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## *Why Not, Indeed*

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Why not use water for cooling in a power plant, then treat it for municipal use?

Why not, indeed, ask researchers who recently completed a study funded through the Texas Water Resources Institute. They found that using water first as power plant cooling water, then as municipal water:

- Could stretch the available water supply.
- Could reduce residential energy demand.
- Could cut costs of producing electricity.
- Could decrease time and chemicals needed for water treatment.
- Could eliminate problems of waste heat disposal.

### *WATER SHORTAGES AND ENERGY COSTS*

The concept of using water destined for city use in a power plant before piping it into a city treatment plant can, according to the researchers, help solve two of the critical problems facing Texas cities today--water shortages and high energy costs.

Many Texas cities surveyed by the Texas Department of Water Resources (TDWR) in 1981 have practically no dependable surface water in reserve at the present time. Especially vulnerable under drought conditions are cities in the San Antonio, Lower Rio Grande Valley, North Central and West Texas areas. Even East Texas cities are not immune to water shortages; many must find additional surface water supplies just to meet normal demands in the future.

Present water supply in the state--even with 65 proposed new reservoirs added--cannot meet all of the projected municipal and industrial needs in the foreseeable future.

Projected increases in energy demands will also place additional strain on the state's water resources. Texas is already one of the top three states in electrical generation capabilities, producing more than 10,000 kilowatt hours per person per year. TDWR predicts that water consumption by power plants will more than triple by the year 2000.

Power plants in the state draw tremendous amounts of water to carry off waste heat from condensing steam back to water. A typical 1,000 megawatt steam electric plant--no matter whether fueled by gas, coal, lignite, or nuclear power--evaporates from 6 million to as much as 15 million gallons of water per day when in full operation.

Steam electric plants require two types of water: boiler water and cooling water. Boiler water is very pure water which is heated to become steam. The steam drives turbines to generate electricity. Boiler water is recycled continuously: heated to steam, cooled and condensed to water, then heated to steam again. The steam condenses to liquid as it comes in contact with cool surfaces of a pipe system passing through the condenser unit.

Cooling water circulates through the pipes to keep the pipe surfaces cool and carry the heat away. The most common type of cooling system, called a "once through" system, pumps large volumes of water directly from a reservoir or a river through pipes. The water returned to the reservoir or river is 15 to 25 degrees Fahrenheit warmer but otherwise unchanged. The difference in temperature between cooling water and receiving water causes evaporation over and above normal evaporation and accounts for over 90 percent of the water consumed by electric generation plants.

When looking at water requirements of electric generation, planners must be careful to distinguish between water use and water consumption. Water use is the total amount of water withdrawn by a power plant. Water consumption refers to that amount of water lost through evaporation, chemical conversion, or other means.

## ***POSSIBILITY STUDIED***

Water carrying heat from a condenser in a power plant could flow directly into a municipal water treatment plant for treatment and distribution into the community, say researchers who studied the concept in research funded by the Office of Water Research and Technology through the Texas Water Resources Institute.

Ralph Ramsey, a civil engineering professor at Texas Tech University, led the team of researchers which included four other Texas Tech scientists: Robert Bowersock, Lloyd Urban, James Strickland, and Robert Sweazy. They found significant advantages in running water already destined for the city treatment plant, through a power plant first. Their recently completed report lists several major economic advantages for the electric utility in piping cooling water directly to municipal systems.

1. The power plant would not be in competition with the city for available water.

2. The power plant would solve its problem of disposing the waste heat carried by the water. Even though water used for cooling is unchanged except for higher temperature,

its disposal is often a problem because of its impact on receiving water. The state of Texas requires a disposal permit and carefully regulates the impact of the heat on receiving waters.

3. The electric utility could use a once-through system of cooling water which is lower in capital investment, cheaper to operate, and less water consumptive than cooling towers or cooling ponds. Also, since water can be released from the plant at a higher temperature, water, pumps, and piping now required for cooling in a power plant system can be reduced.

Ramsey says that even though no city is currently using such a system, his research found some promising advantages and few serious problems in piping the water at approximately 100 degrees F through a city system. He concluded that the heated water, considered a waste product of power generation, could be beneficial to the water utility and its customers.

Water heated to around 100 degrees F is easier and less expensive to treat than cooler water. Chemical reactions, settling and filtration all require less time when water is heated. Reducing the time required for water treatment could reduce or postpone city expenditures for plant expansions.

