators, and municipalities may be forced to operate plants with staffing that may not meet minimum regulatory requirements. Desalination complicates the issues because, in this country, it is a new technology in the municipal arena, and there are very few operators trained to work with membrane technology. As more desalination and membrane plants are placed into operation, the ability to find qualified operators will become more difficult unless training programs are implemented now.

Importance:

This issue is important because qualified operators are necessary to operate desalination plants.

How Do You Propose Meeting or Complying with This Issue?

Local schools, training programs, and operator associations need to include training specific to membrane processes in their programs. The Southeast Desalting Association is one such organization aimed at providing training and technology transfer regarding membrane processes.

Title: **Provide Water Utilities with Technical Personnel Trained in Desalination Technologies**

Originator: **Krishna**

Issue Description:

Civil engineering programs do not routinely offer courses in desalination.

Importance:

Water resources engineers need to have this training.

How Do You Propose Meeting or Complying with This Issue?

Initiate course work and training in water desalination for civil and water resources engineering students.

PRIORITY 19

"Let's Make an Offer They Cannot Refuse" (Finessing the Water Supply Puzzle)

Originator: Arroyo

Issue Description:

Ultimately, we seek to identify, characterize, develop, and maintain reliable, cost-effective sources of water to keep us ahead of the demand curve. All critical issues will need to be satisfactorily addressed to render desalination cost-effective in Texas.

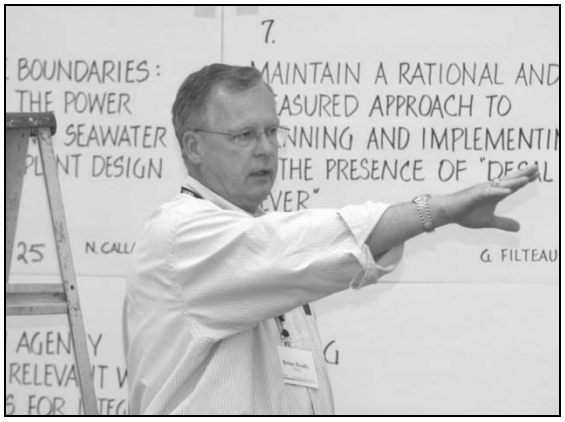
Of critical importance in Texas is the issue of how to best *leverage existing resources to improve the opportunity and value of large-scale desalination projects*. For example, project developers are encouraged to identify and fully assess opportunities for water rights trade-offs, such that they would offset or minimize the need for constructing large water transportation facilities.

Importance:

Exploring all opportunities to leverage resources and enabling their implementation will lead to cost reductions and a broader base of project beneficiaries.

How Do You Propose Meeting or Complying with This Issue?

The successful development of a large-scale desalination projects in Texas will require an increased and intentional awareness of the opportunities, roadblocks, challenges, and innovations in support our project developers. The Texas Water Development Board (TWDB) will work with three TWDB-recommended projects to address, in the feasibility study phase, all opportunities leading to project cost-effectiveness. TWDB will continue seeking opportunities for cooperation with researchers, manufactures, project developers, and other key agencies.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STRENGTH OF FEELING ANALYSIS

The idea behind the Strength of Feeling Analysis is that priority ranking alone does not show unanimity, or lack of unanimity, by the workshop participants. Strength of Feeling Analysis, however, provides a transparent quantitative measure of agreement or disagreement among all participants. Table 1 shows how the 31 participants ranked all 19 major issue areas.

The table lists the research issues in descending order of importance, the issue title, the times it was voted for (picked), the total number of points received from the balloting, and finally, the strength of the group-s feeling, expressed as a percentage.

TABLE 1

Issues (19) Ranked by All Participants (31)

Rank	Title	Times Picked/Pts	Strength of Feeling
1.	Regulatory Permitting Issues Associated with Seawater Desalination	27/166	53.5%
2.	Concentrate Issues and Options Analyses	26/162	52.3%
3.	Regional Planning: When Do You Build a Desalination Plant As a Supply Source?	26/149	48.1%
4.	Public Information and Outreach of Seawater Desalination	25/141	45.5%
5.	Push the Boundaries: Evaluate New and Alternate Integrated Technologies for Optimizing Seawater Desalination Plant Design and Operating Concepts	22/137	44.2%
6.	Policy on Public and Private Roles and Development of a New Project Delivery Process to Minimize Costs and Maximize Performance	22/135	43.5%
7.	Source-Water Issues and Options Analysis	24/114	36.8%
8.	Desalination in the Context of State Water Planning	19/113	36.5%
9.	Work with Ratepayers to Find Particular Seawater Desalination Projects They Perceive As Reasonable to Fund, If Any	20/109	35.2%
10.	Providing Funding for Seawater Desalination Plants	20/97	31.3%
11.	Total Cost of Seawater Desalination Includes a Relatively Large Number of Minor Cost Components That Must Be Identified, Optimized, and Controlled	15/79	25.5%
12.	Understand the Relationship between Finished-Water Quality Specifications and Plant Design/Costs	14/64	20.6%
13.	What Should Be the Federal Role in Desalination?	12/62	20.0%

