U.S. Department of Energy
Office of Inspector General
Office of Audit Services

Audit Report

Calutron Isotope Production Capabilities

DOE/IG-0574

November 2002

U. S. DEPARTMENT OF ENERGY
Washington, DC 20585

November 14, 2002

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman (Signed)
Inspector General

SUBJECT: INFORMATION: Audit Report on the "Calutron Isotope Production Capabilities"

BACKGROUND

In August 2002, the Department of Energy (Department) formalized its plan to permanently disable the only domestic facility capable of producing electromagnetically enriched stable isotopes. The Department intended to dismantle the equipment in the facility, called calutrons, and rely on existing isotope inventories, isotopes produced by Russia, or the adaptation of other isotope separation technologies to meet the domestic demand for stable isotopes. This plan was based on the premise that the calutrons were excess to mission needs and not economical.

The calutrons were initially built to enrich uranium and are capable of enriching most isotopes from the periodic table of elements. Although other enrichment techniques were adopted for uranium, the Department and its predecessor organizations continued to operate the calutrons to ensure the availability of other enriched stable isotopes.

Electromagnetically enriched stable isotopes have many important industrial, medical, and research uses. One isotope, for example, will be used for homeland security in explosives detection devices throughout the country. Another is currently used by both the defense and commercial sectors in global positioning systems for navigation and tracking. In addition, many stable isotopes are used to create the radioisotopes used in a wide variety of medical applications, such as cancer treatments, tumor imaging, and heart scans.

This audit was conducted to determine if the Department would be able to ensure the availability of stable isotopes if it eliminated its domestic isotope production capability.

RESULTS OF AUDIT

We concluded that the Department may not be able to ensure the availability of a full range of stable isotopes if the calutrons were dismantled. Despite the assertions by management that the calutrons were no longer needed because alternative sources were available, the audit disclosed that:

- Current inventories of some stable isotopes are insufficient to cover future needs; and,

- No proven domestic alternative capabilities are currently available to replace the calutrons.

Furthermore, the Department's strategy included reliance on isotopes supplied by Russia. We concluded that this strategy carries with it a number of risks, which need to be carefully considered in the decision-making process. In particular, the Department's past purchasing experience has raised concerns about both the supply and quality of the Russian-produced material. Management disagreed with this position, claiming that the Russian supply chain was sound.

To address the overall concerns, we recommended that dismantlement of the equipment be suspended until a reliable and fully demonstrated alternative source of stable isotopes is obtained. This course of action recognizes the continuing need for stable isotopes and that alternatives, at this time, may be both impractical and, ultimately, more expensive. In fact, replacing the calutrons could cost as much as $45 million, depending on the capacity needed; whereas, maintaining the existing equipment in a standby mode will only cost about $1.5 million annually.

MANAGEMENT REACTION

During the course of the audit, management re-evaluated its decision. Specifically, management agreed to maintain the calutrons in an operable condition until they are no longer needed. However, management stressed that there currently was no meaningful shortage of isotopes in the United States' inventory. In addition, as noted previously, management stated that the Russian supply of isotopes was reliable and that the world stable isotope supply was robust and competitive. Further, management indicated that it planned to continue pursuing the purchase of a small number of electromagnetic separators to pair with other technologies to address the possible future need for small quantities of specialized research isotopes. Finally, although management did not have a formal cost estimate, it believed that it would most likely cost between $8 and $18 million to carry out its plans. However, management admitted that the cost could increase depending on the capacity needed.

We found management's actions to be responsive to our recommendations. We agree that maintaining or replacing the entire currently available production capacity may not be necessary. However, given the importance of having a readily available supply of stable isotopes, we believe it essential to maintain domestic capability to produce a wide variety of such isotopes. In this regard, although management expressed its hope to obtain a small number of electromagnetic separators as well as utilize other technologies to meet future isotope needs, neither funding nor acquisition plans are currently in place to achieve this goal. Therefore, in our judgment, maintaining the existing calutrons in standby mode seems to be the best course of action.

