UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

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ENERGY AND MINERALS
DIVISION

APRIL 11, 1979

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Mr. S. David Freeman
Chairman, Board of Directors
Tennessee Valley Authority

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Dear Mr. Chairman:

We recently began an evaluation of the Tennessee Valley Authority's ~~(TVA's)~~ load management activities. Our primary purpose was to determine the status of various ongoing demonstration projects and evaluate their potential for application to the utility industry. Because most of the projects are in the preliminary stages of testing, their benefits are unclear at this time. We do believe, however, that sufficient experience has been gained with water heater controls so that TVA could accelerate its program for installation of these devices.

BACKGROUND

Load management has not been widely practiced in the United States but is commonplace in many parts of the world. In many countries, time-of-day rates are used in conjunction with compulsory load management to obtain the best load patterns possible for the systems. Time-of-day metering was introduced in the United States in the 1930's. Off-peak storage-type water heaters were controlled first by time clocks and later by various electronic devices. About 20 percent of United States water heaters are already on off-peak controlled systems. For example,

--Detroit Edison Company (DE) has amassed ten years of experience in operating a system that flattens demand by controlling customers' water heaters. This load management system augments system reserves on a seasonal basis so its effect is reflected in long-range capacity planning. It improves system reliability by increasing daily and weekly operating reserves. It also helps minimize consumption of costly oil and natural gas.

Letter Report

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About 203,000 water heater customers, representing 200 megawatts (MW) of load, subscribe to the controlled-service rate. A customer who does so can reduce water heating charges by about 35 percent. These customers are divided into ten groups to provide flexible control of the amount of load to be dropped.

Cost of the DE system totaled about $50 per customer, or a $10 million investment in 1968. In addition to conserving energy and reducing consumers electric bills, operating savings and capacity deferrals amounted to about $1.7 million in 1977.

--Buckeye Power, Inc. is currently saving an estimated $1.2 million annually by cycling electric water heaters for periods up to 5 hours on winter peak days. With 30 transmitters providing full coverage to all 28 local cooperative territories, off and on signals are sent by radio to 35,000 receivers to cycle water heaters. Space heating may be added soon with off cycles up to 20 minutes per hour.

Other utilities, including New England Electric System and Central Vermont Public Service Company have also installed water heater controls. In addition, some utilities have found that remote control of air conditioners offers even more potential for savings than water heater controls.

STATUS OF TVA PROGRAM

A TVA Task Force on Water Heater Control visited the Detroit Edison Headquarters in 1975 to examine its 7 years of experience in remotely controlling water heaters. Information was also obtained from other organizations that were either in the process of installing controls or considering their application.

Because data was not available on the diversity of water heater loads on the TVA system, the Task Force used studies on other utilities. They pointed out, however, that "... there is no assurance that the water heater load data used in the studies is correct for the TVA system and final conclusions on the overall feasibility cannot be made without data obtained from field tests on the TVA system." In 1975, the Division of Power Resource Planning and the Power Research Staff recommended a pilot project to obtain data on water heater load diversity

and to evaluate the operation of controls on both 52-gallon and 120-gallon water heaters. This recommendation apparently was never approved.

In October 1977, the TVA Board approved a program to control 400 homes with existing water heaters, 100 homes with new 120-gallon water heaters, and space conditioning in 200 homes to demonstrate and evaluate the economic and technological feasibility of residential load management. Another test program would determine the financial incentives necessary to induce customers to install and permit control of 120-gallon water heaters in the Nashville area. Also, a $9 million full-system demonstration of load management and distribution system--using automation methods for control, communication, and dispersed energy storage--has been proposed for a single distributor area.

In conjunction with the above, another plan was drafted in March 1978 by the Director of Power Utilization for the immediate implementation of controls on conventional and new 120-gallon water heaters. Implementation was to be achieved by (a) installing remote control devices on existing water heaters; (b) providing superinsulated 120-gallon water heaters, with electric service limited to off-peak hours, for installation in new and remodeled homes; and (c) when feasible, replacing existing water heaters with larger, more efficient units served off-peak. Implementation was to begin without waiting for results of other test programs and an estimated 200,000 water heaters were to be controlled within the first three years.

This number of water heaters would permit peak saving of about 50 megawatts (.25 kilowatts per water heater) in the summer under normal cycling conditions and about 120 megawatts (.6 kilowatts per water heater) under emergency conditions. The equivalent winter loads would be about 150 megawatts (.75 kilowatts per water heater) of peak shaving under normal cycling conditions and about 250 megawatts (1.25 kilowatts per water heater) under emergency conditions. In terms of benefit-cost, TVA's newest nuclear generating plant (Yellow Creek) will have an investment cost of at least $837 a kilowatt, while it is estimated the cost of remote controlling a water heater would be about $172. Thus, even during summer months, remote controlling of water heaters would seem to represent a net benefit when compared to the alternative of additional nuclear capacity.

The implementation plan to control water heaters was to be presented to the Board in early May and control the first water heater load by June 1978. But as of March 1979 the plan is still in the "talking stage."
was still not in effect.

CONCLUSIONS AND RECOMMENDATIONS

Load controls have a certainty not found in time-differentiated pricing approaches. They can be applied exactly as needed, more closely approximating the economic efficiency results of short-run marginal cost pricing. Controls can be used to respond precisely to changes in demand while time-differentiated pricing may be off the mark or cause needle peaking. Thus, direct load controls may be a cost-effective means of dampening peak load growth and managing the time distribution of loads. The use of controls also provides a given level of reliability with less capacity by selectively reducing its level of service to particular customers at specific times.

Time-controlled switches and meters are commonplace in Europe and have been used in the United States since the 1930's. More recently they have given way to more sophisticated electronic controls. Some experts believe that, because of escalating fuel prices and the rising costs of constructing new facilities, load management will become a way of life within the next few years.

Where load management programs have been implemented, customer response has been favorable, although market research surveys indicate that some customers may be poorly disposed to load control approaches. Therefore, customer information programs will be important in achieving acceptance of water heater and space conditioning controls.

Although charged with a utility leadership responsibility, TVA was relatively inactive in load management until about 1978. Little was done to determine the feasibility of controlling water heaters after the Task Force study in June 1975, a period of more than 3 1/2 years.

TVA has recently initiated a number of programs in the load management area, including water heater and space conditioning controls. These programs, however, are experimental, limited in scope, and implementation on a large scale is projected to be several years away. While we believe experiments are beneficial, we also believe--based on experiences of Detroit Edison and Buckeye Power, and the results of studies by TVA and others--that there is sufficient justification for immediate implementation of a water heater control program. We also believe that sufficient justification is available to support acceleration of TVA's efforts to control space conditioning.

We therefore recommend that TVA:

--initiate a comprehensive customer education program to promote the advantages and gain customer acceptance of load control devices;

--proceed with implementation of water heater controls by (1) installing remote control devices on existing water heaters; (2) providing incentives for the installation and control of superinsulated 120-gallon water heaters in new and remodeled homes; and (3) encouraging replacement of existing units with larger, more efficient units, when feasible; and

--accelerate the testing of space conditioning devices with a view toward early installation throughout the TVA service area.

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As you know, Section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and Senate Committee on Governmental Affairs not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report. We would appreciate receiving a copy of your statement when it is provided to the congressional committees and to be informed of any action taken on our recommendations.

We are sending copies of this report to the Director, Office of Management and Budget; the Secretary of Energy; and the House and Senate Committees having oversight and appropriation responsibilities for TVA.

Sincerely yours,

J. Dexter Peach
Director

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