Rank	Title	Times Picked/Pts	Strength of Feeling
14.	Rapid Improvement in Technology Will Potentially Result in Significant Savings for a Seawater Desalination Project	11/61	19.7%
15.	New Water Projects: Same questions, Good Answers—Perhaps	13/56	18.1%
16.	Scaling Pilot Testing to Full-Scale Desalination Plant Design and Operations	7/34	11.0%
17.	Municipal Financing Should Be Allowed for Private Electrical Generator Stations That Favor the Development of Desalination	5/19	6.1%
18.	Will There Be an Adequate Number of Certified Water Plant Operators Qualified to Operate Seawater Desalination Plants?	2/7	2.3%
19	"Let's Make an Offer They Cannot Refuse" (Finessing the Water Supply Puzzle)	0/0	0.0%

APPENDICES

APPENDIX A

ACRONYMS

ACWA	Association of California Water Agencies
AWWA	American Water Works Association
AWWARF	American Water Works Association Research Foundation
BCDC	Bay Conservation and Development Commission
BOO	build-own-operate
BOOT	build-own-operate-transfer
CalOSHA	California Occupational Safety and Health Act
CalTrans	California Department of Transportation
CCC	California Coastal Commission
CEQA	California Environmental Quality Act
CFD	computational fluid dynamics
CIP	Capital Improvement Program
COE	U.S. Army Corps of Engineers
DAD	decide, announce, and defend
DBB	design-bid-build
DBO	design-build-operate
DBOOT	design-build-own-operate-transfer
DFG	California Department of Fish and Game
DHS	California Department of Health Services
DWR	California Department of Water Resources
EIR	environmental impact report
IRP	integrated resources planning
kWh/m^3	kilowatt-hour per cubic meter
LADWP	Los Angeles Department of Water and Power
LBWD	Long Beach Water District
MDL	method detection limit
MGD	million gallons per day
MWD	Metropolitan Water District of Southern California

NIMBY	Not-In My-Backyard
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NWRI	National Water Research Institute
OCWD	Orange County Water District
O&M	operations and maintenance
PQL	practical quantitation limit
PRSA	Public Relations Society of America
psi	pounds per square inch
RO	reverse osmosis
RWQCB	Regional Water Quality Control Board
SCADA	supervisory control and data acquisition
SDCWA	San Diego County Water Authority
SDI	silt density index
SLC	State Lands Commission
SWRCB	State Water Resources Control Board
TWDB	Texas Water Development Board
USBR	U.S. Department of Interior, Bureau of Reclamation
USDOD	U.S. Department of Defense
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WEF	Water Environment Foundation
WERF	Water Environment Research Foundation
WTP	willingness-to-pay

APPENDIX B

PREVIOUS NGT WORKSHOPS CONDUCTED BY NWRI

Decision Support System. Report of a workshop sponsored by NWRI in cooperation with Tellus Institute. Kellogg West Conference Center/Hotel, California State Polytechnic University, Pomona, CA, February 4-6, 2003. 161 p.

Water Quality and Resource Management Issues. Report of a workshop sponsored by NWRI in cooperation with Lawrence Livermore National Laboratory and University of California. Wente Vineyards, Livermore, California, January 28-30, 2003. 252 p.

Life Cycle Environmental Impacts Associated with Different Fuel Options. Report of a workshop sponsored by NWRI in cooperation with Clarkson University, Lawrence Livermore National Laboratory, and USEPA – Office of Research and Development. Kellogg West Conference Center/Hotel, California State Polytechnic University, Pomona, CA, February 15-17, 2002. 202 p.

Issues in Methanol Research. Report of a workshop sponsored by NWRI in cooperation with the American Methanol Institute. Hilton Hotel, Costa Mesa, CA, October 5-7, 2001. 173 p.

Chino Basin Organics Management. Report of a workshop sponsored by NWRI in cooperation with the Inland Empire Utilities Agency, and the Southern California Alliance of Publicly Owned Treatment Plants. Kellogg West Conference Center/Hotel, California State Polytechnic University, Pomona, CA, April 18-20, 2001. NWRI Report No. NWRI-01-03, 205 p.

Desalination Research & Development. Report of a workshop sponsored by NWRI in cooperation with the United States Bureau of Reclamation. Kellogg West Conference Center/Hotel, California State Polytechnic University, Pomona, CA, January 19-21, 2001. 185p.

Knowledge Management. Report of a workshop sponsored by NWRI. Kellogg West Conference Center/Hotel, California State Polytechnic University, Pomona, CA January 5-7, 2001. 169 p.

Oxygenate Contamination. Report of a workshop sponsored by NWRI in cooperation with the United States Bureau of Reclamation. Kellogg West Conference Center/Hotel, California State Polytechnic University, Pomona, CA, September 15-17, 2001: 258p.

Utility Leadership. Report of a workshop sponsored by NWRI in cooperation with Malcolm Pirnie, Inc., the University of Southern California, and the University of South Florida. Kellogg West Conference Center/Hotel, California State Polytechnic University, Pomona, CA, October 24-26, 1999: 154p.

Non-potable Water Recycling. Report of a workshop sponsored by NWRI in cooperation with Irvine Ranch Water District and the Orange County Water District. Kellogg West Conference Center/Hotel, California State Polytechnic University, Pomona, CA, May 23-25, 1999: 174p.

