

GAO

Report to the Chairman, Subcommittee
on Investigations and Oversight,
Committee on Science, Space, and
Technology, House of Representatives

October 1993

NUCLEAR SCIENCE

More Planning Needed to Support Future Needs for Electric Power in Space



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Resources, Community, and
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October 7, 1993

The Honorable Jimmy Hayes
Chairman, Subcommittee on
Investigations and Oversight
Committee on Science, Space,
and Technology
House of Representatives

Dear Mr. Chairman:

The Department of Energy (DOE) builds radioisotope thermoelectric generators (RTG) that produce electric power for use in deep space and remote terrestrial areas. These power systems have been a critical component in the National Aeronautics and Space Administration's (NASA) and the Department of Defense's (DOD) space and terrestrial missions for over 30 years. NASA officials believe that they will need as many as 19 RTGs to support planned missions through the year 2009.

The former Subcommittee Chairman observed that for the past several years, DOE has considered moving its RTG operations from its Mound Plant in Ohio to a new facility that was being built at the Hanford Reservation in Washington. Concerned about the future costs and planning for RTG operations, the former Chairman requested that we examine DOE's plans for RTG assembly operations. Specifically, we were asked to respond to the following questions:

- Where does DOE plan to assemble RTGs in the future?
- What would be the cost to overhaul the facility at the Mound Plant to make it a suitable site for long-term RTG assembly efforts?
- How will DOE address previously cited public safety concerns about Mound's maintaining a nuclear operation in a residential area?
- How much money has DOE spent to modify Hanford's Fuels and Materials Examination Facility (FMEF) in preparation for the assembly of RTGs, and how much money will be needed to complete this modification?

Results in Brief

DOE has decided to continue the assembly of RTGs at its Mound Plant in Ohio. DOE said that a state-of-the art RTG assembly facility, such as the one that was being built at the Hanford Reservation in Washington, is no longer needed and would be too expensive to finish. DOE also said that it is reluctant to introduce any new activities at Hanford because it considers

Hanford to be in the cleanup-and-restoration stage of its life cycle. DOE, however, has not developed a definitive plan for the long-term support of RTG requirements. Furthermore, as part of its facilities consolidation plan, DOE is moving most activities out of Mound in preparation for possible closure. With DOE's intent to continue RTG operations at Mound, these operations, which constitute a very small portion of the Mound Plant, may eventually be the only activity left.

RTG program officials believe that maintaining the assembly operations at Mound will be less expensive, at least in the short term, than completing the Hanford facility. However, DOE has not estimated what it would cost to modernize the Mound facility to handle future RTG requirements after the launch of NASA's Cassini space probe in 1997.

