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

ENERGY AND MINERALS
DIVISION

B-198431

APRIL 27, 1981

The Honorable James B. Edwards
The Secretary of Energy



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Dear Mr. Secretary:

Subject: Concerns Over Efforts to Put in Place a
Permanent Facility for the Solar Energy
Research Institute (EMD-81-68)

The General Accounting Office has completed a review of the Department of Energy's (DOE's) efforts to put in place a planned permanent facility for the Solar Energy Research Institute (SERI) in Golden, Colorado. During our review we noted that about \$3 million has been spent over a 2-year period on designing the facility without (1) the benefit of a clearly defined role for SERI in the national solar program and (2) long-range requirements for the use of the SERI facility. The result is a lack of assurance that DOE can put in place a facility which meets DOE's needs.

As this report was nearing completion, DOE took needed actions to defer design work on the permanent facility pending its reassessment of the role and mission of SERI and a determination of the size and cost of the project. We agree with this decision and believe that these actions should help ensure that DOE puts in place a facility which meets its needs.

There are two matters, however, which give us additional concern and which need immediate attention. First, we are concerned that future design efforts may not take into consideration, to the extent practicable, the requirements for the use of the facility over its estimated life. Second, further design efforts of a field experiment test area and its associated support facilities, both of which are part of the total proposed permanent facility complex should not proceed without adequate justification. We therefore offer a number of recommendations which you should implement to resolve these concerns.

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BACKGROUND AND STATUS

The creation of SERI was authorized over 6 years ago by the Solar Energy Research, Development, and Demonstration Act of 1974 (Public Law 93-473, Oct. 26, 1974). The purpose of the act was, in part, to establish a vigorous Federal program of solar research, development and demonstration (RD&D) to ensure the use of solar energy as a viable source for meeting the Nation's energy needs. Section 10(a) of the act authorized SERI's establishment and provided that it perform research, development, and other functions necessary to achieve the purposes and objectives of the act. DOE subsequently designated SERI as its lead institute for solar RD&D.

SERI began operations in July 1977 in leased office buildings with a staff of 50 and a budget of approximately \$7 million. Staff and funding have increased substantially since then with a fiscal year 1981 staff of about 780 and a total budget of over \$100 million.

Additional leased office buildings were obtained and converted to laboratory use early in 1979. According to DOE and SERI officials, much of SERI's present and future work can be accomplished in these leased buildings. However, DOE and SERI officials believe that these buildings limit SERI's ability to fulfill its objectives because they were built as offices, not laboratories. They added that many costly modifications must be made to use these buildings as laboratories. Therefore, DOE supports the construction of a permanent facility.

In this connection, the State of Colorado in 1977 offered 300 acres of land to the Federal Government for the construction of such a facility. The State stipulated that it will transfer title to the land, which is about 2 miles from the present buildings, when the Federal Government has developed a construction schedule and has funds available for design and construction, but not later than April 1, 1982.

An architect-engineer (A-E) was selected in October 1978 to design the facility. Design of major DOE construction projects usually flows through conceptual, preliminary, and detail phases. The A-E's conceptual design, completed in August 1979, called for an 80-percent energy self-sufficient facility housing about 1,000 persons. It was expected that construction would be completed near the end of 1982 at a cost of \$127 million. The high degree of energy self-sufficiency depended on using active and passive solar energy systems and energy conservation techniques.

DOE authorized the A-E to begin work on the preliminary design in December 1979. Under a directive from the DOE Under Secretary, which was to guide this effort, the cost was limited to \$98.5 million. To accommodate this cost reduction, DOE decided that some of the active solar systems would be eliminated, thereby reducing the energy self-sufficiency from 80-percent to 50-percent. The preliminary design, completed in July 1980, called for a single, integrated laboratory/office facility with demonstrations of solar and conservation features not found in conventional buildings. The A-E then anticipated construction would be completed near the end of 1983.

DOE's analysis of the preliminary design raised several concerns. Technical reviews revealed that a number of key energy systems incorporated into the design had not been tested on a full-scale operational basis and might not work. For example, the glass-enclosed solar courtyards and an energy storage system using a rockbed had never been tested together in a facility as large as the one designed for SERI. DOE was also concerned that these energy systems significantly reduced the usable space. In addition, cost analyses by DOE showed most of the energy systems reduced energy consumption below that of more conventional facilities but would not be cost-effective. For example, the passive energy systems were expected to cost \$1.6 million more than they would save in energy costs over a 25-year period.

