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UNITED STATES GENERAL ACCOUNTING OFFICE

WASHINGTON, D.C. 20548

RESOURCES AND ECONOMIC
DEVELOPMENT DIVISION

OCT 21 1975

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The Honorable
The Secretary of the Interior 33



Dear Mr. Secretary:

As part of our review of Federal power-marketing activities, we examined the power operations of the Boulder Canyon project in the Bureau of Reclamation's Lower Colorado Region. We believe there is an opportunity for increasing the output of electrical energy at that project by changing the method of designating generators used to produce electricity at the Hoover powerplant.¹ Two agents for eight allottees² operate the Hoover powerplant under a leasing arrangement with the Bureau. Each allottee receives its energy from specific generators without regard to how this impacts on efficient operation of the Hoover powerplant as a system.

Several Bureau regional officials agreed with our observation that, if the Hoover powerplant were operated as a single system, its efficiency could be improved to a level comparable to that of the Glen Canyon generating plant in the Upper Colorado Region, with the exception of a certain amount of efficiency which is attributable to the more modern equipment at Glen Canyon.

The regional officials said that they believed the powerplants at the two projects were comparable in that they had similar heads³ and discharge capabilities, that is, they can release the same amount of water through the generating units.

If Hoover's generating efficiency were improved to a level comparable to that of Glen Canyon's, approximately

¹Hoover powerplant is part of the Boulder Canyon project.
²Customers allotted power from Hoover powerplant.
³The difference of elevation between the water surface of the reservoir and the water below the powerplant.

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353.1 million additional kilowatt-hours of electricity could be generated annually at the Hoover powerplant with the same amount of water that is currently being used. This additional energy potential could reduce fossil fuels consumed. For example, from an oil conservation standpoint, this could represent annual savings of 588,000 barrels of oil worth between \$6.2 and \$8.3 million, or \$72 to \$96 million between October 1, 1975, and May 31, 1987, when the Hoover powerplant lease¹ expires. Also this additional energy could provide increased revenues to the U.S. Treasury of about \$620,400 a year, or \$7.24 million between October 1, 1975, and May 31, 1987.

Because of the current energy shortage and the opportunity to increase electric energy generation at the Hoover powerplant, we are bringing this matter to your attention for corrective action.

INTRODUCTION

The Hoover powerplant was authorized under the Boulder Canyon Project Act (43 U.S.C. 617). Under section 6 of the act, the Secretary is allowed to enter into contracts of lease of a unit or units of any Government-built plant, with the right to generate electrical energy (43 U.S.C. 617e). The Boulder Canyon Project Adjustment Act (43 U.S.C. 618) authorizes the Secretary to promulgate charges for electrical energy and authorizes the operation of the Boulder (Hoover) powerplant by the United States directly or through agents.

Pursuant to the authority granted under the adjustment act, the Secretary approved and promulgated the "General Regulations for Generation and Sale of Power in Accordance with the Boulder Canyon Project Adjustment Act." These regulations specify the percentage of energy each customer will receive and groups the generating equipment and machinery into sections for operating purposes. Section 6 of the Boulder Canyon Project Act (43 U.S.C. 617e) states that "the title to said dam [Hoover Dam] reservoir, plant, and incidental works shall forever remain in the United States * * *."

¹Original contract for lease of power privilege and all amendatory and modifying contracts are collectively referred to as the lease.

In accordance with the provisions of the contract between the United States and the two operating agents for the operation of the Hoover powerplant, the generating machinery and equipment are leased to and operated and maintained by the city of Los Angeles and its Department of Water and Power and the Southern California Edison Company, Ltd. The lease expires May 31, 1987.

The agents operate the generating equipment for the eight allottees to whom the Hoover powerplant energy is allocated. The city operates for itself, the States of Arizona and Nevada, the Metropolitan Water District, and the municipalities of Burbank, Glendale, and Pasadena. The Edison Company operates for itself. Various contracts specify the generators or generating groups from which the allottees will get their energy.