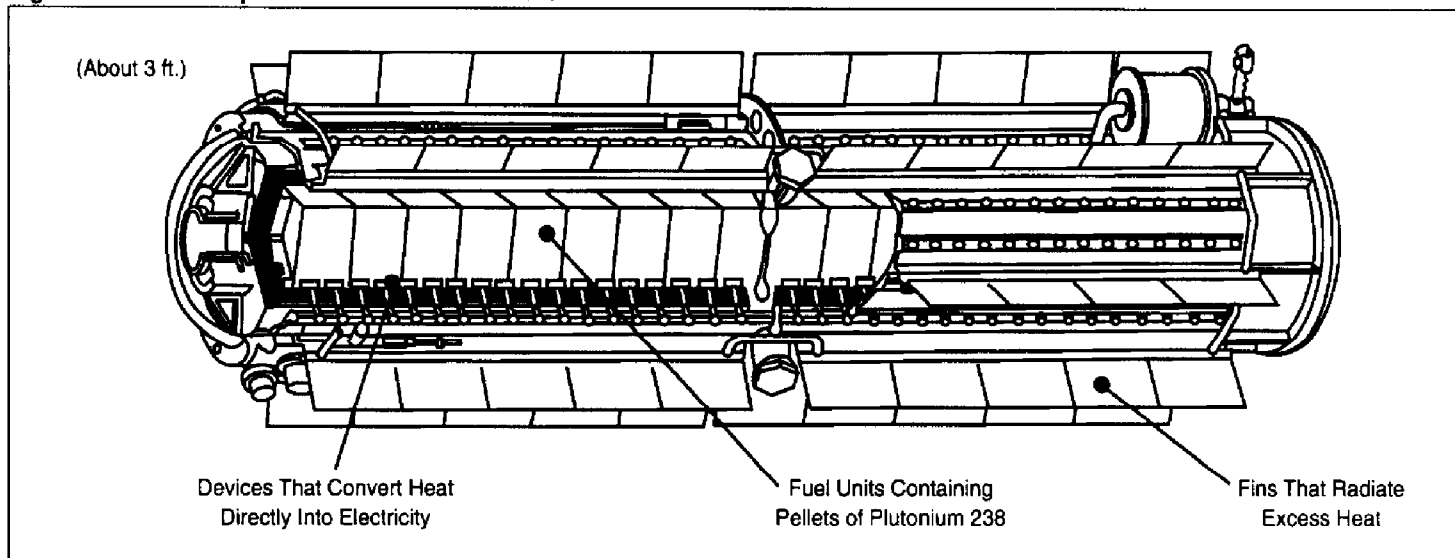
Mound is located in a residential area, and for this reason DOE's past modernization plans have recommended the removal of nuclear operations from Mound. Officials at Mound, however, believe that there is no need to be concerned about the safety of RTG operations because the plutonium-238 (Pu-238) that is used in RTG assembly is encapsulated.

Modification of Hanford's FMEF in preparation for the assembly of RTGs cost \$25.7 million and was 52-percent complete as of February 1993 when it was canceled. Completing the modification would cost an additional \$24.2 million (1992-93 dollars) and could take until 1996.

Background

As shown in figure 1, an RTG consists of a radioisotopic heat source and a small device (a thermoelectric converter) that transforms heat energy into electrical energy. The heat results from the radioactive decay of the radioisotope Pu-238.

Figure 1: Radioisotope Thermoelectric Generator



Source: NASA.

The process for producing RTGs consists of purifying and pulverizing Pu-238 at DOE's Savannah River Plant in South Carolina (in a facility called the HB-Line);¹ sending the powdered Pu-238 to DOE's Los Alamos Laboratory in New Mexico for encapsulation; and sending the encapsulated Pu-238 to Mound, where it is installed in RTGs.

The Mound facility has provided radioisotopic power systems for space and terrestrial missions for more than 30 years. However, in late 1987, DOE decided to move the RTG assembly operations from Mound to a new RTG assembly facility to be built inside of the existing FMEF at Hanford. DOE concluded that this was a more cost-effective way to meet new RTG requirements for a planned large Air Force project and to provide state-of-the-art RTG capability well into the next century. DOE began modifying MEF to accommodate the RTG project in 1988. However, the Air Force subsequently dropped its requirement for DOE's RTG support. DOE, after having spent \$20 million in modifications to FMEF, attempted to cancel the project in 1991 and reprogram \$8 million in funds assigned to the FMEF project to other programs. According to DOE officials, the Congress did not allow DOE to reprogram these funds. DOE, therefore,

¹DOE no longer produces Pu-238 domestically. DOE currently purchases Pu-238 from Russia, but the Pu-238 is still purified and pulverized at the Savannah River Plant.

continued to spend these funds to modify FMEF until it terminated the Hanford RTG project in 1993.

In November 1991, DOE established a Radioisotope Facilities Task Force to gather information to help DOE managers make decisions on where to (1) obtain Pu-238 for future RTGs, (2) encapsulate the Pu-238, and (3) assemble and test RTGs in the future. The task force identified several DOE sites, including the Hanford Reservation, where Pu-238 could be produced in the future.² DOE, however, decided to purchase future supplies of Pu-238 from Russia at roughly one-third of what it would cost to produce domestically.³ The task force also concluded that there were two possible RTG assembly site options for missions beyond Cassini: (1) continue to use the Mound facility or (2) transfer the operations to the new facility at Hanford. The task force concluded that both facilities could do the job.

