



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

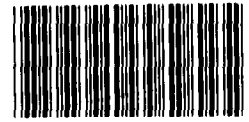
~~116804~~
116804

October 28, 1981

ENERGY AND MINERALS
DIVISION

B-205241

The Honorable Paul S. Sarbanes
United States Senate



116804

The Honorable Dan Daniel
House of Representatives

The Honorable Samuel S. Stratton
House of Representatives

The Honorable Leon E. Panetta
House of Representatives

Subject: Allegations That Low-Cost Solar Space Heating
Systems Are Being Ruled Out in the Solar in
Federal Buildings Demonstration Program (EMD-
82-22)

By separate letters 1/ you requested that we examine the validity of allegations from your constituents concerning the use of low-cost solar space heating systems 2/ in the Solar in Federal Buildings Demonstration Program. The allegations stemmed from the review by the National Aeronautics and Space Administration's Marshall Space Flight Center (Marshall) of solar space heating projects proposed by the U.S. Customs Service (Customs) for the program. The allegations contended that Marshall "arbitrarily" recommended requirements which would effectively rule out the use of low-cost solar space heating systems in the program. In addition, it was alleged that Marshall did not properly evaluate the low-cost solar space heating system proposed for two of the Customs projects prior to concluding that the system was unacceptable for the projects. As agreed with your respective offices, we did not make a technical assessment of the allegations. Instead, we

1/The letters were dated July 21, 1981, June 8, 1981, June 10, 1981, and July 7, 1981, respectively.

2/Generally, these are systems that are simply designed, use inexpensive equipment, and provide heat at moderate temperatures ranging from about 70° F to 125° F.

(307208)

019095

examined whether Marshall's recommended requirements and its evaluation of the low-cost system in question were based on supporting criteria and data.

Under the Solar in Federal Buildings Demonstration Program which is implemented by the Department of Energy (DOE), Marshall acted as the technical reviewer for DOE. ^{1/} In this capacity, Marshall reviewed solar projects proposed by Federal agencies participating in the program. Marshall reviewed the specifications for these projects, recommended requirements when appropriate to assure reasonable system performance, and evaluated particular systems proposed for these projects. In the case of the allegations, Marshall recommended requirements for the solar space heating projects proposed for the program by Customs. In addition, Marshall evaluated the systems proposed for the Customs projects including the low-cost system in question. Marshall concluded that the system was unacceptable because it did not meet the recommended requirements.

The scope and methodology of our examination focused on the process used by Marshall in making reviews, recommendations, and evaluations under the Solar in Federal Buildings Demonstration Program. We examined the process to determine if Marshall's recommended requirements and its evaluation of the low-cost system in question were based on supporting criteria and data. We interviewed DOE, National Aeronautics and Space Administration, Marshall, and Customs officials responsible for the Solar in Federal Buildings Demonstration Program activities. In addition, we reviewed program documents, evaluation reports, and other pertinent information. We conducted our work at the headquarters offices of DOE, National Aeronautics and Space Administration, and Customs in Washington, D.C.; and at Marshall in Huntsville, Alabama.

We found that Marshall's recommended requirements and evaluation of the low-cost system in question were based on supporting criteria and data. Marshall's recommended requirements were not arbitrarily determined but were based on guidelines commonly used in the heating and cooling industry and on data collected by eight independent laboratories that test the performance of solar collectors. In addition, Marshall's evaluation of the low-cost system was based on data collected by one of the eight laboratories and additional data Marshall collected specifically on the system.

^{1/}Beginning in FY 1982, Marshall's responsibilities were transferred to the Energy Technology Engineering Center located in Canoga Park, California, which is a Government-owned facility operated under contract for DOE by Rockwell International Corporation.

The following sections present background information and a discussion of our findings.

BACKGROUND

The Solar in Federal Buildings Demonstration Program is authorized by the National Energy Conservation Policy Act (Public Law 95-619, Nov. 9, 1978). The intent of the program is to stimulate the solar industry by encouraging Federal agencies to use solar systems in new and existing Federal buildings. The program is implemented by DOE with the assistance of a technical reviewer. DOE initially selects the projects proposed by the agencies and then approves them after they receive favorable technical reviews. At the time of our examination, the technical reviewer was Marshall.

On May 29, 1980, DOE announced the selection of 843 projects for Marshall's review under the Solar in Federal Buildings Demonstration Program of which 10 were Customs solar space heating projects. These 10 projects were proposed for Customs inspection stations existing along the U.S.-Canadian border.

During its review of the Customs projects, Marshall recommended that the solar heating systems (1) produce a minimum temperature of 90° F and (2) have collectors with an "X" axis intercept on a collector efficiency graph of 0.5 or greater. The "X" axis intercept is a point that indicates when a collector can no longer absorb heat from the sun.

Also during its review of the projects, Marshall evaluated the low-cost system in question. This system was tentatively selected by Customs for 2 projects--inspection stations located at Westhope, North Dakota and Richford, Vermont. The estimated costs of the Westhope and Richford projects were \$35,000 and \$42,000, respectively.