Conjunctive Use Water Management Program. Report of a workshop jointly sponsored by NWRI, Association of Ground Water Agencies, and the Metropolitan Water District of Southern California. Kellogg West Conference Center/Hotel, California State Polytechnic University, Pomona, CA, May 27-29, 1998: 157p

Barriers to Providing Safe Drinking Water Through Small Systems. Report of a workshop jointly sponsored by NWRI, Pan American Health Organization, and NSF International/WHO Collaborative Center. Pan American Health Organization Headquarters, Washington, D.C., May 13-15, 1998: English report: 175p., Spanish report: 188p. (Bound in a single volume.)

Barriers to Harvesting Stormwater. Report of a workshop jointly sponsored by NWRI, Los Angeles County Department of Public Works, County of Orange Public Facilities & Resources Department, Southern California Coastal Water Project, and the American Oceans Campaign. Kellogg West Conference Center/Hotel, California State Polytechnic University, Pomona, CA, September 22-24, 1997: 159p.

Groundwater Disinfection Regulations Benefits Conference. Report of a conference sponsored by NWRI. Arnold and Mabel Beckman Center, National Academies of Sciences and Engineering, Irvine, CA, March 17, 1997: 75p.

Groundwater Disinfection Regulation. Report of a workshop jointly sponsored by NWRI and the USEPA. Arnold and Mabel Beckman Center, National Academies of Sciences and Engineering, Irvine, CA, January 6-8, 1997: 209p.

Membrane Biofouling. Report of a workshop jointly sponsored by NWRI, UNESCO Centre for Membrane Science and Technology, and CRC for Waste Management and Pollution Control, LTD. UNSW Institute of Administration, Sydney, Australia, November 15-17, 1996: 176p.

The Santa Ana River Watershed. Report of a workshop jointly sponsored NWRI and the Santa Ana Watershed Project Authority. Co-sponsors included: City of San Bernardino Water Department, City of Riverside, Western Municipal Water District, and Orange County Water District. Kellogg West Conference Center/Hotel, California State Polytechnic University, Pomona, CA, August 23-25, 1995: 182p.

The New River. Report of a workshop jointly sponsored by NWRI and the County of Imperial, California. Barbara Worth Country Club, Holtville, CA, May 19-21, 1995: English report: 134p., Spanish report: 134p. (Bound in a single volume)

Establishment of The Middle-East Water and Energy Research and Technology Centre. Report of a workshop jointly sponsored by NWRI and the Sultanate of Oman through the Worldwide Desalination Research and Technology Survey. Muscat, Oman: September 21, 1994: 29p.

Risk Reduction in Drinking Water Distribution Systems. Report of a workshop jointly sponsored by NWRI and the Environmental Criteria and Assessment Office of the USEPA. Arnold and Mabel Beckman Center, National Academies of Sciences and Engineering, Irvine, CA, February 27-28, 1994: 142p.

Fouling and Module Design. Report of a workshop jointly sponsored by NWRI and the National Science Foundation (NSF). Virden Conference Center of the University of Delaware, Lewes, DE, October 30 – November 1, 1993: 115p.

Groundwater Disinfection Rule. Report of a workshop jointly sponsored by NWRI and the USEPA in collaboration with the Weston Institute. Virden Conference Center of the University of Delaware, Lewes, DE. June 7-8, 1992: 103p

APPENDIX C

PARTICIPANTS' BIOGRAPHICAL SKETCHES

Jorge A. Arroyo, P.E.
Special Projects Division Director
Texas Water Development Board

Jorge Arroyo joined the Texas Water Development Board (TWDB) in 1993 to implement the Rural and Regional Planning Component of the USEPA's Colonia Wastewater Treatment Assistance Program, which focused on the use of alternative cost-effective technology applications to community wastewater treatment along the Texas-Mexico border. In 1997, he joined TWDB's Water Resources Planning Division to help with the implementation of a legislatively mandated state and regional water planning process for the State of Texas. His current position focuses on the development and implementation of new agency programs. Among his involvement with desalination, he directed the design and implementation of the process that led to the TWDB Report of Recommendations for the Office of Governor Rick Perry on Seawater Desalination in Texas, dated December 2002. Arroyo received a B.S. in Civil Engineering from the University of Costa Rica and a M.S. in Construction Management from Loughborough University of Technology in England.

Alvin Bautista, P.E.
Civil Engineer, Water Resources
Los Angeles Department of Water and Power

Alvin Bautista has been a Civil Engineer for the Los Angeles Department of Water and Power (LADWP) since 1989. Among his responsibilities, he supervises the development of: the City of Los Angeles Urban Water Management Plan; water availability assessments for planned developments; and legislative policy positions for the Water Services Organization, for which he also developed water supply and demand forecasts. He also supervises projects, such as annual and long-term water supply outlook and rate structure financial impacts analyses, and is Project Manager of LADWP's seawater desalination program. Bautista received both a B.S. and M.S. in Civil Engineering from California State University Long Beach. He is a registered Civil Engineer in the State of California and a licensed Water Distribution Operator.