RTG Assembly to Continue at Mound, but DOE Has No Plan for Long-Term RTG Support

DOE plans to continue RTG assembly and testing at Mound at least through completion of NASA's Cassini mission, which is scheduled for October 1997. DOE, however, has not developed a definitive plan for reliable, uninterrupted RTG support after the Cassini mission. DOE acknowledges that because it has canceled the Hanford RTG project, it is committed to using the Mound facility for long-term RTG support. However, the future existence of the Mound plant is uncertain because of DOE's facilities consolidation plans.

DOE's Reason for Keeping RTG Operations at Mound

DOE officials believe that given current budget constraints, the Mound RTG operations will be less expensive in the short run than finishing the new facility at Hanford. Furthermore, DOE program officials said that with the cancellation of the Air Force's RTG requirement, there is no longer a need for a new facility that has state-of-the-art capability. The officials said that the existing RTG facility at Mound "can be used to meet all National Aeronautics and Space Administration and Department of Defense requirements for the foreseeable future. . . ."

DOE officials told us that if they had decided to maintain a U.S. capability to produce Pu-238 and if Hanford had been selected as the production site,

²DOE considered Hanford's Fast Flux Test Facility, Idaho's Advanced Test Reactor, and Savannah River's K Reactor as possible production sites for Pu-238.

³DOE's RTG task force reported that DOE's decision to buy Pu-238 from Russia may have a negative effect on the United States' Pu-238 technology base.

it might have been logical to do all RTG operations there, including encapsulation and assembly and testing.⁴ DOE officials, however, acknowledge that they are currently reluctant to introduce any new activities at Hanford because they consider Hanford to be in the cleanup-and-restoration stage of its life cycle.

Uncertain Future of Mound as an Active DOE Site

We recently reported⁵ that DOE, as part of its goal of closing plants to consolidate work and reduce costs, plans to remove most activities from Mound. The majority of Mound's current activities are expected to be removed from Mound by the end of fiscal year 1995. DOE's Environmental Restoration and Waste Management Division will then clean up and restore the site. With the DOE Nuclear Energy Office's intent to continue RTG operations at Mound, these operations, which constitute a very small portion of the Mound Plant,⁶ may eventually be the only activity left. Thus, the RTG operations could eventually be solely responsible for paying the site's overhead costs and would face the continual possibility of complete closure of the Mound site.

DOE Has Not Estimated the Cost of Long-Term RTG Operations at Mound

Although DOE will need to modernize and expand Mound's RTG facility if Mound is to support NASA's RTG requirements into the next century, DOE has not estimated how much this would cost. Mound contractor officials estimate that it would cost \$4.1 million (in 1992 dollars) to build a new assembly line, which would be needed to help handle expanded requirements. DOE, however, has not validated Mound's estimate for the assembly line or identified what else would need to be done at Mound to ensure adequate support for NASA missions after Cassini. Some critics indicate that additional funding may be required for modifications, such as additional shielded storage space for RTGs, additional cooling and heating capabilities, additional security measures, and perhaps more remote operations and other modifications to ensure safety.

⁴The Secretary of Energy has recently ordered an independent review of the potential future use of Hanford's Fast Flux Test Facility. DOE RTG officials said that if the results of this review convince the Secretary to produce future supplies of Pu-238 at this facility, then DOE may reverse its decision to terminate the Hanford RTG project.

⁵Nuclear Weapons Complex: Weaknesses in DOE's Nonnuclear Consolidation Plan (GAO/RCED-93-56, Nov. 19, 1992).

⁶The RTG operations are contained in 3 of the 105 buildings located in the Mound Plant. These three buildings occupy less than 1 percent of Mound's total area.

DOE Does Not Have Safety Concerns About RTG Operations at Mound

DOE's past weapons complex modernization plans have recommended that nuclear operations be removed from the Mound Plant because it is located in a residential area. Officials at Mound believe that its location is not a problem with respect to RTGs because only encapsulated nuclear material is handled in the RTG assembly and testing operations. DOE RTG program officials also said that DOE's modernization plans apply only to nuclear weapons applications, not civilian nuclear operations in residential areas. The officials pointed out that nuclear weapons activities will be removed from Mound by the end of fiscal year 1995.

