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ENERGY AND MINERALS  
DIVISION

November 18, 1981

B-202377

The Honorable Richard L. Ottinger  
Chairman, Subcommittee on Energy  
Conservation and Power  
Committee on Energy and Commerce  
House of Representatives

Dear Mr. Chairman:

**Subject: The Costs and Benefits of Alternative Funding  
Levels for the Department of Energy's Light  
Water Reactor Improvement Program (EMD-82-16)**

Your September 30, 1981, letter requested our comments on information provided to you by the Department of Energy on the benefits and costs of continuing funding for its Light Water Reactor Improvement Program. Subsequently, your office directed that we also comment on the testimony of Government and nuclear industry representatives at a hearing conducted jointly on October 6, 1981, by your Subcommittee and the Subcommittee on International Economic Policy and Trade of the House Committee on Foreign Affairs.

Overall, we found the Department's approach to projecting future program costs and benefits to be reasonable. In our opinion, projected future costs and benefits are presented fairly. Our review of the Department's analysis showed that the potential economic benefits to utility rate payers are substantially greater than the cost of continuing the program. Despite these benefits, however, the program may not be funded after fiscal year 1982 because of the current administration's policy to fund only high-risk, long-term research programs. The potentially large benefits raise a question about whether the program should be discontinued simply because it does not fall among the high-risk, long-term research programs being given priority. Any decision to phase out or continue the program--and if so, at what level of funding--should carefully consider (1) the potential budgetary costs, (2) the potential benefits and beneficiaries, and (3) the probability that utilities or the nuclear industry will not be able to continue the program at a pace consistent with the Department's schedule.

OBJECTIVE, SCOPE, AND METHODOLOGY

Our objective was to evaluate--based on information obtained in preparing an earlier report on the Department's Light Water Reactor Improvement Program 1/--the Department's cost-benefit analysis and the testimony of Government and industry witnesses. In meetings with Department officials, we reviewed the detailed analysis and supporting information used in preparing the cost-benefit analysis and other responses to the Subcommittee's pre-hearing questions. We evaluated the Department's support for its analysis, but did not develop our own independent cost and benefit estimates.

In evaluating the program costs and potential benefits, we examined the following four alternative program funding levels.

--Alternative I would phase out the ongoing program work by 1985 at a cost of \$7-8 million (about \$6 million spent in fiscal year 1983 and \$1 million in fiscal years 1984 and 1985).

--Alternative II would continue work already under contract at a full cost of \$20 million. Under this option, work on existing contracts would continue through fiscal year 1989, but the Department would not have the flexibility to enter into new contracts.

--Alternative III would allow for the full demonstration of major near term improvements--extended burnup fuel and low leakage fuel management technologies--at a full cost of \$33 million. This option would give the Department the flexibility to terminate existing contracts and/or award new contracts.

--Alternative IV would allow for full demonstration of all the near and mid-term light water reactor improvements which can be retrofitted into current generation nuclear powerplants. At a full cost of \$140 million, this option is closest to continuation of the program as originally envisioned by the Carter Administration.

We developed alternatives I and II from information submitted to your Subcommittee by the Department on September 30, 1981; alternatives III and IV were developed from the Department's cost-benefit analysis prepared in response to a request made at the October 6, 1981, hearing, and submitted to your Subcommittee on October 26, 1981.

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1/"Department of Energy Light Water Reactor Fuel Utilization Improvement Program," EMD-81-51, Mar. 23, 1981.

**BACKGROUND**

The Light Water Reactor Improvement Program was a keystone in the Carter Administration's policy of deferring the use of nuclear fuel reprocessing and breeder reactor technologies. The objectives of the program were to demonstrate technologies that could lower the uranium fuel requirements of conventional nuclear powerplants 15 percent by 1988 and 30 percent by the year 2000. Most of these technologies were not new but were extensions of existing technologies which, if developed, could be used in nuclear powerplants now operating or under construction. Some, however, would require changes in reactor design of such extent that they could, if developed, only be used in future plants. Prior to the recent change in administrations, Department officials anticipated continued program funding at levels roughly equivalent to \$20 million per year in 1980 dollars.

The current administration, however, has made a major change in the direction of the Nation's energy policy. Current policy is to fund only long-term, high-risk research programs. Other programs are being phased out or terminated because the administration believes that market forces will result in continued support from the private sector for worthwhile programs. In keeping with this policy, the fiscal year 1982 budget of the Department's Light Water Reactor Improvement Program has been reduced from \$16.6 million to \$11.25 million. Whether the program will be supported in the future is uncertain. Official Department budget documents show no budget authority after fiscal year 1982.