In April 1981, Marshall concluded that no solar space heating systems would be suitable for the Westhope project because the project would result in a loss on the Government's investment. In May 1981, Marshall concluded that the low-cost system in question was unacceptable for the Richford project because the system did not meet the recommended requirements. Consequently, DOE canceled the Westhope project from the Solar in Federal Buildings Demonstration Program and did not approve the Richford project as proposed with the low-cost system.

A chronology of key events surrounding Marshall's recommended requirements and its evaluation of the low-cost system is presented in Enclosure I.

WERE MARSHALL'S RECOMMENDED
REQUIREMENTS BASED ON SUPPORTING
CRITERIA?

The allegations contended that Marshall arbitrarily recommended requirements which would effectively rule out the use of low-cost solar space heating systems in the Solar in Federal Buildings Demonstration Program. In addition, the allegations contended that a consultant was used to help draft the recommended requirements and that he is associated with and therefore a proponent of the heat pump industry, which is in competition with the solar space heating industry. The allegations questioned whether the consultant could independently render unbiased advice. We found that the recommended requirements were not arbitrarily determined but were based on supporting criteria. In addition, we noted that while no consultant was used to help recommend the requirements, a consultant was used to help review the Customs Westhope project which is discussed on page 6.

According to Marshall officials, the heat from solar space heating systems such as those proposed for the Customs projects should meet a minimum temperature requirement of 90°F. They said that this 90°F is based on guidelines commonly used in the heating and cooling industry and cited a current handbook by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Incorporated (ASHRAE). 1/ ASHRAE establishes guidelines for systems design and operation for the heating and cooling industry, including solar. Specifically, Marshall officials referred to a system in the handbook which they said is applicable to the Customs projects. This system normally operates with winter heating temperatures of about 90°F to 140°F. Marshall officials also cited a current handbook by the Air-Conditioning and Refrigeration Institute 2/ which also establishes guidelines for the heating and cooling industry. According to this handbook, heating air temperatures range from 90°F to 150°F or more.

Marshall officials pointed out that there are exceptions to the 90°F temperature requirement. They noted that many large buildings are heated with systems providing heating temperatures below 90°F, some as low as 74°F. However, they said that lighting, office equipment, and human occupancy are among a number of other sources which produce heat thereby compensating for the difference. Accordingly, they pointed out that these buildings do not need the higher temperatures generally required in residential dwellings or light commercial buildings. Marshall

1/ASHRAE Handbook and Product Directory--1980 Systems.

2/Refrigeration and Air Conditioning Handbook (1979, Prentice-Hall, Inc.).

officials said that the 90° F minimum temperature requirement is recommended for solar space heating projects in residential and light commercial buildings, a category which includes the Customs projects.

Marshall also recommended the requirement that the solar systems collectors proposed for the Customs projects have an "X" axis intercept on a collector efficiency graph of 0.5 or greater. According to Marshall officials, this recommended requirement is based on solar collector performance data obtained from independent laboratories that test solar collectors under DOE's Solar Collector Testing Program. The objectives of this testing program include enabling DOE to develop uniform procedures for rating solar collectors by collecting and analyzing data on the performance of solar collectors tested under the program. The collectors are tested by eight independent laboratories in accordance with ASHRAE standard collector performance testing methods. Marshall has the responsibility for analyzing the data collected by the laboratories. In its analysis, Marshall found that if, in the northern border States, a 0.5 intercept or greater is not maintained, a solar space heating system would not be able to efficiently maintain the required minimum temperature during the winter months.

Marshall officials said that the "X" axis requirement was recommended only for the Customs projects because these projects were proposed for locations along the U.S.-Canadian border. They said that no other projects in the Solar in Federal Buildings Demonstration Program were proposed for that northern region. They emphasized, however, that most solar collectors would be able to meet the requirement. For example, they pointed out that 98 percent of the approximately 158 solar collectors tested in DOE's Solar Collector Testing Program had "X" axis intercepts in excess of 0.5.

According to Marshall officials, the recommended minimum temperature and "X" axis requirements have ruled out the low-cost system proposed for two of the Customs solar space heating projects under the Solar in Federal Buildings Demonstration Program because the system did not meet the recommended requirements. However, Marshall officials said that this system might be suitable for other projects in the program in regions with milder climates.

WAS MARSHALL'S EVALUATION OF
THE LOW-COST SYSTEM IN QUESTION
BASED ON SUPPORTING DATA?

The allegations contended that Marshall did not properly evaluate the low-cost system which was tentatively selected by Customs for its Westhope and Richford projects and that the evaluation led to Marshall's conclusion that the system was unacceptable for the

two projects. As previously stated, Marshall concluded that no solar space heating system would be suitable for the Westhope project. In addition, Marshall concluded that the low-cost system was unacceptable for the Richford project because the system did not meet the recommended requirements. We found that Marshall's evaluation of the system was based on supporting data collected by one of the eight independent laboratories that test solar collectors for DOE's Solar Collector Testing Program and on data collected by Marshall specifically on the system.

