

**EXCESS PLUTONIUM:
WEAPONS LEGACY OR NATIONAL ASSET?**

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ABSTRACT

The Nuclear Materials Stewardship Initiative was established in January, 2000, to accelerate the work of achieving integration and cutting long-term costs associated with the management of nuclear materials. As part of that initiative, the Department of Energy (DOE), Office of Environmental Management (EM), has established Nuclear Material Management Groups for the management of excess nuclear materials. As one of these groups, the Plutonium Material Management Group (PMMG) has been chartered to serve as DOE's complex wide resource and point of contact for technical coordination and program planning support in the safe and efficient disposition of the nations excess Plutonium 239. This paper will explain the mission, goals, and objectives of the PMMG.

In addition, the paper will provide a broad overview of the status of the plutonium inventories throughout the DOE complex. The DOE currently manages approximately 99.5 MT of plutonium isotopes. Details of the various categories of plutonium, from material designated for national security needs through material that has been declared excess, will be explained. For the plutonium that has been declared excess, the various pathways to disposition (including reuse, recycling, sale, transfer, treatment, consumption, and disposal) will be discussed. At this time 52.5 MT of plutonium has been declared excess and the method of disposition for that material is the subject of study and evaluation within DOE. The role of the PMMG in those evaluations will be outlined.

The goal of the PMMG is to serve as the focal point, catalyst, technical resource, project planner, and facilitator for the integrated, complex-wide management of plutonium materials within its defined scope. The methods by which the PMMG achieves that goal, the accomplishments of the PMMG, the current issues facing the PMMG (and the overall plutonium program), the near-term and long-term planning for the PMMG, and the interfaces with the other Nuclear Material Management Groups will be primary areas of focus for this paper.

INTRODUCTION AND DEVELOPMENT OF MATERIAL MANAGEMENT GROUPS

The EM Nuclear Materials Stewardship Program was created by the U.S. Department of Energy (DOE) Office of Environmental Management (EM) to provide a focus for consolidation and disposition of nuclear materials, achievement of mortgage reductions, and closure of facilities. The first major effort of this program was the Nuclear Materials Integration (NMI) Project. The NMI project defined materials of interest to EM, described the plans in place to disposition those materials, evaluated the maturity of those plans, and developed alternatives to optimize the management of those materials. In general, those materials included all Pu-239 owned by DOE except for materials reserved for national security.

The first phase of the NMI program was completed in 1998. Since that time, the EM Nuclear Materials Stewardship Program has established Nuclear Material Management Groups, including the Plutonium Materials Management Group (PMMG), to continue the mission of the NMI program by:

- Assisting sites to stabilize, package, store, and transport “at-risk” materials,
- Identifying and clarifying the inventories of surplus nuclear materials of interest to EM,
- Enabling sites to develop disposition baseline plans and end states for major inventories,
- Continuing as a resource to assist sites with disposition planning, implementation of plans, and/or managing inventories, and
- Facilitating the necessary cross-program interactions for mission success.

The DOE further committed to review the establishment of the Material Management Groups in *A Strategic Approach to Integrating the Long-Term Management of Nuclear Materials, the Department of Energy’s Integrated Nuclear Material Management Plan*, which was required by Section 3172 of the Fiscal Year (FY) 2000 National Defense Authorization Act.

The PMMG has been successful in meeting the goals provided by the EM Nuclear Materials Stewardship Program and the Integrated Nuclear Material Management Plan. The methods, accomplishments, future activities, and challenges are discussed in the following sections.

OVERVIEW AND HISTORY OF PLUTONIUM-239

In order to understand the functioning of the PMMG, it is first necessary to review plutonium materials. Plutonium is a man-made fissile element, produced by neutron bombardment of uranium. Pure plutonium is a silvery metal, heavier than lead. Material that is rich in the Pu-239 isotope is the preferred form for manufacturing nuclear weapons. Production of plutonium began in the early 1940’s in three reactors at the Hanford Site, then operated by a DOE predecessor agency, the Atomic Energy Commission. Five reactors were constructed at the Savannah River Site in the early 1950’s, and between 1948 and 1963, six additional reactors were constructed at Hanford. Eight of the Hanford reactors and one of the Savannah River reactors were shut down between 1964 and 1971 as a result of decreased need for weapons-grade

plutonium. The remaining Hanford reactor and the four remaining Savannah River reactors continued to operate until they were shut down in 1987 and 1988.