Attachment

cc:; Chief of Staff
Under Secretary for Energy, Science, and Environment
Director, Office of Nuclear Energy, Science and Technology
Manager, Oak Ridge Operations Office

CALUTRON ISOTOPE PRODUCTION CAPABILITIES

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CALUTRON ISOTOPE PRODUCTION CAPABILITIES

INTRODUCTION AND OBJECTIVE

The Department of Energy (Department) planned to permanently eliminate the domestic capability to produce electromagnetically enriched stable isotopes. The Department intended to dismantle the machinery used to produce the isotopes, called calutrons, and rely on existing Department inventories, Russian-produced isotopes, or the adaptation of other isotope separation technologies to meet the domestic demand for stable isotopes.

The calutrons were initially built to enrich uranium and are capable of enriching most isotopes from the periodic table of elements. There are currently 38 individual calutron units located at the Y-12 National Security Complex (Y-12) in Oak Ridge, Tennessee. Although other enrichment techniques were adopted for uranium, the Department and its predecessor organizations continued to operate the calutrons to ensure the availability of enriched stable isotopes to support industrial, medical, and research applications. Evolving from its initial role as the principal domestic supplier of stable isotopes, the Department has modified its mission to focus on ensuring a supply of stable isotopes to support domestic isotope research.

The calutron facility was designated as a Manhattan Project Signature Facility under the National Historic Preservation Act. As such, the Department is required to consult with both the President's Advisory Council on Historic Preservation and the Tennessee State Historic Preservation Officer prior to any activity, such as dismantling, that might affect the historic characteristics of the calutron facility. The Department has received approval to proceed with certain dismantling activities, some of which will permanently disable the calutrons' ability to separate isotopes. However, the Department has not sought or received approval for all of the actions required to excess the calutron facility as planned.

Because electromagnetically enriched stable isotopes have wide applicability, we conducted the audit to determine if the Department would be able to ensure the availability of stable isotopes if it eliminated its domestic isotope production capability.

CONCLUSIONS AND OBSERVATIONS

The availability of some stable isotopes could not be assured if the calutron machines were disabled. We determined that the current inventories of some isotopes are insufficient to cover future demand, the future supply of Russian-produced isotopes may be unreliable, and no proven alternative technologies to replace the calutrons are available. If the Department proceeded with its plan to dismantle the

calutrons, the United States would lose the capability to produce 110 stable isotopes and become dependent on Russia to provide essential isotopes to meet our domestic research needs. In addition, it would incur $5.5 million to dismantle the current calutrons as well as up to $45 million to obtain replacement calutrons should the need arise.

This audit identified issues that management should consider when preparing its year-end assurance memorandum on internal controls.

(Signed)
Office of Inspector General

Ensuring Availability of Stable Isotopes

Alternatives to Domestic Production of Isotopes

The Department has depleted its inventory of several isotopes and, during Fiscal Year (FY) 2002, it was unable to fulfill all customer requests for isotopes. For example, the isotope mercury-202, which is used in environmental research, was unavailable. Requests for lutetium-176, used for cancer research, were also denied. The Department was also unable to fulfill requests for tungsten-186, used for cancer and coronary treatments. Further, less than a three-year supply is projected to exist for several other high demand isotopes, such as rubidium-87, which is used by Department of Defense and the commercial sector in global positioning systems, as well as nickel-62, which is the basis for an isotope used in explosive detection devices.

In addition, the future supply of Russian-produced isotopes may be unreliable. In particular, the Department's past purchasing experience with Russian-produced isotopes has raised concerns about both the supply and the quality of the material. To illustrate, a Department procurement action in February 1999 for the purchase of the stable isotope rubidium-87 resulted in 14 documented instances of non-compliance with procurement requirements. These issues ranged from failure of administrative controls to the material not meeting required specifications. For instance, the supplier failed to label the shipments as radioactive material, all the shipments were received significantly later than the contractual delivery dates, and the material contained excessive impurity levels. In fact, some of the material contained impurities 24 times greater than the amount present in the test samples provided by the supplier as "representative" of the material to be supplied. A second procurement action in May 2000 for the same isotope was initially rejected in its entirety and then accepted after further processing, although seven non-compliance issues similar to those encountered with the first procurement action still existed.

