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Water Supply Information

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WATER SUPPLY INFORMATION

Introduction

This paper was prepared in response to AB 970 in an effort to provide additional assistance to potential thermal power plant developers. This paper focuses on water supply issues, specifically how a developer could obtain water supplies to meet the needs of a new power plant.

A variety of water sources are available for new power plants. These sources include both local and imported surface water supplies, groundwater and reclaimed water. While water consumption by power generation within the state represents only a fraction of one percent of the total amount of water consumed, water demand by a power plant may be competing with other users for deminishing supplies. As California's population and water demand continues to grow, however, there will be increasing pressure for heavy industry, including power plants, to achieve greater water conservation. The Department of Water Resources (DWR) anticpates that the state will be suffering shortfalls in water supplies in excess of several million acre feet of water within the next ten years.

The following discussion briefly reviews the general issues associated with these sources, including regulatory concerns and identifies some alternative approaches for developing a power plant water supply.

Water Supply

The choice of a water supply must take into consideration the quality and the quantity of water the power plant will require. A convention 500 MW thermal combined cycle gas-fired power plant in California may consume from 2,000 to 4,000 acre-feet of water per year. In comparison, one acre-foot is the amount of water that would cover an acre of land to a depth of one foot and would meet the needs of an urban family of 4 for 20 months. The majority of this water, 80 to 90 percent, is used in the closed loop cooling system utilizing wet cooling technology. A simple cycle facility, lacking wet cooling towers will use significantly less water, approximately 60 to 200 acre-feet of water per year. Additionally, water quality issues, driven by the processes involved, also affect water supply decisions. The quality of the cooling water make-up is not as critical as that of steam cycle or plant process water needs which require high quality water. The quality of the source water will also affect the quality of the wastewater generated by the facility.

Approximately 70 percent of the developed water supplies in California are provided by one of the more than 600 water districts within the state. These districts are made up of a number of public and private entities providing water on a retail and/or wholesale basis for agricultural, domestic and industrial uses. Most districts supply industrial customers such as a power plants, although a number of irrigation districts do not. A list of the private water districts is available on the California Public Utilities website: http://www.cpuc.ca.gov. In addition, the Association of California Water Agencies has a list of a substantial number of public and private water districts within the state: www.acanet.com.

Many districts within the state rely upon a combination of surface water and groundwater or just groundwater for their water supply. For much of the state, surface water supplies depend on two major water projects, the Central Valley Project and the State Water Project that route water from Northern California through the Sacramento-San Joaquin River Delta to Central and Southern California. Other significant water projects include the All-American Canal, the Colorado River Aqueduct, and the Hetch Hetchy Project. Given the variety of water sources utilized by local water districts, it is not unusual for water supply availability to vary significantly from district to district.

Some water districts in the state have sufficient resources to meet anticipated future demand either through existing water rights, water project entitlements, or a declining customer base. Accordingly, the cost of water may also vary greatly from district to district.

Given a project's location, water from the local district may be the only option available. Relying on a water district to supply a project's water requirements provides the project the infrastructure necessary for a secure water supply. It may also reduce the environmental compliance efforts associated with a project pumping or diverting its own water supply. On the other hand, water costs are expected to increase, perhaps significantly over time. In addition, many water districts will curtail water deliveries to heavy industrial facilities, such as power plants, under drought conditions.

An alternative to relying on a water district to supply project water needs is for the project owner to develop the facility's own supply. Many power plants in the state rely on groundwater pumped from their own wells on or near the site. Such an approach provides the facility with control of its water supply and is relatively inexpensive. On the other hand, it requires a more substantial investment in infrastructure, such as backup wells, and additional environmental compliance requirements. Most areas of the state do not regulate groundwater wells beyond well design requirements. Even in areas where the groundwater basin has been adjudicated, new groundwater wells are not prohibited but additional costs may be involved. Information on groundwater conditions throughout much of the state and on adjudicated groundwater basins can be found on the Department of Water Resources website: www.dwr.water.ca.gov.

New diversions of surface water would likely require a new water right by the State Water Resources Control Board. Information on water rights is available on the Board's website: www.swrcb.ca.gov. Given the over-allocation of many water bodies, competition for remaining supplies, and significant environmental concerns water diversions involve, this approach is not recommended.

Another option is water transfers. A water transfer is a change in the allocation of water supplies and may be between neighboring farmers or between water districts on opposite ends of the state. Since changes in allocation are usually for a limited duration, water transfers do not provide a reliable, long-term water supply. Transfers can, however, be used to augment water supplies when necessary. In response to recent droughts, the water transfers intended to alleviate shortfalls has increased and are now a key element of the recent CalFed accord. In addition, state law encourages public agencies to facilitate water transfers. For further information, see the paper on water transfers prepared by the State Water Resources Control Board: www.waterrights.ca.gov/watertransfer/watertransfer.