Millions Spent on Now Terminated Hanford RTG Project

In February 1993, DOE directed Hanford to terminate its RTG project, which at that time had cost \$25.7 million and was 52-percent complete, on the basis of the latest \$49.9 million cost estimate.⁷ The original cost estimate for the RTG modifications to FMEF was \$32.1 million, and the projected completion date was October 1992. However, DOE subsequently imposed more stringent radiation safety design requirements on new facilities.⁸ Consequently, the estimated cost to complete the Hanford RTG project increased to \$49.9 million (in 1992 dollars), and the estimated completion date was changed to September 1995.

Conclusions

NASA has identified RTG requirements through 2009. DOE, however, has not developed a definitive plan for providing long-term RTG support beyond the 1997 Cassini mission. For example, although DOE has selected Mound to assemble and test RTGs in the future, DOE has not planned for and estimated the costs of modifications needed at Mound for long-term RTG support. In addition, the Mound RTG operations appear to be in a very precarious position since DOE has decided to move most, if not all, of the other activities out of Mound. At a minimum, the RTG program may have to pay a larger share of Mound's overhead costs, and there is a possibility that the Mound Plant, including the RTG operations, may be closed entirely. DOE has not made contingency plans to help ensure uninterrupted RTG support if assembling RTGs at Mound becomes too costly or if Mound closes.

⁷Hanford officials estimate that it may cost an additional \$2.5 million and take about 6 months to close the Hanford project.

⁸Mound's older facility will be "grandfathered in"—exempt from having to meet these new radiation safety requirements. However, any new nuclear facility construction or modifications will have to meet these new safety requirements, according to Mound officials.

Recommendation

To ensure that an RTG infrastructure will be in place to meet requirements after the 1997 Cassini mission, we recommend that the Secretary of Energy direct DOE planners to develop a plan for RTG support. The plan should include the validated cost of modifications needed to ensure that the Mound RTG operations can effectively support NASA's and DOD's long-term RTG requirements. The plan should also include arrangements that ensure uninterrupted support of these long-term RTG requirements if the Mound facility is unable to perform this function.

Agency Comments

As requested, we did not obtain written agency comments on a draft of this report. We did, however, discuss the results of our work with RTG program managers from DOE's Office of Nuclear Energy. The managers generally agreed that more detailed planning was required to help ensure reliable, uninterrupted support for RTG requirements beyond NASA's Cassini mission. The managers also acknowledged that such planning would most likely contain arrangements for continued RTG assembly and testing operations in case the Mound Plant becomes unable to support this mission into the next decade. We have incorporated the managers' comments into our report where appropriate.

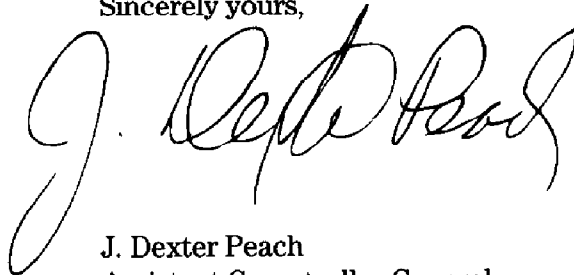
Scope and Methodology

We conducted our review from October 1992 through August 1993 in accordance with generally accepted government auditing standards. We interviewed officials at DOE headquarters and visited the Mound Plant in Ohio and Hanford's FMEF in Washington. We interviewed DOE and contractor officials at these sites. We also interviewed a NASA official to discuss NASA's future requirements for RTGs. In addition, we reviewed pertinent documents, including recent and past evaluations of RTG facilities.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to the appropriate congressional committees; the Secretary of Energy; the Director, Office of Management and Budget; and those involved in our review. We will also make copies available to others upon request.