Although DOE concluded that the A-E's conceptual and preliminary designs met DOE's original design requirements and other guidance, DOE's Energy System Acquisition Advisory Board 1/ met in November 1980 to consider whether the design effort should proceed to the detailed design phase, given the problems noted. As a result of its review and recommendations, the DOE Under Secretary directed that, due to the high cost estimates, questions regarding the relative value of the integrated facility, and the inclusion of energy systems which were not cost-effective, a new conceptual design should be developed for a less expensive, more conventional SERI laboratory and office facility. He also directed DOE to assume direct management of design and construction, a function SERI had been performing. The Under Secretary recognized that DOE had inadequate control over the project. He further stipulated that the new facility should cost no more than \$75

1/ The Board is an organization of key DOE officials that monitors the progress of major construction projects.

million, which includes \$3.4 million already spent on the first design and \$2 million already spent on laboratory equipment.

As a result of the Under Secretary's decision, DOE contracted with the A-E in December 1980 for a more conventional design incorporating cost-effective energy systems. To house the originally estimated 1,000 persons, the new facility was to be designed and constructed in phases. Construction was expected to start in late 1981, with initial occupancy anticipated in mid-1982 and final occupancy slipping further to the end of 1984. DOE expected the A-E to complete the new conceptual design by the end of March 1981, and, based upon its approval, to start on the new preliminary design in April 1981. However, as already noted, further work on the design has been deferred.

ACTIONS NEEDED PRIOR TO
PUTTING IN PLACE A PERMANENT
FACILITY FOR SERI

A clearly defined role for SERI and long-range requirements for the use of the SERI facility are needed to ensure that a facility is designed, and ultimately constructed, which meets DOE's needs. Additionally, adequate justification should be developed before proceeding with further design efforts on the experiment test area and support facilities, both of which are part of the total proposed permanent facility complex.

Need for a clearly defined
role and long-range require-
ments for the use of the
SERI facility

Although SERI began operations over 3 years ago, DOE has not clearly defined SERI's role in the national solar program nor developed long-range requirements for the use of the facility. We have previously reported on DOE's lack of a clearly defined role for SERI in the national solar program. ^{1/} We reported that, although DOE designated SERI as the Nation's primary institute for solar RD&D and the Congress intended SERI to serve as a focal point for solar RD&D, SERI did not have major

^{1/} Solar Energy Research Institute and Regional Solar Energy Centers: Impediments to Their Effective Use (EMD-80-106, Aug. 18, 1980).

responsibilities in many areas of the national solar program. We reported that, of the eight solar technology areas, 1/ SERI had lead responsibility in only one (active solar heating and cooling RD&D) and in only selected portions of four others (photovoltaics, wind, solar thermal, and ocean energy systems). For the most part, SERI appeared to be supporting overall efforts performed by DOE or other national laboratories in the other remaining areas. There are major areas of individual technologies, however, such as systems engineering in photovoltaics, in which SERI has virtually no responsibilities.

DOE officials stated at that time that SERI's lead center role was still evolving, and that they expected SERI to assume more of a focal point role in the future. However, we noted that DOE seemed to make little effort to bring this about and that DOE program managers were left to decide whether SERI would have responsibilities for certain program areas. For instance, one program manager stated that in his view SERI was just another contractor, while other program managers stated that SERI does not necessarily have the management capability to be the focal point for all of the solar program areas.

The lack of a clearly defined role for SERI is still causing confusion regarding its lead responsibilities. This is evidenced in DOE's November 1980 and January 1981 reviews of the SERI Institutional Plan for fiscal years 1981-1986. In November 1980, a DOE official at SERI stated that the existing lead missions listed in this plan have been given to SERI with varying degrees of official sanction. He added that it was essential for DOE to clarify SERI's exact authority and responsibility concerning its existing and proposed lead missions. In January 1981, DOE headquarters had to inform SERI that it did not have lead responsibility for two areas in the biomass energy systems program and had not been authorized to work in another biomass area. This confusion over existing and proposed future responsibilities for SERI raises serious questions concerning how a facility for SERI could be designed without first establishing SERI's role.

The Office of Management and Budget (OMB) has also been concerned with the SERI role and planned facility. In July 1980, OMB requested from DOE a

1/ The eight solar technology areas are: photovoltaics, biomass, wind, solar thermal, ocean energy, active heating and cooling, passive solar, and industrial heat.

"* * * clear definition of the SERI mission, the type and scale of activities SERI must perform to accomplish this mission, and the building requirements and staff size this implies."

DOE was asked to "* * * indicate how the recommended facility * * * is the minimum required to fulfill SERI's mission."

In its August 1980 response to OMB on the justification for a permanent SERI facility, DOE cited in general terms SERI's role in the solar program. It stated

"SERI is DOE's lead institution for solar energy research, development and demonstration * * *. It is intended that SERI have sufficient staff, laboratory facilities, and test equipment to perform essential work * * *."

OMB officials told us that the response was too general to assist them in judging the necessity, size, or specific laboratory requirements of the permanent facility. The DOE response did not include what DOE considered to be SERI's future role in the national solar program and the corresponding specific laboratory requirements that should be incorporated in the facility design. OMB stated that these requirements should have been identified in order to adequately justify the facility.