According to Marshall officials, no solar space heating system would be suitable for the Westhope project. The project specified integrating a solar space heating system with a base-board heating system which had no duct work or temperature controls to accommodate solar heating. Marshall found that such an integration would result in essentially no savings from the use of a solar system. Marshall officials explained that the installation of a solar system would require installing extensive duct work for air distribution and temperature controls to regulate the heat. They estimated that accommodating these conditions would have resulted in a loss on the Government's investment equal to about the cost of the project.

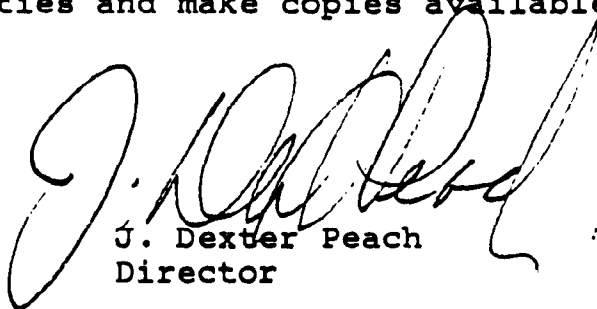
Marshall had used a consultant to help review the Westhope project. Marshall occasionally uses consultants when special expertise is required to assist in the review of a specific project. The allegations contended that the consultant is associated with and a proponent of the heat pump industry--a situation seemingly in conflict with rendering unbiased advice on solar space heating. Although the consultant has a background in heat pump technology, we found that the consultant also has expertise in solar heating and cooling technology; has been involved in activities to promote the use of solar energy, and thus could be considered as a solar proponent. Since the 1930s, the consultant has designed, installed, and tested solar heating systems in two small residences in Minneapolis; helped initiate the formation of the International Solar Energy Society in which he is still an active member; presented numerous technical papers dealing with solar energy use and increasing the efficiency of solar use without increasing complexity or cost; and served as a consultant to the National Bureau of Standards solar energy and energy conservation programs, to solar equipment manufacturers, and to designers of solar heating and cooling systems. The consultant is a member of ASHRAE, and other engineering groups.

With respect to the Richford project, Marshall officials stated that their evaluation of the low-cost system proposed for the project was based on supporting data on the system. Marshall had obtained data on the performance of one of the system's collectors from an independent laboratory in Huntsville, Alabama, which tested the collector in October and November 1979 for DOE's Solar Collector Testing Program. In addition, Marshall collected

field test data on the system in March 1981 from three northern locations where the system's manufacturers had installed their systems. In analyzing these data, Marshall found that the system's collector had an "X" axis intercept of less than 0.5. In addition, Marshall found that at one field test location, the system provided no solar heat during its testing. Based on its analysis, Marshall determined that the system would provide practically no heat during the winter months for the Richford project. Accordingly, Marshall concluded that the system was unacceptable for the Richford project.

- - - -

As requested by your respective offices, we did not obtain official DOE comments on this report. We will send copies of this report to interested parties and make copies available to others upon request.



J. Dexter Peach
Director

Enclosure

KEY EVENTS SURROUNDING MARSHALL'S
RECOMMENDED REQUIREMENTS AND EVALUATION
OF THE LOW-COST SYSTEM IN QUESTION

The following presents a chronology of key events surrounding Marshall's recommended requirements for the Customs solar space heating projects proposed under the Solar in Federal Buildings Demonstration Program, and Marshall's evaluation of the low-cost system tentatively selected for two of the Customs projects.

<u>Date</u>	<u>Key events</u>
October 14 and 15, 1980	Customs submitted its first group of solar space heating projects for competitive bidding after the projects were selected by DOE for Marshall's review. The projects were those proposed for inspection stations located at Westhope, North Dakota; Richford, Vermont; and Bridgewater, Maine. The Westhope project specified integrating a solar space heating system with an existing baseboard heating system and the Richford and Bridgewater projects specified integrating a solar space heating system with an existing oil heating system.
November 18 and 19, 1980	Customs tentatively selected the lowest bidders on each of the three proposed projects. It tentatively selected the low-cost system in question for the Westhope and Richford projects, and a more expensive system for the Bridgewater project. The low-cost system was not bid and thus was not in contention for the Bridgewater project.
February 25, 26, and 27, 1981	Marshall conducted reviews of Customs first group of proposed projects which included the Westhope, Richford, and Bridgewater projects.
March 24, 1981	Marshall recommended to Customs that the solar space heating projects include the 90°F minimum temperature requirement.

<u>Date</u>	<u>Key events</u>
April 14, 1981	Marshall advised Customs and DOE that the Westhope project should be canceled along with others that specify integrating a solar space heating system with an existing baseboard heating system. Consequently, DOE canceled the project from the program.
April 22, 1981	Marshall recommended to Customs that the projects include the requirement that the solar heating systems collectors have an "X" axis intercept of 0.5 or greater.
May 12, 1981	Marshall informed Customs and DOE that it gave a favorable evaluation to the solar heating system tentatively selected for the Bridgewater project. Consequently, DOE approved the project.
June 18, 1981	Marshall informed Customs and DOE that it gave an unfavorable evaluation to the low-cost system tentatively selected for the Richford project. Consequently, DOE did not approve the project as proposed. However, Customs had the option of proposing another system for the project.