Currently, no proven alternative technologies are available to replace the capability of the calutrons. In FY 1999, the Department tasked an independent contractor to identify a technology in which the Department might invest to replace the calutrons for the production of research isotopes. The overwhelming consensus of the isotope separation experts who conducted the study was that the only technology capable of providing the full spectrum of enriched stable isotopes was electromagnetic separation. The calutrons are currently the only domestic production facility that can perform electromagnetic separation. They also concluded that no combination of technologies could be relied upon in the next several years to provide the same or similar capability as the calutrons, even with a substantial research investment. We noted that the Department has continued to pursue alternative technologies for specific stable isotopes. For example, in

FY 2000, the Department funded a study to demonstrate the feasibility of producing rubidium-87 using plasma separation. However, while the feasibility has been demonstrated, the production of useful quantities of rubidium-87 has not been accomplished. In addition, the Department concluded that plasma separation would be most effective when coupled with a calutron.

Decision to Eliminate Stable Isotope Production Capability

The Department determined that the calutrons were excess to current or future programmatic needs based on its conclusion that the large fixed costs for the calutron facility outweigh the benefits to the program now and for the foreseeable future. Historically, revenue generated from isotope sales was used to support the development and production of research isotopes. The Department has encouraged private sector investment in the production of commercially viable isotopes, where possible, which has resulted in reduced revenues to support its research mission. Therefore, the Department concluded that the continued operation or standby of the calutrons under its anticipated cost structure would not be economical. However, estimates prepared by three separate groups show almost no reduction in costs even after the Department dismantles the calutrons. Further, the Oak Ridge Operations Office prepared an analysis of calutron operations that concluded that the Department would actually save money through the limited production of stable isotopes to offset the fixed cost of the facility.

The Department anticipates the need to replace a small number of the calutrons to support research mission needs. The Department's isotope program *Five-Year Plan* identified funding requirements for replacement calutrons in FYs 2004 through 2007; however, funding has not been requested. An official from the isotope program indicated that, if supply problems arise, the Department could replace the calutrons within a year of receiving funding. However, we noted that the year time frame appeared to be unrealistic considering the time required to resolve technical design issues, build or modify a replacement facility, and contract for the fabrication and installation of the replacement calutrons. Also, the Department has not developed an implementation plan for replacing the calutrons or conducted a comprehensive analysis to show the benefits associated with permanently disabling the calutrons prior to the acquisition of replacements.

Isotopes May Be Unavailable

If the Department proceeded with its plan, the United States would lose the capability to produce 110 stable isotopes and become dependent on Russia to provide essential isotopes to meet our domestic needs. In addition, an expert panel report, *Forecast Future Demand for Medical*

Isotopes, noted that without a reliable isotope production facility, the practice of nuclear medicine would suffer, as would the patients who require these services. Currently, clinical trials, which are the core of promising new therapies, often need isotopes that are not readily available in the commercial sector. Accordingly, if the Department does not maintain the stable isotope production capabilities, it could lead to the abandonment of research, or at least significant delays in clinical trials.

In addition, the cost to obtain replacement calutrons would outweigh the cost of maintaining the current machines. Specifically, if the Department dismantled the calutrons and then had to replace their capacity, the Department would incur $5.5 million in avoidable dismantling costs and between $3.5 million and $45.1 million in avoidable replacement costs, depending on number of calutrons replaced. These costs are only for the purchase of the machines and do not include the installation or construction costs which would be incurred to build a new or modify an existing facility to house the replacement calutrons if the current facility is decommissioned as planned. The current cost to maintain the calutrons in a standby mode is only $1.5 million annually. The surveillance and maintenance costs that would have to be paid until the calutron facility is demolished are about the same as maintaining the calutrons in standby mode with their capability intact. Also, at the incremental cost of a few hundred thousand dollars, the calutrons can be operated from the standby mode for short campaigns to produce stable isotopes that are in critically short supply. In at least some instances, the revenues from those isotopes would exceed the cost of production, thereby reducing the net cost to the Department for maintaining this capability. Finally, if one segment of the calutrons was placed into an operating mode, the total cost would only be about $5.2 million annually and some of that cost could be offset by sales revenue. We could not determine the breakeven point for replacing the calutrons because the Department has not identified the estimated operating costs for replacement calutrons.

RECOMMENDATIONS

We recommend that the Director of the Office of Nuclear Energy, Science and Technology:

1. Conduct a comprehensive study to identify the cost and operating benefits of disabling the calutrons versus continuing to maintain their current condition until such time as replacements can be obtained.