Neil V. Callahan
Principal and Client Service Director
R.W. Beck

Neil Callahan has 27 years of experience in the water and wastewater industry. He joined R.W. Beck – a consulting firm with expertise in energy, water resources, solid waste, and telecommunications – in 1997, and specializes in assisting municipal utilities in the areas of Alternative Project Delivery, Capital Improvement Program (CIP) Implementation, and seawater desalination project development and implementation. Callahan has been a consultant to Tampa Bay Water's for Procurement, Alternative Project Delivery methods, and CIP implementation since 1998. He is also the project principal for the Feasibility Study for the Siting of Seawater Demineralization facilities for the Saint John's River Water Management District in Florida. In addition, he is the project lead for the strategy, planning, and development of the procurement for Tampa Bay Water's Gulf Coast Desalination project, as well as a lead advisor to the San Diego County Water Authority on the procurement methods, financial feasibility, and vendor negotiations for the Carlsbad Seawater Desalination. Callahan received both a B.S. and M.S. in Environmental Science from Rutgers University.

Robert C. Cheng, Ph.D., P.E.
Water Quality/Process Manager
Long Beach Water Department

Since 1997, Robert Cheng has served as Water Quality/Process Manager of the Long Beach Water Department (LBWD), which delivers water supply to a total population of 461,000 in the City of Long Beach, the fifth largest city in the State of California. He is responsible for all water-quality issues for LBWD, including oversight of operations of the 62.5-MGD Groundwater Treatment Plant and associated distribution system, operations of Water Quality Laboratories (microbiology, inorganic chemistry, and organic chemistry), and interacting with regulatory authorities to ensure compliance with present and future regulations. He was also Project Engineer for LBWD's bottled water plant and other research projects, including seawater desalination. Cheng received both a B.E. and M.S. in Chemical Engineering from Vanderbilt University and a Ph.D. in Civil Engineering from the University of California, Los Angeles.

Neil M. Cline
Consultant

Neil Cline has 46 years of experience in water resources management, planning, and construction. Currently, he is a consultant to the Metropolitan Water District of Southern California, which is a consortium of 26 cities and water districts that provides drinking water to nearly 17 million people in six counties in Southern California. He provides technical and administrative support for Metropolitan's Seawater Desalination Program. Prior, he was the General Manager of the Santa Ana Watershed Project Authority – an agency formed to protect and extend the use of the Santa Ana River – for 8 years. In addition, he was the Secretary Manager of the Orange County Water District, which maintains the groundwater supply for Orange County, California, for 19 years. Cline received a B.A. in Geology from the University of California, Los Angeles.

B. Anatole Falagan, P.E.
Assistant Manager, Water Resources Management Group
Metropolitan Water District of Southern California

Anatole Falagan has 20 years of varied civil engineering planning and design experience in water resources. At present, he is the Assistant Manager for the Water Resources Management Group at the Metropolitan Water District of Southern California (MWD), which is a consortium of 26 cities and water districts that provides drinking water to nearly 17 million people in six counties in Southern California. The Water Resources Management Group oversees long-range water resources planning and program development for MWD's service area as well as MWD's Colorado River and State Water Project supplies. Since 1999, Falagan has served as MWD's lead on their Seawater Desalination Program, focusing on both research and development of seawater desalination plants. Falagan received both a B.S. and M.S. in Civil Engineering from Stanford University and a M.B.A. from the University of California, Irvine. He is a registered Professional Engineer in the states of Texas and California.

Gerry Filteau
Vice President
Separation Processes, Inc.

Gerry Filteau is Vice President of Separation Processes, Inc. (SPI), a consulting engineering firm specializing in the application of membrane technologies for water treatment, including reverse osmosis, ultrafiltration, and microfiltration. He has over 20 years experience in the application of membrane separation processes to water and wastewater treatment. His capabilities in process engineering of membrane systems support SPI's activities involving feasibility studies, pilot studies, and full-scale membrane system design. Filteau has provided membrane technology expertise to dozens of municipal desalination projects. Prior to joining SPI in 1998, he was Director of Applications Engineering at Fluid Systems Corporation, a manufacturer of reverse osmosis membranes. In this capacity, he was heavily involved in seawater desalination projects worldwide. Filteau received a B.S. in Civil Engineering from the University of Massachusetts at Lowell.

Paul Gagliardo, M.P.H., P.E.
Senior Program Director
Earth Tech

Paul Gagliardo recently joined EarthTech as a Senior Program Director responsible for strategic water supply planning, alternative project delivery schemes, and technology development and analysis. He previously worked in municipal government for over 20 years. For the last 10 years, he has developed strategic plans for groundwater, reclaimed water, and watershed management programs. He managed the City of San Diego's Groundwater Asset Development Program, Reclaimed Water Business Plan, and Seawater Desalination program. He also created the Aqua 2000 Research Center, which focuses on new technology testing and development for wastewater, reclaimed water, groundwater, seawater, and surface water applications. Gagliardo has authored over 50 papers and has spoken nationally and internationally on technical, political, strategic, and water business related issues. He received a B.S. in Mechanical Engineering from Union College and a M.P.H. in Public Health from San Diego State University. He is a registered Professional Engineer in the State of California.