Chemical processing facilities were also constructed at the Hanford and Savannah River Sites to produce purified plutonium products, consisting primarily of metal. The metal product was sent primarily to the Rocky Flats Site to be made into weapons parts, then to the Pantex Site for assembly into nuclear weapons. The production and processing activities were designed and operated for high output. As a result, large quantities of residue, scrap metal, oxides, solutions, and other waste forms were produced. These forms still contained large amounts of plutonium and were stored at various sites in several types of temporary storage containers.

As a result of the plutonium production activities, the DOE currently has approximately 99.5 MT of plutonium in its inventory. Figure 1 (based on the Secretary of Energy's *Openness Initiative* announcement of February 6, 1996) illustrates the plutonium inventories (primarily Pu-239) at seven sites in the United States.

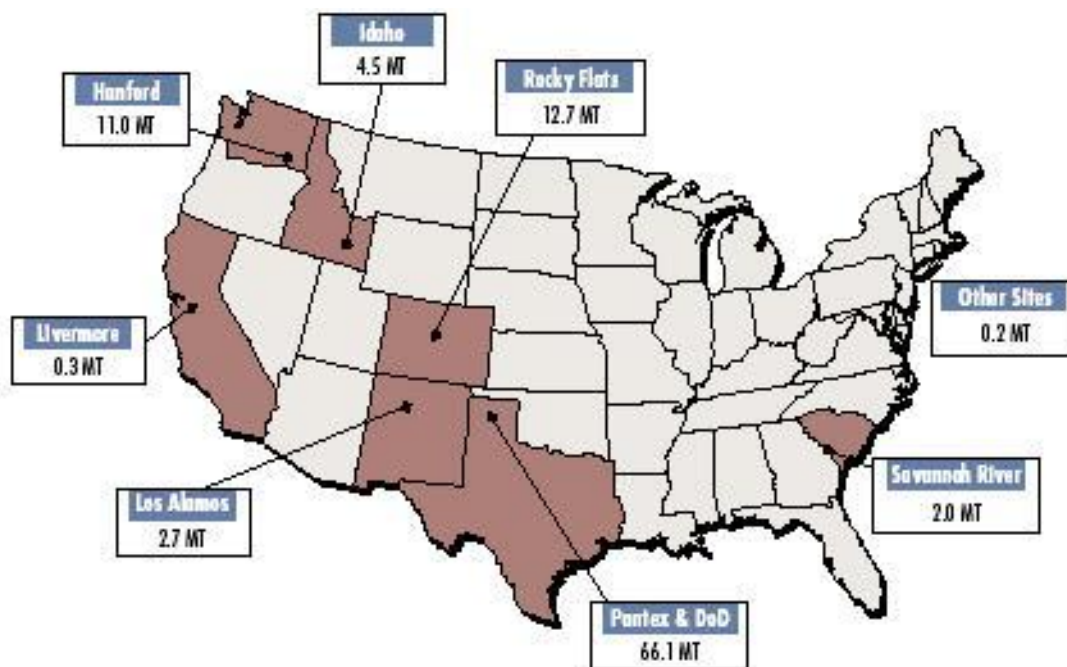


Fig. 1. Plutonium Inventories by Site

Of the inventory shown in Figure 1, a large part is maintained by the DOE and the Department of Defense and is considered *necessary for national security needs*. That material is used in the nuclear weapons stockpile, held for reserves, or used for Research and Development at the nuclear weapons research laboratories. The remaining Pu materials, 52.5 MT, is considered *excess to national security needs*. Of the excess material, a small portion is reserved for *non-national security programmatic use*, such as basic scientific research, criticality research, production of medical isotopes, or heat sources. The majority of the excess Pu material, approximately 48 MT, has no programmatic use and is considered *surplus nuclear material*.

This is the plutonium that must be dispositioned and is, therefore, primarily of interest to the PMMG. The potential disposition paths for the surplus plutonium are:

- Stabilize, blend down as necessary, and ship to the Waste Isolation Pilot Plant for disposal as TRU waste.
- Immobilize in a ceramic matrix and seal in High Level Waste canisters for future disposal in a geologic repository.
- Convert to Mixed Oxide Fuel, irradiate in commercial reactors, and send to the geologic repository as spent fuel.

MISSION, SCOPE, AND OPERATION OF THE PMMG

As noted in the previous section on Introduction and Development of Material Management Groups, one of the primary purposes for the Material Management Groups was to provide a focus for consolidation and disposition of surplus nuclear materials. As an initiating function, the PMMG developed the Mission and the Scope for the organization, as provided in the following sections.

Mission of the PMMG

The Plutonium Material Management Group will serve as the Department's complex-wide resource and point of contact for technical coordination and program planning support in the safe and efficient disposition (including reuse, recycling, sale, transfer, storage, treatment, consumption, or disposal) of the nation's excess plutonium 239 materials. The PMMG will work to ensure the availability of the technical expertise, knowledge, facilities, and processes to perform these functions.