Independent of the budget reduction, the Department also narrowed the focus of its program by eliminating the development of fuel improvement technologies which cannot be used in nuclear powerplants now operating or under construction. Thus, the program as refocused would demonstrate only those near and mid-term technologies that could be used in existing nuclear powerplants and are more likely to be implemented by the nuclear industry. If completed and fully implemented for the purpose of saving uranium fuel, the refocused program could result in fuel savings somewhere between 15 and 30 percent.

We completed a detailed evaluation of this program--as it was being conducted by the prior administration--earlier this year. We concluded among other things that the

--Department's 1988 goal of 15 percent improvement was reasonable. Much of the Department's short-term demonstration program consists of proving that existing fuel can be used longer and developing new fuel savings designs and other improvements.

--implementation by the nuclear industry of fuel saving technologies developed by the Department was uncertain. Rather than saving uranium fuel, many utilities would probably use the technologies to accomplish their own economic objectives of minimizing power generation costs.

--Department's program was adequately structured to identify and resolve technical and regulatory problems related to the specific demonstrations now underway.

COSTS AND BENEFITS OF  
CONTINUED PROGRAM FUNDING

In calculating the costs and benefits achievable under this program, the Department made assumptions about the future growth in the commercial nuclear power industry, the rate at which industry would implement demonstrated improvements, and many other technical and cost factors. It is important to recognize that cost-benefit analyses by their nature are a collection of estimates and assumptions. This is their inherent limitation. In evaluating the Department's analysis, we examined the basis for these estimates and the underlying assumptions. In some cases the Department relied on published reports, in other cases it made intentionally conservative assumptions.

As we pointed out in our earlier report, it is uncertain how utilities and the nuclear industry might implement technologies developed by the Department. Thus, there is also a corresponding uncertainty attached to any estimates of potential program benefits. Recognizing this inherent uncertainty, we believe the Department's approach for projecting future program costs and benefits to be a reasonable one. In our opinion, the Department's underlying assumptions about how utilities and industry might implement demonstrated technologies are reasonable and--with the possible exception of the benefits reported for alternative II--the projected costs and benefits of each option are presented fairly. The table on page 5 shows the costs and benefits as well as the cost-benefit ratios, for each of the alternatives we examined.

According to Department program officials, under alternative I insufficient improvements will have been demonstrated for the Department to take credit for any future benefits that might be realized if the nuclear industry continued the program on its own initiative.

The potential benefits under alternative II may be overstated. Department officials told us that because the program's existing contracts involve only the smaller nuclear fuel suppliers, industry-wide benefits are difficult to quantify. Thus, the rate and extent to which major suppliers and utilities would implement demonstrated improvements is uncertain. The Department's \$6.3 billion in estimated

**COSTS AND BENEFITS OF FUNDING ALTERNATIVES FOR THE  
DEPARTMENT'S LIGHT WATER REACTOR IMPROVEMENT PROGRAM**

<u>Funding alternative</u>	<u>Full cost of each alternative beyond FY 1982 (note a)</u>	<u>Benefits expressed as savings through year 2000 (note a)</u>	<u>Cost-benefit ratio</u>
I - Phase-Out	\$7-8 million (thru FY 1985)	none	none
II - Complete Ongoing Work	\$20 million (thru FY 1989)	\$6.3 billion (note c)	1:315
III - Full Demonstration of Major Near Term Improvements (note b)	\$33 million (thru FY 1989)	\$12.7 billion	1:385
IV - Full Demonstration of All Near  and Mid Term Improve- ments	\$140 million (thru FY 1992)	\$17.7 billion	1:126

a/Constant 1981 dollars.

b/The two major near term improvements are extended burnup fuel which can be burned longer than conventional fuel and low leakage fuel management which reduces the number of neutrons escaping or "leaking" from nuclear powerplant cores.

c/The \$6.3 billion is not an official departmental projection, but a program official's estimate of the cost savings derived from departmental information suggesting that about three-fifths of the program's original 15 percent uranium utilization goal would be realized under this option.

benefits therefore is very optimistic, but may be achievable with full utility and nuclear industry implementation. Further, as noted on page 5, the \$6.3 billion is not an official departmental projection, but a program official's estimate of the cost savings derived from departmental information suggesting that about three-fifths of the program's original 15 percent uranium utilization goal would be realized under this option. These uncertainties make the estimated benefits of this alternative less supportable than those projected for the other alternatives in which the major suppliers and utilities would be involved and the rate of implementation more certain. Therefore, the high cost-benefit ratio of 1:315 may not be realistic.