This work was performed under the direction of Victor S. Rezendes, Director, Energy and Science Issues, who can be reached at (202) 512-3841. Major contributors to this report are listed in appendix I.

Sincerely yours,

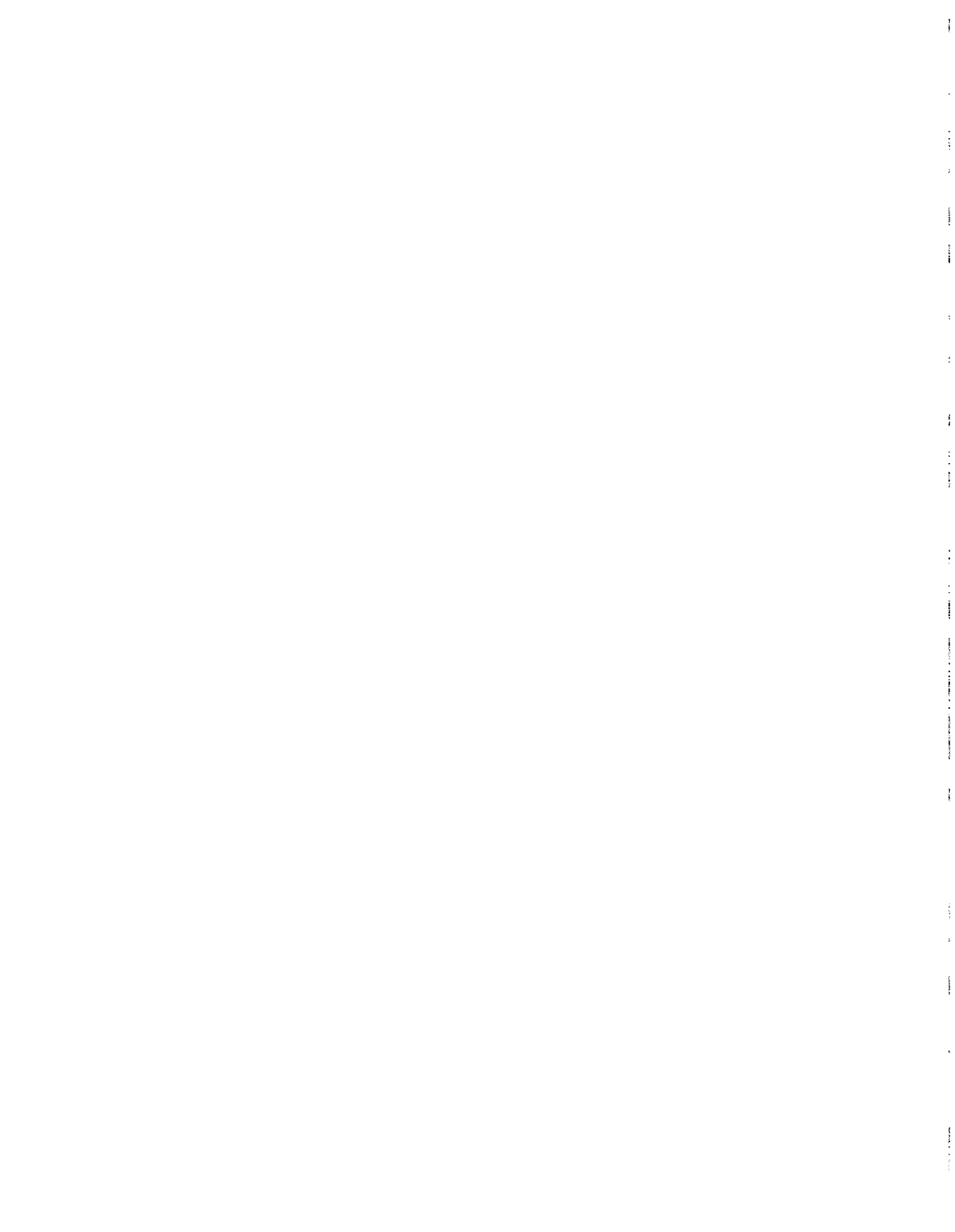
A handwritten signature in black ink, appearing to read "J. Dexter Peach". The signature is written in a cursive style with a large initial "J" and a long, sweeping underline.