Joseph P. Geever
Southern California Regional Coordinator
Surfrider Foundation

While Joe Geever was earning his law degree at the University of Virginia School of Law, he was employed as a Law Clerk for the National Oceanic and Atmospheric Administration, where he worked on issues involving the Coastal Zone Management Act, National Marine Sanctuaries Act, Magnuson-Stevens Fisheries Conservation Act, and similarly related procedural law. After receiving his J.D. in 2000, he became the Pacific Fisheries Coordinator for the American Oceans Campaign. There, he served as a conservation community representative on California Fish and Game advisory committees, prepared public comment of legislative and regulatory action, and assisted in public education, among other responsibilities. He joined the Surfrider Foundation in 2002 as the Southern California Regional Coordinator, which involves such duties as planning local campaigns and building collaboration and partnerships. Geever received both a B.A. in Economics and J.D. from the University of Virginia.

Jerome B. Gilbert, P.E., DEE
Consulting Engineer
J. Gilbert, Inc.

Jerry Gilbert has been an independent consulting engineer since 1991, providing advice on water and wastewater management, rate analysis, water resources, water transfers and rights, and strategic planning and regulatory compliance. In the areas of water treatment and watershed protection, he has been appointed to serve on expert panels by Cities such as Tucson, Seattle, New York, San Francisco, as well as the Metropolitan Water District of Southern California, USEPA, and Water Science and Technology Board, to provide independent assessments of watershed practices, public health protection, and water treatment facility plans and operations, including desalination and compliance with the Clean Water Act and Safe Drinking Water Act. He is a member of the National Academy of Engineering and is the co-author of two books published by the American Water Works Association: *The Changing Water Utility: Creative Approaches to Effectiveness and Efficiency* and *The Evolving Water Utility: Pathways to Higher Performance*. Gilbert received a B.S. in Civil Engineering from the University of Cincinnati and a M.S. in Civil Engineering from Stanford University.

Lisa R. Henthorne, P.E.
Partner
Aqua Resources International

Lisa Henthorne is a founding Partner with Aqua Resources International, a consulting firm in Colorado, created in 1999. She is responsible for overseeing water resources studies and projects related to desalination and membrane treatment of which she has 20 years of experience. To do this, she provides advice regarding project evaluation, including technical and financial feasibility and environmental suitability; business development; and market analysis for water and desalination projects for a range of public and private clients. She also assists clients in the feasibility study and analysis of potential desalination and membrane treatment projects, domestically and internationally. In addition, she has conducted worldwide, regional, and country-specific analysis of the desalination industry for clients to assist them in market entrance, strategic planning, and project initiation. Henthorne received a B.S. in Chemistry from Southwest Missouri State University and a M.S. in Chemical Engineering from the Colorado School of Mines, and is a registered Professional Engineer.

James H. Jensen, P.G.
Assistant Vice President
Parsons Brinckerhoff

Jim Jensen is a Senior Water Resources Scientist and Hydrogeologist with 20 years of technical and managerial experience. He has directed or been the project manager in a number of complex water resources projects, including the design, technical specifications, application to construct and other permitting issues, construction oversight, testing, data analysis, and evaluation. Jim's experience as project manager includes desalination, Class I injection well systems, aquifer storage and recovery well systems, wastewater disposal, environmental assessments and audits, and contamination assessment projects. He has spent the last 6 years employed with Parsons Brinckerhoff, one of the world's leading planning, engineering, and program management organizations. Jensen received a B.S. in Geology from the University of Missouri-Rolla and a M.S. in Geology from the University of Florida.

Ernest O. Kartinen, Jr., P.E.
Vice President
Boyle Engineering

Ernie Kartinen, who specializes in water treatment and economic feasibility studies, has been with Boyle Engineering – a design consulting firm – since 1968. He is experienced in the planning, design, and construction administration of public works projects, including water treatment transmission, pumping, storage, and distribution facilities; wastewater collection, treatment, and disposal; drainage improvements; and road and street improvements. He has considerable experience in water desalting studies and desalting plant design, and has been the Project Engineer/Manager for many reverse osmosis treatment plant or desalination plant projects in California, Nebraska, Colorado, and Texas, just to name a few. His first experience with a desalting process was over 20 years ago when he was involved in pilot plant testing of reverse osmosis and ion exchange for the removal of nitrate from groundwater in the late 1970s. Kartinen received both a B.S. and M.S. in Civil Engineering from California State University Long Beach.

John C. Kiernan
Senior Project Developer
Ionics Incorporated

John Kiernan has worked for Ionics Incorporated, a global separations technology company involved in the manufacture and sales of membranes and related equipment, since 1990. Among his projects, he developed desalination projects throughout the Caribbean and was extensively involved in the Barbados and Trinidad projects. Presently, he is focusing on the developing U.S. market. Prior to Ionics, John worked at Memtek Corporation of Billerica, Massachusetts, as a Project Engineer and later, Project Manager, where he managed the design, procurement, fabrication, and installation of large-scale membrane-based wastewater treatment. His introduction to membrane water treatment was through a co-op assignment at Albany International, where he worked on a chlorine resistant seawater hollow fiber element in 1980. Kiernan received a B.S. in Chemical Engineering from Northeastern University and a M.B.A. from Bentley College.