Under alternative III, near term improvements in uranium utilization totaling about 15 percent would be demonstrated by the end of fiscal year 1989, at a full cost of \$33 million. The potential costs and benefits associated with this option--which has the highest cost-benefit ratio of the four alternatives--are more certain because the technologies being demonstrated under this option have the greatest near term potential for improving uranium utilization and are of the most interest to public utilities.

Alternative IV would demonstrate all near and mid-term light water reactor improvements that can be retrofitted into current generation nuclear powerplants. With full funding, the technologies included under this option would take until 1992 to demonstrate. Although industry is interested in these improvements, the extent to which uranium utilization would be improved under this option is less certain than is the case under Alternative III largely because it would be attempting to demonstrate longer term improvements and more risk is involved. Thus, the incremental improvements cost more, take longer to demonstrate, and offer fewer benefits over and above the potential benefits of Alternative III. This is not to say the benefits are not substantial, nor to imply that demonstrating them may not be worthwhile. It merely points out that it will cost relatively more to attain these additional potential benefits.

The fiscal year 1982 budget provides \$11.25 million for the Light Water Reactor Improvement Program, but Department budget documents show no budget authority after this fiscal year. Whether the program will be funded in the future--and, if so, at what level--has not been decided. The issue is currently being debated by the Department and the Office of Management and Budget.

Two observations can be made from the Department's cost-benefit analysis. First, the potential benefits to utility rate payers of continuing the program clearly outweigh the program's cost. Second, the incremental cost of going one step further is minimal for the first three alternatives. For example, the

difference between the cost of phasing out the program (alternative I) and funding the full demonstration of major near-term improvements (alternative III) is only \$25 million, but the potential benefits of alternative III are estimated by the Department to be \$12.7 billion by the year 2000. Going one step further to the fourth alternative, however, is estimated to cost another \$107 million with another \$5 billion in potential cost savings. This alternative has the highest technical risks, would take the longest period of time to demonstrate, and thus is the least likely to be achieved.

COMMENTS ON THE TESTIMONY OF  
GOVERNMENT OFFICIALS AND  
INDUSTRY REPRESENTATIVES

On October 6, 1981, at a joint hearing before your Subcommittee and the Subcommittee on International Economic Policy and Trade, House Committee on Foreign Affairs, Government and industry witnesses testified on the economic, resource, and security implications of improved uranium efficiency achievable under the Department's Light Water Reactor Improvement Program.

The views on the economic implications of successful completion and industry implementation of the Department's program were, in our judgment, the most significant part of all of this testimony. The thrust of the testimony on economic implications was that the potential benefits of the Department's program far exceed its costs and those benefits would largely accrue to utility rate payers, but lack of continued Federal funding will dramatically slow, if not stop, realization of the potential benefits.

We generally agree with these views because they are consistent with what we found in our earlier evaluation of the Department's Light Water Reactor Improvement Program and in other recent work of our Office. From our earlier evaluation of the Department's program, for example, we concluded that the potential program benefits are substantial enough--particularly in the area of reducing the number of times reactors must be shut down for refueling--to provide economic incentives for utilities to implement fuel utilization improvements. We also found that there are other potential benefits not included in the Department's cost and benefit projections discussed earlier. For example, if successful, the program could lead to

--less spent fuel to store and eventually dispose of as either spent fuel or reprocessed high-level wastes;

--lower total radiation exposure to nuclear powerplant workers if, as envisioned, the program leads to a

general reduction in fuel failures and longer operating cycles between refueling outages;

--safer, more reliable nuclear powerplant operations resulting from improved fuel integrity and performance; and

--reduced uranium enrichment requirements, thereby reducing the Department's enrichment plant capacity requirements.

Furthermore, utilities are generally required to pass fuel costs--including fuel cost reduction or increases--on to rate payers through mechanisms such as fuel cost adjustments to rate payers' bills. Therefore, the potential economic benefits from industry implementation of demonstrated improvements would be passed on to utility rate payers in the form of lower costs.

Finally, based on our earlier evaluation and other work, we agree with industry representatives' position that it is questionable whether industry will continue the Department's program at its current pace without continued Federal funding. Industry representatives pointed out that light water reactor fuel improvement developmental costs are sizeable, and that there are some performance risks to be overcome. Continuation of the program without Federal funding would mean that these costs and risks would have to be assumed by the utilities but, as noted above, the potential economic benefits must be passed on as savings to rate payers. Perhaps more importantly, they also pointed out that most utilities have found it difficult to secure rate relief from state regulatory commissions, thereby making it unlikely that sufficient research and development funds would be available for utilities to fully fund the program in lieu of the Department.