Hoover powerplant's operations are subject to various other treaties, compacts, and contracts.

Bureau officials told us they did not know why, in 1937, the Bureau, rather than operate the facilities, leased them to two operating agents or why the contracts specify that the allottees must take their generation from certain generators or generating groups. There is no requirement in the contracts, regulations, or legislation that any specified level of efficiency be maintained in generating electricity.

PRESENT EFFICIENCY

As presently operated, the Hoover powerplant achieves an average yearly efficiency of about 74.5 percent. By comparison, the Glen Canyon powerplant achieves about 86.5 percent efficiency.

The following example of the operations at Hoover illustrates the reduction in kilowatt-hours an acre-foot of water that accompanies a reduction of efficiency. With an average head of 532 feet in November 1974, one generator at Hoover, operating at 80 percent efficiency, generated

The ratio between the power delivered by a machine or other apparatus and the power supplied to it, usually is expressed as a percentage. Plant and generator efficiencies are based on the average head, number of acre-feet of water used for generation, and number of kilowatt-hours transmitted.

7,730,000 kilowatt-hours of electricity with 17,654 acre-feet of water--approximately 438 kilowatt-hours for each acre-foot. During that same month, another generator, operating at 43 percent efficiency and using a comparable amount of water--17,218 acre-feet--generated only 3,900,000 kilowatt-hours, or 232 kilowatt-hours for each acre-foot.

REASONS FOR PRESENT EFFICIENCIES

About 4 percent of the 12-percent (one-third) difference between efficiencies of the Hoover and the Glen Canyon powerplants is attributed by Bureau regional officials to the physical differences between Hoover generators and the more modern Glen Canyon generators. The Glen Canyon powerplant generators have newer designed turbine runners, which are more efficient than the type originally installed at Hoover.¹ The officials attribute the remaining 8 percent difference in efficiency to the present methods of operations.

The Bureau's regional water and power officials told us that they believed the major reason for the lower efficiency at Hoover was that many of the generating units carried less than full loads. Operating at lower loads reduces efficiency. For example, a turbine may maintain 92 percent efficiency carrying 80 percent of full load; i.e., the machine is carrying 80 percent of its kilowatt capability. If carrying a 40-percent load, however, the turbine efficiency is reduced to about 74 percent. Thus it is important for a unit to carry as full a load as possible, to maintain the greatest efficiency.

The regional officials also said that certain allottees may be using their generators for spinning reserve capacity. Spinning reserve capacity is provided by unloaded or lightly loaded generators so that they are ready to assume load on short notice. This could cause the same inefficiencies described above, if the generators were lightly loaded to accomplish spinning reserves.

The general regulations applicable to the operation of the Hoover powerplant do not specify a required level of

¹Of the 17 generators at Hoover, 6 currently have the newer designed runners. Regional officials estimate that plant efficiency would increase about 4 percent if the remaining 11 generators were equipped with these runners.

efficiency. Instead the regulations allocate to the allottees, by percentage, the actual energy generated. For this reason there is little incentive for the individual allottees to improve the operation of their units because any increased generation resulting from improvements in efficiency by an individual allottee will be shared on a percentage basis among all allottees. The Bureau told us, however, that it had been successful in encouraging changes in equipment which improved efficiencies. These physical changes took place before 1971 and are reflected in the efficiency percentages cited in this report.

HOW EFFICIENCY CAN BE IMPROVED

If Hoover were operated as a system under one operator, several smaller loads being carried on individual generators could be combined on the smallest number of generators needed to serve the combined loads. Additionally, if each allottee were carrying a lighter load to provide spinning reserves, spinning reserves of individual allottees could be combined and those generators¹ best suited for this function could be used, thus conserving water and increasing overall efficiency. Under a system operation more energy could be produced and each allottee would receive its percentage share of the increased energy.

