WATER AS A CONSTRAINT TO THE USE OF COAL FOR CALIFORNIA

Ronald B. Robie, Director

Department of Water Resources

The Resources Agency
State of California

I would like to begin by stating that I appear before you today in dual capacities: first as Director of the Department which plans for the management of California's water supplies, and secondly, as sponsor of a coal-fired power plant to furnish necessary power for the State Water Project. As part of our power plant development, we also will have to solve some problems and meet the regulatory requirements which I will address today.

The State Water Project delivers large quantities of water from Northern California to the San Joaquin Valley and Southern California.

As water must be pumped from the Sacramento-San Joaquin Delta to the places of use, the Project is a large user of electric power. Under normal water conditions, the Project will require about 5.5 billion kilowatt-hours this year (about one-third that sold last year by the City of Los Angeles) and over 10 billion kilowatt-hours by the year 2000.

Presently, power for the Project is obtained from power recovery plants on the California Aqueduct, by purchases from major California electric utilities, and by purchases from utilities in the Pacific Northwest. While some power purchase contracts will be renegotiated, others will expire in 1983. We are evaluating several possible sources of energy for future project operation to replace that lost by contract expiration. These sources include hydroelectric, geothermal, coal, nuclear, and others. The Department has participated in research and development activities related to wind energy and has also submitted a proposed solar-electric research project to the Federal Government.

We have proposed development of a 1000-MW coal-fired power plant as one of the most practical ways to fill a portion of our future power need.

This Department will be the lead agency and manage the development through all stages. The Department would generate only for our own needs and would retain ownership of about 350 MW of the total plant capacity. The remaining capacity would be owned by public and private utility participants. It is presently envisioned that the plant would be comprised of three generating units, each being completed one year apart, the first being on line in 1987.

One of the most important considerations in use of coal, or for that matter, any fuel used in a thermal plant, is the water supply for cooling. I cannot overemphasize; this is not exclusively a coal plant problem. Competition among various water uses is keen and, of course, during the drought conditions of the last two years this competition was especially intense. In the past, most thermal plants were constructed near the coast or on connected bays where ample supplies of saline water were available for cooling. Today, however, for many reasons thermal plant sites are moving into inland areas where water is less abundant.

A 1000-MW coal-fired plant would require on the order of 15,000 acre-feet per year of fresh water. As the following tabulation indicates, cooling is by far the largest requirement:

Purpose	Requirement (Acre-foot/year)
Cooling	13,300
Domestic	10
Boiler makeup	300
Flue gas scrubbing	1,200
Miscellaneous	200

When we use water of high salinity, however, buildup of salt concentration by evaporation limits the reuse of water in the cooling system and water requirements could increase to 30,000 acre-feet per year for a 1000-MW plant. The Department, in cooperation with major electric utilities has recently completed pilot plant studies which indicate that with proper pretreatment, brackish agricultural waste water can be used for power plant cooling, where the TDS concentration of the coolant is increased to as high as 70,000 milligrams per litre by recirculation. We will soon have a full report on these studies.

This Department and the California State Water Resources Control Board have made studies to determine the quantities of water needed for future power plant cooling and to develop a consistent policy regarding cooling water uses.

The principal guidance to the Board and the Department is Article X of the California Constitution, which controls the waste of water and requires use of water to be both reasonable and beneficial. Both the Board and the Department are required under Section 275 of the Water Code to implement this provision. The Department's policy is that California's water resources shall be managed in a manner that will result in the greatest long-term benefit to the people and that water shall be reused to the maximum extent feasible. Consistent with this policy, the preferred sources of cooling water at inland sites are urban and agricultural waste waters and other poor-quality water. The Water Resources Control Board's policy regarding water for power plant cooling provides that cooling water should come from the following sources in order of priority depending on environmental, technical, and economic feasibility considerations: (1) wastewater being discharged to the ocean, (2) ocean waters, (3) brackish water from natural sources or irrigation return flow, (4) inland wastewaters of low TDS, and (5) other inland waters. Where the Board has water rights jurisdiction, use of fresh inland waters for power plant cooling will be approved by the Board only when it is demonstrated that the use of other water supply sources or other methods of cooling would be environmentally undesirable or economically unsound. In issuing a permit or license for water for power plant cooling, the Board considers the reasonableness of the proposed water use when compared with other present and future needs for the water sources. The State Department of Food and Agriculture also opposes the use of fresh water for power plant cooling where that water could be used elsewhere.

In all of these determinations regarding power plant cooling, no rule applicable to all circumstances is possible. Reasonableness of use depends on all aspects of each particular situation; therefore, each plant must be examined on a case-by-case basis.