Warm water is also less costly to distribute, according to study results, because elevated water temperatures decrease gas solubility and thus reduce concentrations which cause corrosion or deposits.

The primary benefit for water customers, says the Texas Tech professor, is in the energy savings of heating water. In an average Texas household, as much as 25 percent of the total energy bill goes for heating water. Hospitals and restaurants also spend tremendous amounts of money on energy to heat water. Approximately 7.9 percent of all the energy consumption in the U.S., as a matter of fact, goes for heating water.

Estimates show that in the Lubbock area, a family using electricity to heat household water could save as much as $105 per year if city water were distributed at 100.9 degrees F rather than the current 62.5 degrees F. Households with gas water heaters would save $43 per year.

Ramsey admits that ice making and water cooling will cost more, but these costs will not compare, he says, to the present expense of heating water for bathing, food preparation, and laundering.

The researchers designed a computer model to determine heat losses in a water treatment system and distribution network. They evaluated the temperature of water entering a treatment plant and at various stages during conventional treatment. Influencing the heat loss during treatment, according to the study, were (1) the water temperature at the inlet, (2) the size and shape of settling tanks and filters, (3) the flow rate through the system,

(4) atmospheric conditions, (5) construction materials, (6) soil type, temperature, and moisture, and (7) location in distribution system.

Most adverse impacts, according to Ramsey, can be avoided by selecting and controlling flow rate, thereby controlling the temperature of the water entering the distribution system. Even so, water in many points in the system would probably have temperatures around 100 degrees F.

Perhaps the most serious drawback to using power plant water in a city system would be its effect on equipment already installed. Since 100 degrees F is the maximum recommended for plastic pipe--now widely used for city water distribution systems--water temperatures above 100 degrees F might damage city pipes as well as household pipes, appliances, or toilet parts.

Most water meters currently in use are constructed to operate within relatively fixed temperature ranges. Modifications to old meters or installation of new meters would have to be included in adopting a system distributing water from a power plant.

The researcher feels, however, that the benefits of using cooling water in a municipal system far outweigh the inconveniences. His research concluded that it would be economically and environmentally beneficial to first use water for cooling in a power plant, then as a municipal water source. Ramsey says implementation will depend, however, upon a favorable reception by each of three groups: the electric utility, the water utility, and the customers of both utilities.

In February, 1980 questionnaires were sent to 50 water customers in each of seven cities: Albuquerque, Amarillo, Denver, El Paso, Lubbock, Tucson, and Wichita Falls. Seventy-three percent of the returned questionnaires gave a favorable response to using heated water from a power plant in their city water distribution system.

Negative responses and concerns expressed by respondents dealt mainly with warm instead of cool water for drinking, food preparation, summertime showers, or toothbrushing. Drinking water requirements could be handled by cooling small quantities, says Ramsey, but cold showers would be a thing of the past.

Arguments for using power plant cooling water as a municipal source of water are convincing:

- Multi-use of a water resource stretches the water supply.
- Using waste heat rather than discharging it into a water course cuts cooling costs and reduces water loss from evaporation.
- Warmer water temperatures reduce water treatment and distribution costs.
- Piping warm water into homes and buildings cuts energy consumption and bills.

## *ONCE, TWICE, WHY NOT THRICE?*

Ramsey's study concept has not been seriously considered by cities in the past because it suggests that a city treat and distribute "used" water. Actually, any city drawing river water downstream from another water user is re-using that water.

The concept of cities selling their "used" water--their treated wastewater--is a more accepted one. Today, according to the Texas Department of Water Resources, nearly 300 Texas cities have found some way to reuse wastewater after it has been treated. The most common uses of wastewater in Texas are for irrigation and for power plant cooling water.

While wastewater reuse is now a matter of choice and convenience for cities, the National League of Cities predicts that as demands on dwindling water supplies continue to increase in some parts of the country, the element of choice may disappear and reuse may be the only way a community can augment its water supply. Presently about two percent of available municipal wastewater nationally is reused.

Federal experts predict that the current 139 billion gallons per day of wastewater now reused nationally each year will increase to 869 billion by the year 2000. This means that more than 70 percent of the water used annually in the year 2000 will be reused (by someone other than the discharger) or recycled (by the original user).

Why not run water through a power plant for cooling water, treat and distribute it in a city system, and then treat it and run it through another power plant for cooling water?

Why not, indeed.