



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

Audit Report

Management of Beryllium Metal Supply

DOE/IG-0583

January 2003



Department of Energy

Washington, DC 20585

January 27, 2003

MEMORANDUM FOR THE SECRETARY

FROM:

Greg Friedman
Gregory H. Friedman
Inspector General

SUBJECT:

INFORMATION: Audit Report on "Management of Beryllium Metal Supply"

BACKGROUND

Beryllium metal, a non-radioactive metal considered to be essential for many applications within the Department of Energy, is used primarily to fabricate parts for nuclear weapons. The National Nuclear Security Administration (NNSA) maintains the capability to manufacture beryllium metal components both for nuclear weapons and for experiments required to certify the reliability of the nuclear weapons stockpile.

Because there are no longer any domestic producers of beryllium metal, the only available source to meet the Department's need for this material is the National Defense Stockpile, managed by the Department of Defense. The stockpile was originally established to retain critical materials the United States might need in a national emergency. Current Department of Defense posture, however, is that the stockpile is no longer necessary and will be discontinued by 2007. Of 303 tons of usable beryllium metal now in the stockpile, 50 tons have been reserved for the Department of Energy.

NNSA's best estimate is that, over the next three decades, it will need about 90 tons of beryllium metal – 40 more tons than is available to the Department in the National Defense Stockpile – to fulfill mission requirements. NNSA's preferred alternative is to attempt to obtain more material from the National Defense Stockpile. However, since the Department of Defense also has national security requirements for the same material, it is unclear whether obtaining more beryllium metal is a viable option. We initiated this audit to determine whether obtaining additional material in this manner was the most efficient and effective method for meeting future requirements for beryllium metal.

RESULTS OF AUDIT

Our audit disclosed that other alternatives, such as changing the beryllium metal manufacturing process and recycling, might allow NNSA to drastically reduce its need for additional material. At our request, NNSA conducted a preliminary analysis of a process change and concluded that mission requirements could be met with existing



supplies of beryllium metal, assuming the new process was adopted. In making an initial decision to attempt to purchase more material from the National Defense Stockpile, NNSA had not fully considered alternative approaches that would reduce its need for more beryllium metal. Adoption of such alternatives has the potential to save NNSA as much as \$42 million and to reduce worker exposure to potentially harmful material.

We recommended that NNSA formally evaluate process alternatives and recycling as methods for reducing its overall need for beryllium metal. Based on the outcome of these analyses, NNSA should then select the most cost-effective means for meeting related mission requirements.

The Office of Inspector General has reported that management of the aging weapons infrastructure and the inventories of essential materials are among the most serious challenges the Department faces. As we noted in our report on *Management Challenges at the Department of Energy* (DOE/IG-0538, December 2001), improving manufacturing processes and technologies is an essential part of ensuring that the Department can continue to meet future mission requirements.

MANAGEMENT REACTION

NNSA's Associate Administrator for Management and Administration generally agreed with the finding and concurred with our recommendations that NNSA evaluate alternatives to meeting its beryllium metal requirements.

Attachment

cc: Deputy Secretary
Acting Administrator, National Nuclear Security Administration
Director, Policy and Internal Controls Management

Management of Beryllium Metal Supply

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SOLUTIONS TO BERYLLIUM METAL SHORTAGE

Background

The Department of Energy (Department) uses beryllium metal to fabricate weapons components and to facilitate a number of weapons-related experiments. Based on its analysis of the President's 2001 Nuclear Posture Review, the National Nuclear Security Administration (NNSA) estimated that it would need approximately 90 tons of beryllium metal to meet mission requirements over the next 30 years. About 50 tons of the material is currently available for purchase from the Defense Department's National Defense Stockpile. Because the only domestic producer of beryllium metal from ore ceased production in 2000, NNSA had been uncertain how it would overcome the perceived shortfall.

Beryllium Metal Supply

NNSA's preferred alternative – requesting more material from the National Defense Stockpile – was problematic. In May 2002, NNSA sent the Department of Defense a memorandum requesting that all remaining beryllium metal in the stockpile be reserved for NNSA purchase. NNSA officials were skeptical, however, as to whether the request would be approved because the Defense Department also has national security requirements for the same material. As of October 2002, the Department of Defense had not indicated what its response would be.

Our audit disclosed that NNSA had not fully considered alternative approaches for meeting its requirements. We noted at least two options, each involving process changes that could help NNSA reduce its overall need for beryllium metal, that had not been analyzed. These processes, involving "near-net shaping" and recycling, are briefly described below.