The State Board implements its policy by intervening in Energy Commission proceedings.

The Legislature also has established policy on power plant cooling. The Waste Water Reuse Law of 1974 directed the Department to investigate the use of reclaimed waste water for beneficial purposes, including power plant cooling. This law also declares that water conservation requires the maximum practical reuse of waste water. The results of these DWR studies pertaining to power plant cooling are presented in DWR Bulletin 204, "Water for Power Plant Cooling", July 1977. Another recent law relating to water use for power plant cooling permits The Metropolitan Water District of Southern California to provide up to 100,000 acre-feet of Colorado River water and up to 60,000 acre-feet of State Water Project water per year for cooling purposes. This same law, however, also directs that agricultural waste water and other water not suitable for other purposes shall be used for cooling to the extent practicable.

Let's consider some forecasts published recently in Bulletin 204. Projects by the Department and the California Energy Commission vary widely depending on the assumptions made. On the average, however, they indicate that in 1995 about 280,000 acre-feet of power plant cooling water per year will be required at inland sites assuming evaporative cooling. Agricultural waste water available for cooling at that time in the southern San Joaquin Valley would be slightly in excess of 140,000 acre-feet per year. In the Palo Verde Valley, agricultural waste waters are returned to the Colorado River to satisfy downstream water rights, and use of these waters for cooling would be contingent on increased compensatory releases at Parker Dam. The utility must pay to make this water available. In the Imperial Valley, Colorado River water is also used for irrigation, and the drainage is routed to the Salton Sea. The volume of drainage water is more than ample to meet projected cooling needs; however, a new water level balance in the Salton Sea would result. This change, and especially the effect on the fishery, has not been evaluated.

Recently, studies were concluded at UCLA regarding utilization of coal for power in California. These studies were jointly funded by the Department and the California Energy Commission. The general criteria for power plant siting considered in the UCLA studies (air quality, population, etc.) pointed to desert region locations. Limited water supply studies were done for several selected potential sites. Here, water supply alternatives considered were the Colorado River, agricultural waste water, and ground water of varying quality. In general, it was found that there would be sufficient ground water for potential power plants at the Cadiz, Goffs, Barstow, Rice, and Blythe sites, and sufficient agricultural return flows at all except the Blythe site. Constraints on the use of each water source would require specific studies for each alternative site to determine the costs and engineering and environmental factors in getting the required quantities of water to the plant. Studies would also be required to determine the existing water quality at each source to determine its fitness for other purposes and the amount of makeup water required to keep salt concentrations from rising too high.

In some areas, use of ground water for cooling would result in mining (extraction at a greater rate than natural recharge). Studies are required to determine the ground water reserves needed for the life of the power plant. For our new power plant, the Department will conduct more extensive studies on water sources as part of our site selection process. The Department will soon publish a bulletin on ground water data for the southeastern part of the State. This will utilize recently developed USGS data.

One of the questions that always comes to mind when discussing cooling water requirements is: Can anything be done to reduce the amount of water needed? This Department is continuing to study this question. Of course, within the plant system the basic concept of reuse of water will be carried out to the fullest extent possible, e.g., highly saline water from the plant cooling system will be used in ash handling, dust control, or other purposes where quality is not a problem. Dry cooling was reviewed and found to have drawbacks. This system is comparable to the radiator in your car--air cools the water in a closed system and no water is lost. Besides having higher

capital cost, dry cooling towers are not as effective in reducing water temperature as evaporative systems. Turbine outlet steam temperatures are, therefore, higher and turbine efficiencies are lower. Fuel consumption rises, and since dry-cooled units depend on cool ambient air temperatures to carry away heat, in hotter climates, efficiencies drop further.

The Department is participating in a prototype test of a wet-dry cooling tower. This study is being sponsored by Southern California Edison Company; several other utilities and governmental agencies are involved. Such a tower would first use a dry system to partly cool the water; the water would then drop into a conventional evaporative section. Louvers would control the amount of air passing through each section. Under cooler ambient conditions, most of the cooling would be accomplished in the dry section and water savings should be up to 25 percent, or hopefully more.

I have not mentioned coal slurry pipelines and the water supply impacts of interstate transfers of water. Most of the Western states zealously guard their water resources and this can be a serious impediment to use of this form of coal transport. Whether Congress will enact coal slurry legislation is open to question, and if it does, "area of origin" provisions for water will surely be a part of the considerations.

In summary, there is sufficient water available in California for power plant cooling. The resource, however, is finite and every effort must be made in this use, as in all others, to obtain maximum conservation and recycling of the resource.