Bureau regional officials told us that the Bureau could not make unilateral changes in operating methods at Hoover and that agreements among the allottees and the Secretary would be required before the operating procedure could be revised.

BENEFITS OF POTENTIAL IMPROVEMENTS

During the 3-year period 1972 to 1974, the Hoover powerplant averaged about 3.3 billion kilowatt-hours annually, operating at 74.5 percent efficiency. If the Hoover powerplant were operated as a single system and obtained an efficiency level comparable to that being obtained at Glen Canyon, the efficiency would be increased about 8 percent. An 8-percent increase in efficiency could represent a 10.7-percent ($8/74.5 = 10.7$ percent) increase in the number of kilowatt-hours generated, or 353.1 million kilowatt hours of electricity.

¹Some generators have special "tailwater depression equipment" which enables the generators to spin more efficiently.

This additional energy potential could reduce fossil fuels consumed. For example, from an oil conservation standpoint, this energy could displace (at 60 kilowatt-hours a barrel) 588,000 barrels of oil. At a cost of \$10.50 to \$14 a barrel, this could represent annual savings in equivalent barrels of oil of about \$6.2 to \$8.3 million, or \$72 to \$96 million over the remaining life of the present contract for the operation of the Hoover powerplant.

Furthermore, on the bases of current energy rates of 1.757 mills a kilowatt-hour, the additional energy could provide increased revenues to the U.S. Treasury of about \$620,400 a year, or \$7.24 million between October 1, 1975, and May 31, 1987.

Put into perspective, this 353.1 million additional kilowatt-hours of electricity would supply the residential needs of an average U.S. city of 130,000 residents for a 1-year period.¹

We discussed our findings and conclusions with Bureau regional officials and they agreed with our conclusion that an additional 8-percent efficiency could be achieved if the Hoover powerplant were operated as a system. They also agreed that this could result in a 10.7-percent increase in annual generation, or 353.1 million additional kilowatt-hours of electricity.

Also we discussed our findings and conclusions with an official of the city of Los Angeles Department of Water and Power and with an official of the Edison Company--the present operators of the Hoover powerplant. These officials agreed with our conclusions that the potential existed for increased operating efficiency of the Hoover powerplant. The Edison Company official said that the areas we discussed should be investigated because of the potential for increasing hydroelectric energy and thus contribute to the company's program for reducing oil consumption and pollution. Both operating officials said that they would be receptive to entering into negotiations with the Bureau with the objective of improving the operating efficiency of the Hoover powerplant. They pointed out, however, that any suggested changes should consider the benefits to be derived compared

¹Based on average use of 8,079 kilowatt-hours for each customer--Total Electric Utility Industry (source: Edison Electric Institute Yearbook for 1973)--and three persons for each residence, per 1970 census data updated.

to the costs to be incurred. We agree that, before any action is taken, such analysis should be made.

RECOMMENDATIONS

we believe that by improving the efficiency at the Hoover powerplant, considerable opportunity exists for reducing consumption of fossil fuels. Therefore, we recommend that you instruct the Commissioner, Bureau of Reclamation, to:

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--Meet with the allottees and ascertain the reasons for present levels of efficiency.

--Discuss with the allottees methods for improving overall efficiency and the benefits to be derived and costs to be incurred therefrom.

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--Offer assistance to the allottees in drawing up agreements which will allow them the same allocations but with increased total amounts of energy, by allowing the Hoover powerplant to be operated as a system, either under one operator or through coordinated efforts of the present two operators.

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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 and Senate Committees on Government Operations 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 appropriation made more than 60 days after the date of the report.

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We are sending copies of this report to the Director, Office of Management and Budget; appropriate congressional committees; your Commissioner of Reclamation; and the Regional Director of the Bureau's Lower Colorado Region.

We appreciate the cooperation received during our review and would like to be informed of any action taken

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on our recommendations. We would be glad to discuss this report with you or your staff.

Sincerely yours,

Henry Eschwege

Henry Eschwege
Director