Near-Net Shaping

NNSA's existing beryllium metal weapon component manufacturing process involves machining down large blocks of beryllium metal so that only about four percent of the feed material ends up in the final product. This means that the process results in a discard of 96 percent of the material as scrap. Technical experts explained that this metal could not be reused for weapons production without reprocessing since it contains impurities from the manufacturing process. Near-net shaping, on the other hand, is a process by which beryllium powder is sized to a shape closer to that of the final parts, thereby allowing NNSA to use significantly less beryllium metal to manufacture the same parts. A 1989 National Material Advisory Board Report, *Beryllium Metal Supply Options*, stated that successful implementation of near-net

shaping for Department uses is virtually assured since near-net shaping techniques have been used commercially for years and the basic process technology is well established. In fact, the Department's preliminary evaluation of near-net shaping successfully demonstrated efficiencies almost six times greater than the current process.

At our request, NNSA conducted a preliminary analysis of the use of near-net shaping for its manufacturing processes. NNSA concluded that the near-net process had the potential to allow NNSA to meet all currently identified stockpile requirements with less than 48 tons of beryllium metal. In this scenario, NNSA could meet its needs with supplies already available and would not need to rely on the Department of Defense for any additional material.

Recycling

Another approach that could allow NNSA to conserve its limited supply of beryllium metal is reestablishing the Department's beryllium recycling capability. In the late 1980s, the Department successfully demonstrated the capability to recycle processed beryllium at the Rocky Flats Plant. Since that time, the recycling equipment has been decommissioned and the Department has not pursued a recycling option. Although costs associated with purchasing or manufacturing new recycling equipment would need to be considered, NNSA has estimated that recycling could allow it to reuse up to 98 percent of the beryllium metal scrap. As described above, the Department's current manufacturing process generates large amounts of beryllium scrap due to the low material utilization rate. If near-net shaping were employed, less scrap would be generated, but recycling could still be employed to reduce wasted material to an absolute minimum.

Consideration of Other Alternative Approaches

NNSA did not fully consider all available alternatives for addressing its beryllium metal requirements because it focused solely on obtaining more material, rather than also considering ways to conserve existing supplies. In early 2002, NNSA chartered a working group to formulate and evaluate alternatives to assure that beryllium metal would be available for future stockpile requirements. However, the working group limited its scope to increasing the supply of beryllium metal and did not include an investigation of methods to reduce the initial amount of beryllium required in the manufacturing process.

During the audit, we discussed the near-net shaping and recycling approaches with NNSA officials. In October 2002, officials informed us that they planned to fund research and development activities to further explore the feasibility of implementing the near-net shaping process and recycling.

Potential Costs and Hazards

The Department's program to certify that nuclear weapons in the nation's stockpile remain safe and reliable could be jeopardized if an adequate supply of beryllium metal is not assured. Specifically, given NNSA officials' belief that the Department of Defense is unlikely to make additional beryllium metal available, the further examination of alternatives is, in our judgment, a prudent step toward ensuring that mission needs will be met.

In addition, implementation of NNSA's preferred alternative will require NNSA to spend \$42 million to purchase additional beryllium metal from the National Defense Stockpile. This additional cost represents the difference between the 90 tons of beryllium metal required using the current manufacturing process and the 48 tons needed if near-net shaping was implemented. In addition to avoiding this cost, health risks can be mitigated by implementing alternative solutions. While NNSA has taken steps in recent years to limit worker exposure to beryllium, additional improvements can be made. Specifically, dust control is the primary preventative measure used to limit occupational beryllium exposure. NNSA's current manufacturing process produces significantly more dust than would be generated by using a near-net shaping process. The alternative process forms the beryllium metal into shapes close to the final product, which requires less machining and produces much less beryllium dust.

RECOMMENDATIONS

We recommend that the Deputy Administrator for Defense Programs:

1. Evaluate the feasibility and cost of incorporating near-net shaping into the manufacturing process for beryllium metal;
2. Evaluate the feasibility and cost of establishing a beryllium metal recycling capability; and,
3. Implement the most efficient and effective alternative to meet the future nuclear weapons stockpile demand for beryllium metal.

MANAGEMENT REACTION

NNSA's Associate Administrator for Management and Administration generally agreed with the finding (Appendix 2). In separate technical comments, the Associate Administrator concurred in principle with the first two recommendations, disagreed with the third, and proposed a fourth recommendation requiring NNSA to more adequately fund beryllium metal research.