Hari Krishna, Ph.D., P.E., P.H.
Senior Engineer
Texas Water Development Board

Hari Krishna is a licensed Professional Engineer and a Certified Professional Hydrologist. He served as the Director of the Virgin Islands Water Resources Research Institute in St. Thomas, VI, from 1988 to 1993, where he reviewed desalination proposals, plans, and projects in the U.S. Virgin Islands. He also served as a Team Leader in the Office of Permitting at the Texas Natural Resources Conservation Commission from 1993 to 2000. Since then, he has been a Senior Engineer at the Texas Water Development Board in the area of alternative water resources, including desalination. Most recently, he assisted with developing in-house seawater desalination proposals, and in the review of 10 Statements of Interest (proposals) for building seawater desalination plants on the Texas Gulf Coast. Krishna received a B.S. in Mathematics and Physical Sciences from Osmania University, India, a M.S. in Hydrology and Water Resources from Kansas State University, and a Ph.D. in Engineering from Utah State University.

Christopher F. Kuzler, P.E.
Vice President and Environmental Engineering Department Manager
King Engineering Associates, Inc.

Chris Kuzler has 18 years of experience ranging from utility projects to complex water and wastewater treatment plants. Currently, he is Vice President and Environmental Engineering Department Manager at King Engineering Associates, Inc., a consulting firm in Tampa, Florida, that specializes in engineering, planning, ecology, surveying, and construction management services. As such, he is in charge of King's water, wastewater, solid waste, and industrial waste projects. He has also served as lead Project Engineer for the design and permitting of the 25-MGD Tampa Bay Desalination Facility and is currently involved with process analysis, design, permitting, and construction management of several water treatment facilities. Kuzler received a B.S. in Mechanical Engineering from the Polytechnic Institute of New York and an M.S. in Business Administration from Adelphi University in New York.

Donald E. Lindeman, P.E.
Civil Engineer
Tampa Bay Water

Don Lindeman has been a Civil Engineer at Tampa Bay Water – which provides an average of 176 million gallons of water to its member agencies every day – since 1994. He is the Project Manager and Lead Negotiator for the Tampa Bay Seawater Desalination Project, which began producing drinking water in March 2003. This plant will produce 25 MGD and could be expanded in the future to 35 MGD, making it the largest seawater desalination plant in North America. Lindeman is also the Project Manager for the Gulf Coast Desalination project of Tampa Bay Water's Master Water Plan, and he was the Project Manager for three large-diameter pipelines for the Regional System and two Stage A Master Water Plan projects. Lindeman received a B.S. in Civil Engineering from the University of Nebraska at Lincoln and a M.S. in Civil Engineering from the University of Kansas at Lawrence. He is a registered Professional Engineer in the State of Florida.

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Senior Water Resources Specialist, Water Resources Department
San Diego County Water Authority

Since 1998, Cesar Lopez has served as Senior Water Resources Specialist in the Water Resources Department at the San Diego Water Authority, a water wholesaler that provides water supply to 23 member agencies in the San Diego, California, region. As Senior Water Resources Specialist, he manages and coordinates special projects, such as the Regional Recycled Water System Study and demand forecasting efforts. He also participated in the preparation of the Authority's Urban Water Management Plan and other planning documents. As a member of the Authority's seawater desalination team, he performs key duties, such as managing, coordinating, and providing technical support to the Seawater Desalination Program. In addition, he provides support in addressing recycled water issues handled by the Authority and assistance to member agencies in addressing issues related to recycling, desalination, and research. Lopez received a B.S. in Civil Engineering from Mapua Institute of Technology in the Philippines and a B.S. in Sanitary Engineering from National University in the Philippines.

Matthew P. Lyons, M.P.H
Manager of Planning
Long Beach Water Department

Matt Lyons began his career with the Long Beach Water Department in 1994. He is responsible for the development of the Department's strategic plan, manages the water conservation program, and is the project manager for the Department's seawater desalination program. He began his career with the City in 1993 as an intern in the City Manager's nationally recognized Management Assistant Program. After spending 1year rotating through several City departments, he was hired by the Long Beach Water Department. He began work with the Water Department as an Administrative Analyst, moving up the organization through several positions including Manager of Water Resources, Special Assistant to the General Manager, and his current position as Manager of Planning. Lyons received a B.A. in Political Science from the University of California, Los Angeles, and a Master of Public Policy from Harvard University's John F. Kennedy School of Government.

John P. MacHarg
General Manager
Energy Recovery, Inc.

Since 2002, John MacHarg has been General Manager of Energy Recovery, Inc., a leader in high efficiency energy recovery technology for seawater and brackish water reverse osmosis systems. As General Manager, he is responsible for operations, which includes production, engineering, and product development. He also developed successful corporate strategies to penetrate the seawater and brackish water desalination markets with new energy recovery technology. Prior to joining Energy Recovery, Inc., MacHarg spent 9 years as Vice President of the Commercial Division for Village Marine Technology, where he was involved in the design, manufacture, and sales of packaged seawater desalination equipment. Some of his projects included explosion-proof offshore platform reverse osmosis systems for several major oil companies, large-scale skid packaged land-based systems for the Marriott Hotels, and shock-qualified bromine water disinfection units for the U.S. Navy. MacHarg received a M.A. in Manufacturing Engineering from Boston University.