During our review DOE officials told us that they were designing the facility based on SERI's general mission requirements and on SERI's present programs and anticipated program requirements through fiscal year 1984, the year the project would be completed. We noted that for these years there is still disagreement between DOE and SERI over requirements in SERI's proposed operating plan regarding funding, staffing, and the amount of work to be done in-house at SERI versus the amount to be contracted out. We were concerned that DOE was designing a facility without having these basic items resolved.

In the area of funding, DOE officials told us that SERI's funding projections for these years are too high and should be the same amount as fiscal year 1981 funds. SERI has based its funding for these years on a 10-percent per year increase. This, DOE said, impacts on all programs in the plan and needs to be revised.

Concerning staffing, DOE officials told us that SERI's staffing projections for these years were based on previously

established maximum personnel ceilings. DOE informed SERI that these levels are permissible only when program activities justify such staffing, and that this, coupled with the need to plan on the same funding for these years as in 1981, may require staffing adjustments in SERI's plan.

DOE officials also told us that SERI needs to carefully consider its subcontracting versus in-house activities in light of the above funding and staffing changes. DOE officials expect that the percentage of in-house work will increase, but they could not tell us to what extent. The expected amount of work to be accomplished in-house compared to that contracted out is of course an important factor in projecting facility needs.

DOE officials told us, however, that the phased design and construction of the facility should provide the flexibility to accommodate any future changes in SERI's activities. While the phased approach to design and construction should offer the flexibility to accommodate future changes in SERI's activities, we believe, that the uncertainty existing over SERI's funding, staffing, and in-house versus subcontracting work demonstrates the need to clearly define SERI's role and identify, to the extent practicable, long-range requirements for the use of the facility.

Conclusions and recent budgetary initiatives

Work has continued on the SERI facility design in spite of DOE's lack of a clearly defined role for SERI in the national solar program and a lack of information on the RD&D and administrative requirements associated with the use of the facility over its expected life. We are concerned that until DOE clarifies SERI's role and identifies long-range requirements for the facility's use, there will be little basis for ensuring that further design efforts will adequately and effectively meet DOE's anticipated solar RD&D needs. Therefore, we believe no further efforts aimed at putting in place a permanent facility for SERI should be undertaken at this time. Instead, DOE should first clearly define SERI's role in the national solar program and identify, to the extent practicable, anticipated requirements over the life of the facility. These requirements should be set forth in a long-range plan for SERI's use.

These actions should be completed before proceeding with any further design work. DOE should, however, be mindful of the April 1, 1982, deadline and other requirements imposed

by the State of Colorado for transferring to the Federal Government title to the land upon which the facility is to be located. DOE, therefore, will want to complete these actions as soon as possible.

As our report was nearing completion, the administration took several actions which impacted on DOE's efforts to put a permanent facility in place. In early February 1981, OMB reviewed DOE's budget request for fiscal year 1982 and recommended that a decision on construction be deferred until SERI's mission is better defined and appropriate staffing is agreed upon. On February 18, 1981, the administration proposed a number of major reductions for the fiscal year 1982 budget. Among these was a \$360 million cut in solar energy funds. If this is carried out, it could have a significant impact on SERI's role and activities and correspondingly on the type and size of facility needed to carry out these activities. DOE subsequently revised its fiscal year 1982 budget request for the permanent facility to reflect a decision deferring future design work until its Office of Field Operations and International Programs reassesses the role and mission of SERI and determines the size and cost of this project. As a result, DOE was not requesting fiscal year 1982 funds for constructing the facility.

DOE's decision to defer design work until the Office of Field Operations and International Programs completes its assessment of SERI's role and mission should help to ensure that a facility is designed, and ultimately constructed, which meets DOE's needs. However, we remain concerned that future facility design efforts may not take into consideration the requirements for the use of that facility over its estimated life. We continue to believe, therefore, that those requirements should be identified--to the extent practicable --and considered in any further design efforts.

The administration's recent budgetary initiatives, however, raise an additional matter with which we have concern. Although no fiscal year 1982 funds are being requested for constructing the facility, DOE officials told us that design work will be completed and construction, upon approval, will be initiated in fiscal year 1981 on part of the permanent facility complex--a field experiment test area and its associated support facilities--with the remaining \$9.5 million of the \$14.9 million appropriated to date for the project. The experiment test area and support facilities, although expected to be located a short distance from the main facility, are nonetheless part of the permanent facility project. The purpose and projected costs of the experiment test area and

support facilities were included as part of the justification for the total facility project. The planned experiment test area is to include a field test laboratory building and space for indoor as well as outdoor solar experiments. The support facilities are to include a building and other structures for carrying out maintenance work; shipping, receiving, and storing activities; and related office functions. We were concerned that the conceptual design of the experiment test area and associated support facilities, however, was proceeding (1) prior to DOE's completing its assessment of SERI's role and mission, (2) without identifying long-range requirements for the facility's use, and (3) in the face of recently proposed sizable reductions in solar energy funds.