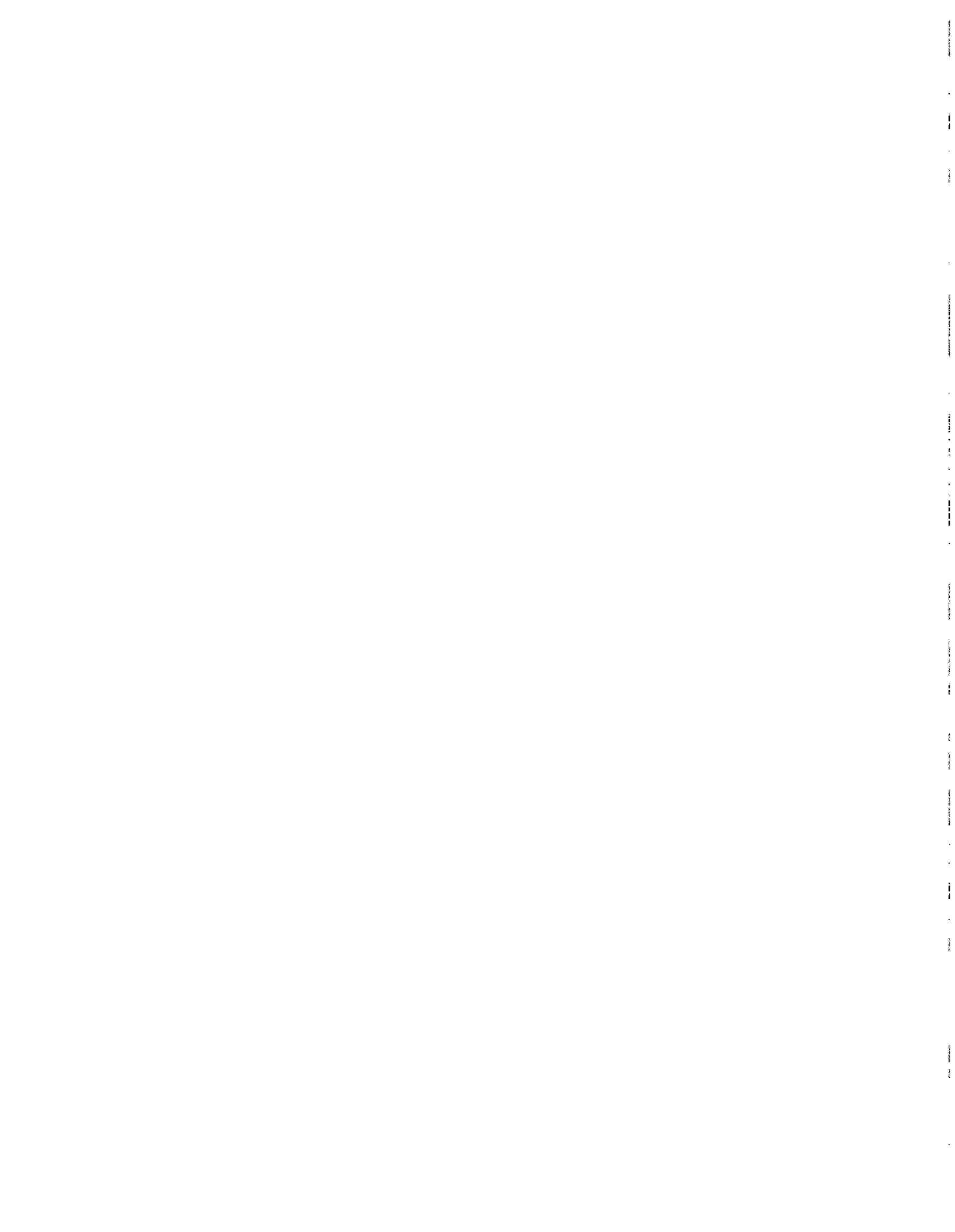
J. Dexter Peach
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