2. Continue to maintain the calutron isotope production capability until a more viable alternative has demonstrated the ability to produce a wide variety of isotopes similar to that provided by the calutrons.

MANAGEMENT REACTION

Management concurred with the recommendations and, based on the results of the recommended cost analysis, agreed to maintain the calutrons in an operable condition until they are no longer needed. However, management did not believe that the entire production capacity associated with the current calutrons would be needed. Management also stated that, based on its own four-year inventory analysis, there was no meaningful shortage of United States inventory. In addition, management stated that the Russian supply of isotopes was reliable and that the world stable isotope supply was robust and competitive. Finally, management planned to continue pursuing the purchase of a small number of replacement calutrons to pair with other technologies to address the possible future need for small quantities of specialized research isotopes. Management anticipated that it would cost between $8 and $18 million to carry out its plans.

Management's response to the recommendations is included as Appendix 2.

AUDITOR COMMENTS

We consider management's actions to be responsive to our recommendations. In addition, we agree that maintaining or replacing the entire production capacity currently available may not be necessary. The intent of the second recommendation was to ensure that the capability to produce a wide variety of isotopes was maintained, but not necessarily at the current capacity. Therefore, we revised the second recommendation to clarify this point. In addition, the audit focused on the Department's ability to meet domestic isotope needs in the future, rather than current needs. Based on the results of our audit, we are concerned that the Russian supply of isotopes may not be reliable in the future and that the world market for stable isotopes may not continue to be competitive if the calutrons are dismantled and Russia becomes the sole producer. Finally, although management hopes to obtain replacement calutrons as well as utilize other technologies to meet future isotope needs, it currently has neither the funding nor the implementation plans in place to do so.

Appendix 1

SCOPE

The audit was performed from June 24, 2002, to August 22, 2002, at the Office of Isotopes for Medicine and Science, in Germantown, Maryland, and the Oak Ridge Reservation, in Oak Ridge, Tennessee. The audit included a review of the Department's decision to dismantle the calutrons and its strategy for supplying stable isotopes.

METHODOLOGY

To accomplish the audit objective, we:

- Reviewed the various uses for stable isotopes;
- Reviewed the Department's dismantling plans for the calutrons;
- Evaluated alternative sources for the supply of stable isotopes;
- Reviewed various reports on the Department's isotope program; and,
- Evaluated the cost of replacing the calutrons.

The audit was performed in accordance with generally accepted Government auditing standards for performance audits and included tests of internal controls and compliance with laws and regulations to the extent necessary to satisfy the audit objective. Accordingly, the audit included a review of the Department's stable isotope production activities. Because our audit was limited, it would not necessarily have disclosed all internal control deficiencies that may have existed at the time of our audit. As part of our review, we also evaluated the Department's implementation of the Government Performance and Results Act of 1993. We found that the Department had implemented specific and measurable performance measures related to supplying stable isotopes to its customers. We did not rely on computer-processed data to achieve our audit objective.

We held an exit conference with the Deputy Director for Operations and Management/Chief Operating Officer in the Department's Office of Nuclear Energy, Science, and Technology, on October 28, 2002.

United States Government Department of Energy

memorandum

DATE: October 11, 2002

REPLY TO ATTN OF: NE-40

SUBJECT: Draft Report on "Calutron Isotope Production Capabilities"

TO: Frederick D. Doggett, IG-30

Attached are a "Management Reaction, " detailed comments to the subject draft report, and a current inventory analysis. These comments state a path forward for providing stable isotope supply and clarify a number of items in the report.

The first recommendation in the report states " Conduct a comprehensive study to identify the cost and operating benefits of disabling the calutrons versus continuing to maintain their current condition until such time as replacements can be obtained." Nuclear Energy concurs with the first recommendation and has provided information to your office. We consider this action closed.

The second recommendation states "Continue to maintain the calutron isotope production capability until a more viable alternative has demonstrated production capability equal to that provided by the calutrons." We partially agree with this recommendation. We are maintaining the calutrons in an operable condition until they are no longer needed. However, we believe there is no basis for having production capability equal to that provided by 30 calutrons. The attached comments and listing of current sales and inventory support this conclusion.

Robert Paul Knapp for
William D. Magwood, IV, Director
Office of Nuclear Energy, Science
and Technology

Attachment

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