While NNSA agreed with the first recommendation, the response noted that since near-net shaping was a mature industrial technology whose feasibility had already been demonstrated, an evaluation of feasibility would be unnecessary. However, NNSA would still need to insure that parts produced using near-net shaping could be certified for NNSA applications, and request approval from the design agencies for the new process.

With regard to the second recommendation, management agreed to evaluate the establishment of a fully integrated beryllium metal recycle and fabrication facility/capability. NNSA added that the equipment previously used for recycling beryllium metal used a low throughput technology and that more modern technology has been proposed but never proven.

Management indicated that the third recommendation was premature since other organizations within the Department have beryllium metal requirements that were not addressed in the draft report. Furthermore, the supply of beryllium metal is a national problem. Accordingly, NNSA's path forward would be greatly impacted by the position taken by the Department of Defense. Once the Department of Defense establishes its position with respect to beryllium metal, the path forward for NNSA will be clearer. Management stated that they would be willing to establish a joint task force with the Department of Defense to work towards implementing the most cost effective and efficient means to meet NNSA's demand for beryllium metal, once the Department of Defense established its own beryllium metal position.

AUDITOR COMMENTS

We consider management's response to the first two recommendations to be responsive. With regard to the third recommendation, however, we believe that the conservation of the finite supply of beryllium metal would benefit all parties and, as the report indicated, if NNSA adopted the measures proposed, their path forward would not be impacted by the Department of Defense. We did not incorporate the proposed fourth recommendation because the Department had already planned to fund beryllium metal research.

Appendix 1

OBJECTIVE

We initiated the audit to determine whether NNSA identified the most efficient and effective method to meet the future nuclear weapon stockpile demand for beryllium metal.

SCOPE

The audit was performed from April 24, 2002, to September 19, 2002, at the Los Alamos National Laboratory in Los Alamos, New Mexico, the Albuquerque Service Center and Sandia National Laboratory, in Albuquerque, New Mexico, and NNSA Headquarters, in Washington, D.C. The audit included a review of the NNSA's future beryllium metal requirements and current manufacturing processes and inventories. The scope of the audit did not include the future beryllium metal requirements for other programs within the Department. Historically, these other requirements were significantly less than the NNSA requirements and required a lower grade of beryllium, which would be available from the scrap beryllium metal from NNSA's beryllium metal operations.

METHODOLOGY

To accomplish the audit objective, we:

- Reviewed the beryllium metal inventory level in the National Defense Stockpile;
- Evaluated NNSA's consideration of alternative manufacturing processes;
- Reviewed reports discussing beryllium metal supply;
- Evaluated NNSA's actions to address the beryllium metal supply; and,
- Interviewed personnel from NNSA Headquarters, the Albuquerque Service Center, Los Alamos National Laboratory, and Sandia National Laboratory.

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 reviews of NNSA's beryllium metal supply management activities. Because our review 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. While we did not find any specific performance objectives related to beryllium production, we did determine that the NNSA had developed requirements for stockpile maintenance. We did not rely on computer-processed data to achieve our audit objective.

NNSA waived the exit conference.

Appendix 2



Department of Energy
National Nuclear Security Administration

Washington, DC 20585

December 23, 2002

MEMORANDUM FOR Frederick D. Doggett
Deputy Assistant Inspector General
for Audit Services

FROM: Anthony R. Lane *Anthony R. Lane*
Associate Administrator
for Management and Administration

SUBJECT: Comments to Draft Report; Beryllium Metal
Supply

The Office of Inspector General (IG) issued their draft report, "Management of Beryllium Metal Supply" on November 20, 2002. We appreciate having had the opportunity to have reviewed the draft report. We understand from the report that the IG believes their audit disclosed other alternatives, such as changing the beryllium metal manufacturing process and recycling, might allow the National Nuclear Security Administration (NNSA) to drastically reduce its need for additional material. The IG also believes that NNSA has not fully considered alternative approaches that would reduce its need for more beryllium metal. Finally, we understand that the IG is recommending that the NNSA formally evaluate process alternatives and recycling as methods for reducing its overall need for beryllium metal and then should select the most cost-effective means for meeting related mission requirements.

NNSA generally agrees with the report. However, we have provided some program generated comments that may clarify points raised in the report. We further recommend some minor word changes to two of the recommendations to make them stronger and that the IG consider adding a fourth recommendation. This fourth recommendation focuses on the funding of beryllium metal fabrication and recycle development as well as reviewing and developing a more modern and efficient technology for future metal production.

Attachment



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