Darryl G. Miller
General Manager
West Basin Municipal Water District

In 1999, Darryl Miller was named General Manager of the West Basin Municipal Water District and Central Basin Municipal Water District, which are public agencies that provide wholesale imported water and locally developed recycled water to local cities, mutual water companies, industrial customers, private water companies, and investor-owned utilities. A 30-year water industry veteran, Miller is a member of the Department of Water Resources 2002 Recycled Water Task Force, a Board member of the National WateReuse Association, and a California Registered Geologist experienced in water resource planning, water resource management, and water quality development and protection. Miller is also an elected director and past president of the Irvine Ranch Water District. Miller received a B.S. in Geology from Brigham Young University and a Certificate in the Executive Management Program from the University of California, Los Angeles.

Kevin L. Morisset
Senior Engineer
San Diego Gas & Electric

Kevin Morisset is an Industrial Sales Engineer with 20 years of energy marketing and industrial sales and engineering experience. He has been a Senior Engineer with San Diego Gas & Electric since 2001, where he is responsible for providing technical support for account executives of the Southern California Gas Company -- the nation's largest natural gas distribution utility – and San Diego Gas & Electric, which serves 3 million customers in Southern California. His duties also include identifying and developing new business opportunities for Sempra Utility companies. Prior to joining San Diego Gas & Electric, Morisset served as Business Development Manager for Sempra Energy Utility Ventures, where he developed corporate opportunities for water, natural gas, and electric utilities resulting from natural deregulation. One project (Mare Island Naval Shipyard) received top prizes from the California Cities Helen Putnam Award for Excellence for Economic and Community Development Partnerships and the Council for Urban and Economic Development for innovations in public private partnerships that benefit economic development. Morisset received a B.S. in Mechanical Engineering from California State Polytechnic University, Pomona.

M. Kevin Price
Manager, Water Treatment Engineering and Research Group
U.S. Department of the Interior, Bureau of Reclamation

Kevin Price is the Manager of the Water Treatment and Engineering Group at the U.S. Department of the Interior, Bureau of Reclamation (USBR). He also oversees the Desalination and Water Purification Research and Development Program, Advanced Water Treatment Research Program, and the Water Reuse Research Program. In addition, he has also worked on desalination research projects in the Middle East, as well as with the European Union, Korea, and Japan. He is currently the U.S. Technical Representative (through the U.S. Department of State) to the Middle East Desalination Research Center in Muscat, Oman. He represents USBR on the Joint Water Reuse, Reclamation, and Recycling Task Force with NWRI, WERF, WRF, and AWWARF. Price received a B.S. in Zoology from Albertson College of Idaho, M.S. in Chemical Engineering from Columbia University, and MBA in Finance from the University of Denver.

C. Robert Reiss, P.E.
President
Reiss Environmental, Inc.

Robert Reiss is President and Founder of Reiss Environmental, Inc., a consulting engineering firm specializing in advanced water treatment and membrane processes. He has been involved with membrane treatment processes and advanced treatment issues for the past 12 years, and his experience includes the detailed design, process engineering, and technical review of membrane treatment systems, including seawater, groundwater, and fresh surface-water systems. This experience includes microfiltration, ultrafiltration, nanofiltration, and reverse osmosis technologies. In addition, he has similar experience with conventional coagulation systems, media filtration, and other advanced treatment technologies. Reiss received both a B.S.E. and M.S.E. in Environmental Engineering and is a Ph.D. candidate in Environmental Engineering at the University of Central Florida. He is a registered Professional Engineer in the States of Florida, Georgia, Indiana, Ohio, North Carolina, South Carolina, and Virginia.

Dale L. Rohe, P.E., DEE
Principal Engineer
Montgomery Watson Harza

Dale Rohe has over 26 years experience in water supply, distribution, operations, and treatment, with emphasis on alternative, unconventional treatment methods such as demineralization, reverse osmosis, membrane softening (nanofiltration), microfiltration membranes, and ultrafiltration membranes. Currently, he is Principal Engineer at Montgomery Watson Harza, a consulting firm that specializes energy, infrastructure, water, and wastewater issues. At Montgomery Watson Harza, Rohe has been involved in providing consulting engineering services for water supply agencies, covering the planning, design, construction, start-up, and operational phases. In addition, he has provided consulting engineering to sanitation districts for reclaimed water pumping and storage facilities; and reclaimed water advanced treatment processes, including the application of membrane treatment processes. Rohe received a B.S. in Environmental Engineering Sciences from the University of Florida and is honored as a Diplomat of Environmental Engineering by the American Academy of Environmental Engineers.

Richard H. Sakaji, Ph.D., P.E.
Senior Sanitary Engineer, Drinking Water Program, Technical Programs Branch
California Department of Health Services (Berkeley, CA)

For the past 8 years, Rick Sakaji has been Senior Sanitary Engineer in the Drinking Water Program of the California Department of Health Services, which has regulatory oversight of California public-water systems and is responsible for the enforcement of the Federal and State Safe Drinking Water Acts. Sakaji's unique background in research and regulatory affairs has allowed him to bring a public-health perspective to advisory committees and workshops on public health, water quality, and water-treatment issues surrounding drinking water and wastewater reclamation. Currently, he has served on several project advisory committees for the American Water Works Association Research Foundation and the Water Environment Research Foundation. He was also among the co-authors of NWRI's *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse*. Sakaji received an A.B. in Marine Biological Studies and both a M.S. and Ph.D. in Environmental Engineering from the University of California, Berkeley.