When we asked DOE to justify this, DOE officials told us that the test area is needed as soon as possible because the present leased buildings are not adequate for experiments without costly modifications. They added that some major modifications have been deferred pending placement of new experiments at the test area. They also told us that although the test area and support facilities will be designed to support specific SERI program requirements, they will be very basic and flexible and could be adapted for any RD&D role DOE eventually assigns to SERI.

We agree that the present situation involving leased office buildings at SERI is less than ideal and that there are many problems related to this situation. Modifications to the buildings are being made so that laboratory experiments can be carried out. These modifications have not always resulted in satisfactory laboratory space and, in some cases, safety and health hazards have been created. In addition, it is probable that DOE will have to restore this space to its original condition when the leases run out.

However, recognizing that additional justification was needed in light of recent budgetary initiatives, DOE in a letter dated March 11, 1981, informed SERI that because space requirements for the experiment test area and support facilities were established prior to the new DOE fiscal year 1982 budget submission, a new justification was needed. DOE stated that the justification:

"* * * must answer: (1) specifically what the space will be used for, (2) what source of funding will be used to support the proposed use (the source of funding should be identified by specific DOE or other agency program), and (3) why the present leased space is not suitable for the proposed use."

DOE also stated that the new justification was needed to help respond to inquiries as to why DOE was proceeding with design efforts at this time.

A DOE official informed us that DOE's final approval to construct the experiment test area and support facilities will depend largely on whether headquarters program managers agree with SERI's proposed use of the experiment test area. The DOE official stressed that in the interim, related design efforts should continue in order to make possible an early commitment to build the test area and support facilities. According to this official, in this way, DOE can ensure adequate space for needed experiments and better ensure meeting the State of Colorado's deadline and other requirements for transferring title to the land.

While we remain sympathetic to SERI's efforts relating to the design and construction of the experiment test area and support facilities, we believe that no further design efforts should be undertaken until they are justified. The justification should spell out the specific rationale for why the experiment test area and related facilities are needed, and specifically include SERI's requirements for the test area and DOE headquarters program managers' formal approval of SERI's requirements. In essence, we believe the key to making an early commitment to constructing the experiment test area and associated support facilities is the development and approval of justification which adequately presents the rationale for why such construction should proceed. Any such construction ultimately undertaken, however, should be based on a design that is sufficiently flexible to accommodate whatever role, mission, and long-range requirements are ultimately determined for SERI.

Recommendations

To ensure that a permanent facility for SERI is designed and ultimately constructed to meet DOE's needs, you should direct that further efforts aimed at putting such a facility in place are not undertaken--with the exception of the experiment test area and support facilities--until SERI's role in the national solar program is clearly defined and the best information available is considered in identifying the long-range requirements for the use of that facility over its estimated life. In this connection, we recommend that you:

- Monitor the Office of Field Operations and International Programs' assessment of the role and mission of SERI to ensure that it is done in a timely manner

and results in a clear definition of SERI's role in the national solar program.

- Identify, to the extent practicable, the RD&D and administrative requirements for the facility over its estimated useful life and incorporate those requirements in a long-range plan for the facility's use.

With respect to the construction of the experiment test area and support facilities, we recommend that you:

- Defer related design and construction until such efforts are justified.
- Give high priority to ensuring this justification is prepared and approved in a timely manner, taking into consideration the inadequacies of the leased facilities presently being used for carrying out SERI's activities and any advantage that an early commitment to such construction may offer in meeting Colorado's deadline and other requirements for transferring title to the land on which the facility is to be located.

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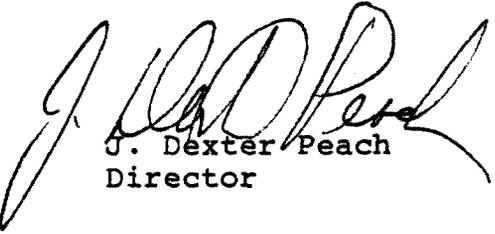
As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Operations not later than 60 days after the date of the report, and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We discussed the matters contained in a draft of this report with DOE officials. While they generally agreed with the recommendations, they believed that the phased approach to designing and constructing the permanent facility and the conceptual design for the facility offered sufficient flexibility to accommodate whatever role and mission are ultimately determined for SERI. We appreciate the courtesy and

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cooperation extended to our staff during this review and would appreciate being informed of actions you take on our recommendations.

Sincerely yours,



J. Dexter Peach
Director