Alternative Water Supplies

The State Water Resources Control Board's "Water Quality Control Policy on the Use and Disposal of Inland Waters Used for Powerplant Cooling" (Order No. 75-58) encourages the use of alternative sources of cooling water and/or the use of alternative cooling technology. Alternative sources of cooling water identified in the policy include wastewater, irrigation return flows, and naturally brackish water. The policy also encourages the evaluation of dry or wet/dry cooling technology for those facilities that may require water from the Sacramento-San Joaquin River Delta. These alternatives are discussed further below. A copy of the policy is available on the Board's website: www.swrcb.ca.gov/plnspols/wqplans/pwrplant.doc.

An alternative water source available in urbanized areas is wastewater or effluent from a wastewater treatment facility. A number of facilities within the state use wastewater for use in cooling towers. One facility, a combined cycle plant currently under construction, will use wastewater for both cooling and steam cycle processes. Many wastewater treatment plants, responding to a state mandate to recycle, do provide effluent for beneficial uses, mainly for irrigation. A survey conducted by the State Water Resources Control Board of wastewater treatment facilities and their recycling efforts can be found on their website at www.swrcb.ca.gov. Draft Department of Health Regulations require the use of tertiary treated, disinfected effluent in cooling towers. These regulations are available on the Department of Health Services website: www.dhs.ca.gov. Although most wastewater facilities within the state provide only secondary treatment, the addition of the necessary filtration and chlorination to achieve tertiary treated standards is not a significant cost.

California Water Code Section 13550 et seq. requires the use of effluent for industrial purposes, especially for cooling if it is available under certain conditions. These conditions include the potential affect on other water users, environmental concerns, and costs. The California Water Code is available on the web through the State Water Resources Control Board website: www.swrcb.ca.gov/water_laws/index.

Another approach is to utilize surface or groundwater sources not suitable for most agricultural or urban uses because of natural or anthropogenic contamination. These include brackish or contaminated groundwater supplies. The State Water Resources Control Board's policy on inland sources of cooling water encourages the use of these and other sources such as irrigation return flows. It is likely, however, in many locations, irrigation returns flows vary greatly with the season and could not be considered a reliable, year-round water supply. While use of brackish or contaminated surface or groundwater for a project may raise a number of environmental concerns, it does present a potentially beneficial use of water that otherwise would further degrade other water supplies.

Alternative Technology

As noted above, a significant portion of a combined cycle power plant's water demand is to meet cooling water makeup requirements. Cooling towers reject heat from a power plant's steam cycle to condense the steam exiting the steam turbine and to maintain the lowest possible condenser vacuum. The heat rejection mechanism in wet cooling towers is primarily the evaporation of water to the atmosphere. Dry cooling towers transfer heat convectively through heat exchangers, while wet/dry hybrid cooling towers use combinations of the two mechanisms to reject heat to the atmosphere. The use of dry or hybrid cooling technology therefore can reduce a project's water demand by up to 90 percent.

The fundamental differences between wet, hybrid, and dry cooling towers are initial capital costs and heat rejection effectiveness. Dry cooling towers are two to three times more expensive than a wet system. Hybrid systems fall in the range between the two, depending upon the ratio of "wet to dry" cooling in the hybrid design. In general, the cost differences are due to the dry condenser, or heat exchanger, and taller and larger structures for dry and hybrid cooling systems.

Not taken into account in these relative cost estimates, are a variety of factors including the cost of water which will likely increase over time and the associated environmental compliance requirements. In addition, dry or wet/dry cooling substantially reduce a facility's wastewater stream and those associated costs. Perhaps more importantly, use of these technologies avoids the potential for curtailment of a project's water supply. However, heat rejection inefficiencies inherent in dry cooling towers can reduce net generator output during high ambient air temperatures. These production losses would need to be taken into consideration.

Although there is a variety of water sources within the state available to meet a project's water needs, the anticipated shortfall of the state's water supplies, even under normal conditions, must be taken into account. It is likely that under drought conditions, water deliveries to heavy industry, including power plants, may be curtailed. Another factor is that a project should be a good neighbor and not perceived as squandering limited high quality water supplies. As noted above, there are opportunities to use alternative water sources or alternative cooling technology to achieve water conservation. Another way to achieve water conservation is for a facility to cycle water through the cooling towers as much as possible. Hundreds of acre-feet of water can be saved by a facility cycling water 15 to 20 times through the cooling towers instead of just five. Such an approach poses additional treatment costs but does reduce water supply costs. This approach also raises concerns about wastewater quality but these issues can be readily addressed.

For further information on this topic, please contact the California Energy Commission staff at:

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