In a recent report we prepared at the joint request of the Chairman, House Committee on Science and Technology and the Chairmen of three of that Committee's subcommittees, we pointed out some of the above constraints on substituting utility funding for Federal funding of selected non-nuclear electricity-related research and development projects. 1/ In that report, we stated that an assumption that the electric utility industry would continue research previously funded by the Federal Government did not consider factors unique to the electric utility industry. Three of these factors were

--rates-of-return are governed by public utility commissions, and therefore profits do not necessarily reflect risks as in the case of non-regulated industries,

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1/"Analysis of Federal Funding for Electric Utility R&D Projects," EMD-81-145, Sept. 28, 1981.



--many State utility commissions do not permit research and development in the utility rate base, and

--financial problems facing the industry and its inability to generate capital funds for expansion make additional R&D funding even more difficult.

Based on that work, we tend to agree that the potential benefits of the Light Water Reactor Improvement Program, even as refocused to concentrate on near and mid-term technologies which can be used in existing nuclear powerplants, may not be realized without continued Federal funding.

### OBSERVATIONS AND CONCLUSIONS

Industry implementation of demonstrated improvements under any of the three alternatives for continuing Federal funding for the Light Water Reactor Improvement Program could result in \$6.3 billion to \$17.7 billion in lower electric power generating costs by the year 2000. These benefits, if realized, would largely accrue to utility rate payers. On the other hand, the new administration's energy research and development policy is to emphasize only long-term, high-risk, but potentially high-payoff research and development while terminating larger technical demonstrations. The administration believes that large demonstrations and development of commercial applications should be left to the private sector. The Department's program, as currently focused, concentrates on extending existing technologies rather than developing new ones.

In deciding on future funding for the Department's Light Water Reactor Improvement Program within the context of the administration's energy research and development policy, there are two important issues which need to be considered. First, there are as yet no specific definitions of what constitutes "long-term, high-risk, and high-payoff" research and development. In an earlier report, we found that major synthetic fuels program reductions have come from phasing out pilot plants and eliminating demonstration efforts, without a review of the remaining research and development efforts based on specific criteria or their relationship to eventual commercialization of advanced processes. 1/ We recommended that the Secretary of Energy establish specific definitions for long-term, high-risk, high-payoff programs and direct that they be consistently applied to funding current and future research and development projects. As of November 17, 1981, the Secretary had not told us whether or not he intends to act on our recommendations.

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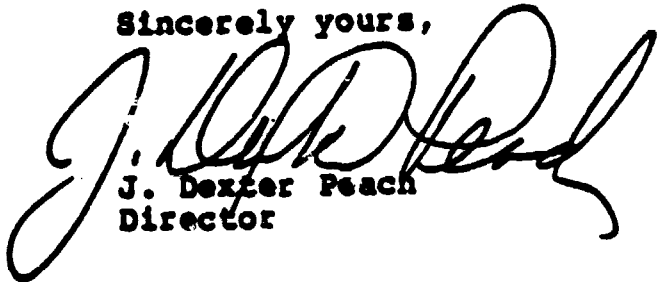
1/ "Unresolved Issues Resulting From Changes In DOE's Synthetic Fuels Commercialization Programs," EMD-81-128, Aug. 17, 1981.

Second, Federal policy toward electric utility research and development projects may have to be viewed in a different context than the rest of the private sector because of unique factors affecting electric utilities. Therefore, individual projects and programs need to be carefully evaluated before they are discontinued. The Department's Light Water Reactor Improvement Program is no exception.

It is not yet clear to us whether the Department will phase out or continue this program--and if so, at what funding level. Certainly, the potential benefits of the program raise a question about whether the program should be dismissed simply because it may not fall among the high-risk, long-term research programs being given priority under the new administration's energy policy. Any future decisions on phasing out or continuing the program--and if so, at what level of funding--should carefully consider (1) the potential budgetary costs, (2) the potential benefits and beneficiaries, and (3) the probability that the nuclear industry will not be able to continue the program at a pace consistent with the Department's current schedule.

As arranged with your office, we will not release this report to other interested parties for 15 days unless you publicly announce its contents before that time.

Sincerely yours,



J. Dexter Peach  
Director