The PMMG mission of technical coordination and program planning support is sponsored by the Office of Environmental Management (EM) and is designed to complement, support, and interface with the Office of Fissile Materials Disposition (NN-60) plutonium disposition activities.

Scope of the PMMG

The plutonium materials within the scope of the PMMG include current and future non-national security Pu 239 materials such as:

- Pure plutonium metals and oxides
- Plutonium alloys
- Non-irradiated fuel and fuel fabrication scraps
- Plutonium processing residues
- Surplus plutonium weapons components, and
- Samples, standards, and research materials as appropriate.

Excluded from the current scope of the PMMG are plutonium materials contained in spent fuel, strategic weapons material, sealed sources, and waste materials. These inventories will be monitored for potential changes in status and to support interfaces with user and disposition programs.

Operation of the PMMG

As previously stated, the goal of the PMMG is to serve as the focal point, catalyst, technical resource, project planner, and facilitator for integrated, complex-wide management of Pu materials within its scope. In order to meet that goal, the PMMG established specific objectives within broad areas of interest:

- *Inventory:* Develop and maintain an item-level plutonium database that provides needed inventory information regarding future disposition of surplus plutonium.
- *Planning and Decision Analysis:* Develop and maintain Pu disposition models, including risk profiles, that support long range planning for the management and disposition of Pu, including future surplus Pu materials from the DOE office of Defense Nuclear Nonproliferation (NN) and the DOE office of Defense Programs (DP).
- *Facility and Infrastructure Planning:* Develop and utilize management systems that define and project facility and infrastructure needs for Pu disposition over the next 25 years.
- *Core Competency and Expertise:* Provide technical expertise and direct technical support to DOE sites and maintain corporate knowledge of forms, quantities, locations and planned disposition of surplus Pu.
- *Program Facilitation:* Facilitate programs complex-wide and act as an interface among sites for safe and efficient life-cycle management of surplus Pu.

As part of the overall implementation of the Materials Management Groups (MMG) program, a steering committee was formed and tasked to provide an oversight role for the MMG's. For day-to-day operation, the PMMG reported to and received operational guidance from the Savannah River Operations Office. Funding for the PMMG was, and continues to be, provided by EM.

In addition, there was a strong interface and guidance function performed by the EM Nuclear Material Stewardship (NMS) program at DOE-HQ. The NMS program also provided a strong coordination function for all the Material Management Groups. Weekly telecons were led by the NMS program and overall scheduling was coordinated by the NMS office. In addition, visits to the major sites with surplus nuclear materials were scheduled and coordinated by the NMS office. The primary purposes of the site visits were to confirm that all the nuclear materials and the associated disposition baselines were identified, review the TBD's and resolve those where possible, review programmatic risk scores, develop integration opportunities, and identify cost-effective alternatives for planned disposition pathways. During the last two years, three major closure sites (Mound, Fernald, and Rocky Flats) and four major operating sites (Hanford/Pacific Northwest National Lab, Idaho National Engineering and Environmental Lab, Argonne National Lab-West, and the East Tennessee Technology Park at Oak Ridge) were visited.

ACCOMPLISHMENTS OF THE PMMG

Over the past two years, the PMMG has provided significant assistance to the DOE for its mission of managing the disposition of surplus plutonium. The PMMG has come to be regarded as a source of technical expertise, project planning, and facilitation for the disposition of Pu. Some of the significant accomplishments include:

- Developing the Materials Management Plan (MMP) for plutonium 239. The MMP defined materials and baseline plans for disposition of Pu materials, evaluated the maturity of baseline plans, and proposed integrated alternatives to reduce risk and accelerate disposition.
- Identifying alternative Pu storage facilities. The PMMG was instrumental in identifying the K-Area Materials Storage Facility (KAMS) at SRS. This facility is key to allowing Rocky Flats to de-inventory their site on an expedited basis.
- Updating and revising the Nuclear Material Disposition Maps. As part of the Nuclear Material Integration Program, predecessor "teams" of the MMG's developed disposition maps for the nuclear materials of concern to EM. These disposition maps identified the materials, their current location and condition, and their paths to ultimate disposition. Many of the paths to disposition ended at a "TBD", which was a technology or process that did not exist and was yet "To Be Determined". The PMMG, as well as other MMG's, participated in an effort that was coordinated by the EM Nuclear Materials Stewardship Program to identify known technologies or processes that could remove the "TBD's". The PMMG also initiated a visit to Argonne National Lab-West (ANL-W) to assist ANL-W in identifying alternate methods for disposition of their Pu materials. The Nuclear Material Disposition Maps are then revised to reflect available disposition paths in place of the prior "TBD's".
- Identifying remaining Pu materials in the DOE complex that could potentially require canyon processing at SRS.
- Developing an integrated Pu materials database that will provide one source for all necessary Pu inventory information and meet the needs for various inventory reports for multiple DOE offices.
- Facilitating Pu de-inventory from the Mound site to SRS.
- Developing the Charter and Fiscal Year Work Plans for the PMMG.
- Supporting completion of the Unallocated Off-Specification Highly Enriched Uranium Trade Study that identified recommended disposition paths, with backups, for 22 MT of off-spec HEU.
- Developing a Pu Hazards Profile for three of the major Pu sites, Rocky Flats, Hanford, and Savannah River. This was done in cooperation with the DOE Center for Risk Excellence and the Pacific Northwest National Lab. The objective of the Pu Hazards Profile was to formulate and demonstrate a method for producing Pu relative hazard profiles that effectively communicate the story that the relative hazard associated with Pu is reduced as it is effectively treated and dispositioned.
- Providing technical criteria for justification to dispose of Pu materials as transuranic (TRU) waste at the Waste Isolation Pilot Plant (WIPP). As the facilities planned by DOE for the immobilization of Pu and the conversion of Pu into MOX fuel are

- delayed, and the requirements to immobilize Pu to meet the terms of prior agreements with the USSR are renegotiated, DOE can take advantage of a more cost-effective means of disposition by disposing of Pu to WIPP as TRU waste.
- Assisting Argonne National Lab-West and Oak Ridge National Lab by identifying cost-effective alternatives for disposition of Pu materials at their sites. This is an excellent illustration of one of the key functions of the PMMG: establishing and maintaining the technical expertise to assist sites with disposition questions and problems. The PMMG initiated a visit to ANL-W to meet with the personnel associated with treatment, storage, and disposition of surplus Pu at ANL-W. As a result, several cost-effective alternatives for disposition of the ANL-W surplus Pu were identified and are currently being pursued by both PMMG and ANL-W personnel.
 - Providing technical expertise and data to characterize the Pu material streams for a preconceptual design study to identify alternatives for production of feed streams for the Mixed Oxide Fuel Fabrication Facility.

FUTURE ACTIVITIES

Since its formation in 2000, the PMMG has established itself as a source of technical expertise, project planning, and cost-effective alternatives for disposition of PU materials throughout the DOE Complex. Over the next year, several activities will be done to further improve DOE's ability to address the issues associated with disposition of Pu materials. Those activities include:

- Continue to develop a national, integrated Plutonium database. This database will support integrated program planning; provide consistent, readily available data for trade studies and white papers on transportation, treatment, storage, disposal, and waste evaluations; avoid loss of technical knowledge as current "experts" retire; and maintain tracking consistency across time periods and among programs.
- Support evaluation of options to dispose of additional Pu materials to WIPP.
- Interact with the DOE Office of Defense Programs (DP) to identify future excess plutonium from the materials currently maintained for national defense purposes. This will be a major effort and is necessary to allow adequate planning for disposition of these materials once they become surplus.
- Complete follow-up actions to identify and implement preferred alternatives for disposition of Pu materials from both ANL-W and Oak Ridge National Lab.
- Identify and implement approaches to address plutonium at small DOE sites as well as plutonium associated with loan-lease agreements between DOE and commercial sites, such as universities and other R&D facilities. The effort thus far has focused on the major DOE sites where large quantities of plutonium are stored. It is important to identify other sources of excess plutonium and plan for disposition of that material.
- Continue to resolve and remove "TBD's" in the plutonium disposition maps by identifying applicable disposition methods for problem materials.

An additional area of emphasis for the PMMG during the next year is the development and further strengthening of relationships and ties among personnel throughout the DOE complex

that are dealing with Plutonium storage, treatment, shipping, and disposition. Although this is not a specific task, it is crucial for further success of the PMMG.

CONCLUSIONS

Since January of 2000, the Plutonium Materials Management Group has been successful in addressing many areas of concern for DOE in the disposition of excess plutonium materials. It has demonstrated the benefits of developing a source of technical expertise and applying that expertise throughout the complex. The PMMG has played a major role in expediting the removal of plutonium residues from DOE sites that are scheduled to be closed in the near future and in the identification of cost effective alternatives for plutonium disposition at other DOE sites. It has, and will continue to, provide a path for identifying and implementing technologies for plutonium disposition in a coordinated, consistent, and cost-effective manner.