Karl W. Seckel, P.E.
Assistant General Manager/District Engineer
Municipal Water District of Orange County

Since 1987, Karl Seckel has been Assistant General Manager/District Engineer at the Municipal Water District of Orange County (MWD of Orange County), a wholesale water agency and member agency of Metropolitan Water District of Southern California, which covers most of Orange County California and which provides imported water and other services to the 28 local agencies within their service area. He worked for Boyle Engineering Corporation for about 6 years prior to joining MWD of Orange County, where he has worked for almost 20 years. At MWD of Orange County, he is involved in a variety of planning and coordination activities to assist the 28 local agencies. One of the current study efforts, the South Orange County Water Reliability Study, has identified ocean desalination as one of the emerging projects that could improve both supply and system reliability in the South County area. Seckel received both a B.S. and M.S. in Civil Engineering from the University of Maryland.

Ron E. Wildermuth
Director of Communications
Orange County Water District

Since 1997, Ron Wildermuth has been the Director of Communications for the Orange County Water District (OCWD), which manages and maintains the groundwater supplies for nearly 2 million people in Orange County, California. Among his current responsibilities, he is conducting outreach for OCWD and its joint project with the OCSD called Groundwater Replenishment Program. Previously, Wildermuth was Director of Corporate Relations for the engineering firm, Parsons Corporation, and was the Public Relations advisor to General H. Norman Schwarzkopf before, during, and after the Gulf War. Wildermuth received a B.A. in International Relations and Sociology from St. Ambrose University, an M.S. in Public Relations from the American University, and a M.S. in Naval Science at the Naval War College in Newport, Rhode Island.

Mark Wilf, Ph.D.
Vice President, Corporate Technology
Hydranautics

Mark Wilf joined Hydranautics in 1985, with more than 28 years experience in the fields of membrane technology and desalination. Currently, he oversees the development of membrane products for reverse osmosis and ultrafiltration applications and process design. Responsibilities include evaluating and designing commercial reverse osmosis plants operation, conducting field research and pilot system operation, and evaluating the economics of membrane processes. Other responsibilities include identifying new technologies, implementing new technologies developed by the technical staff, and ensuring the proper use of current technology by Hydranautics' customers. Before joining Hydranautics, Wilf severed as the Head of Membrane Projects Department at Mekorot Water Co. Ltd, in Tel Aviv, Israel, where he developed reverse osmosis systems, completed data analysis, developed new processes, identified new technologies, and developed project test plans. Wilf received a M.Sc in Chemical Engineering from the Technology Institute in Wroclaw, Poland, and a Ph.D. in Chemistry from the Institute of Technology in Israel.

Robert C. Wilkinson
Senior Fellow
Rocky Mountain Institute

Bob Wilkinson is a Senior Fellow with the Rocky Mountain Institute, as well as a Lecturer in the Environmental Studies Program at the University of California, Santa Barbara (UCSB). For the past 5 years, he has served as Coordinator for the Climate Impacts Assessment of the California Region for the U.S. Global Change Research Program and the White House Office of Science and Technology Policy through the National Center for Geographical Information Analysis at UCSB's Department of Geography. His teaching and research focus is on environmental policy issues, energy and water policy, climate change and variability impact analysis, and urban environmental issues and sustainable communities. Over the past decade, he has worked extensively in Western Europe and in every country of Central Europe from Albania through the Baltic States and throughout the former Soviet Union, including Siberia and Central Asia. Presently, he is working with the Inland Empire Utilities Agency on an integrated, landscape-level planning process for the utilities service area. Wilkinson received a double B.A. in Environmental Studies, and a M.A. and Ph.D. Candidacy in Political Science at UCSB.

Gary Wolff, Ph.D., P.E.
Principal Economist and Engineer
Pacific Institute

Gary Wolff is the principal economist and engineer at the Pacific Institute for Studies in Development, Environment and Security in Oakland, California. His professional career has included solar energy construction contracting, water-quality regulations for the State of California, and design engineering at a wastewater treatment plant, among others. He is the past president of the Alameda County Recycling Board and past chair of the East Bay Municipal Utility District Demand Management Advisory Committee. Wolff has also performed numerous pre-design, cost-benefit, cost-effectiveness, and feasibility studies for water, wastewater, solid waste, and renewable energy projects. Currently, he is working on water conservation economics in California, the issues associated with privatization of the water sector in an increasingly global economy, guidelines for World Bank employees on environmental issues in the water sector, and pesticide regulation in California. Wolff received a B.Sc. in Renewable Energy Engineering Technology from Jordan College, M.S. in Civil and Environmental Engineering from Stanford University, and Ph.D. in Resource Economics from the University of California, Berkeley.

APPENDIX D

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APPENDIX E

WORKING GROUPS' VISUAL PRESENTATION

APPENDIX F

HYDRO-ILLOGICAL CYCLE

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By

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