

**NUCLEAR MATERIALS STEWARDSHIP  
WITHIN THE DOE ENVIRONMENTAL MANAGEMENT PROGRAM**

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**ABSTRACT**

The Department of Energy (DOE) Environmental Management (EM) Program has made significant progress in planning disposition of its excess nuclear materials and has recently completed several noteworthy studies. Since establishment in 1997, the EM Nuclear Material Stewardship Program has developed disposition plans for excess nuclear materials to support facility deactivation. All nuclear materials have been removed from the Miamisburg Environmental Management Project (Mound), and disposition planning is nearing completion for the Fernald Environmental Management Project and the Rocky Flats Environmental Technology Site. Only a few issues remain for materials at the Hanford and Idaho sites. Recent trade studies include the Savannah River Site Canyons Nuclear Materials Identification Study, a Cesium/Strontium Management Alternatives Trade Study, a Liquid Technical Standards Trade Study, an Irradiated Beryllium Reflectors with Tritium study, a Special Performance Assessment Required Trade Study, a Neutron Source Trade Study, and development of discard criteria for uranium. A Small Sites Workshop was also held. Potential and planned future activities include updating the Plutonium-239 storage study, developing additional packaging standards, developing a Nuclear Material Disposition Handbook, determining how to recover or dispose of Pu-244 and U-233, and working with additional sites to define disposition plans for their nuclear materials.

**INTRODUCTION**

The Department of Energy set aggressive goals to close as many excess facilities as possible by 2006. To support this objective, it is necessary to first deinventory the facilities of nuclear materials. In some cases, it is also necessary to process materials from other facilities and DOE sites prior to shutdown, such as with F Canyon at the Savannah River Site. In 1997 the Environmental Management Nuclear Materials Stabilization and Stewardship Program was established as a partnership among DOE Headquarters, the Albuquerque Operations Office, and the Savannah River Operations Office. Since that time, Idaho Operations Office and the Oak Ridge Operations Office have also joined the program. This program has made significant progress in identifying excess nuclear material inventories, identifying disposition plans,

determining barriers to success, and helping sites resolve these barriers. The program has five major components that are described as follows.

- **Establish EM Nuclear Material Baseline**  
This step applies uniform procedures and processes to work with sites under the Environmental Management Program to identify excess materials, identify the baselines, use standardized scoring to rate the likelihood of programmatic success, to identify barriers/issues, and to maintain the inventory in a corporate database (the Integrated Planning And Budgeting System, IPABS)
- **Resolve EM Disposition Barriers**  
Four Nuclear Material Management Groups have been established to provide technical assistance to the sites in planning disposition of their excess nuclear materials and to help resolve barriers, share lessons learned, and to develop a Departmental understanding of assigned nuclear materials. The initial focus of these groups is excess materials either owned by the Environmental Management Program or that will require processing in facilities owned by the Environmental Management Program prior to their shutdown. The four Groups are:
  - Heavy Isotopes           at Oak Ridge
  - Uranium                   at Oak Ridge
  - Plutonium               at Savannah River
  - NISS                      at Albuquerque
- **Consolidate Materials**  
In limited cases the Material Management Groups have been able to provide actual consolidation services to support site deinventory. The Uranium Management Group has assisted in the deinventory of Fernald through consolidation at Portsmouth, and some miscellaneous materials containing Plutonium from small sites have been consolidated at Savannah River.
- **Assist Other Program Disposition Planning**  
As planning for the disposition of materials affecting the Environmental Management Program nears completion, it is expected that the technical resources that have been funded by the EM program will be made available to other DOE programs to provide assistance in planning disposition of their excess materials.
- **Program Integration, Monitoring and Technical Support**  
An organization of technical experts at many DOE sites has evolved to support nuclear material management. The program integration function involves the collection of information, analysis, prioritization and recommendation of specific tasks, such as trade studies. Monitoring involves the collection and analysis of performance metrics. Status information is kept by site, and by material to provide summary information to EM management on barriers/issues that require attention. In addition to developing specific plans and analysis, technical resources are available to respond to specific requests, answer calls, provide advice, etc.

Several key activities are described below in more detail with specifics on eight major tasks that were completed or initiated during Fiscal Year 2001. Planned future activities are also described at the end of this paper.

## **SAVANNAH RIVER SITE CANYONS NUCLEAR MATERIALS IDENTIFICATION STUDY**

This study was conducted to determine how long the SRS canyons should be utilized. These facilities are old and expensive to operate; however, they are unique National capabilities. The Savannah River Canyons include two chemical processing facilities (F and H) that were constructed in the 1950's and primarily processed enriched Uranium fuels and Plutonium targets from the SRS reactors for the U.S. nuclear weapons program. The Canyons also processed research reactor fuel from both U.S. domestic and foreign reactors. Since the end of the Cold War, the Canyons' mission has changed to stabilizing and dispositioning surplus nuclear materials. While the Canyons and associated facilities are expensive to operate and maintain (over \$150M/year/canyon), they represent the Nation's only capability to process spent reactor fuel and large quantities of highly radioactive materials that have nuclear criticality concerns. This study involved over three years of examination of nuclear material inventories, their disposition paths, and their potential need for canyon processing. The study built on previous studies and involved subject matter experts from across the DOE Complex. Based on these in-depth reviews of the excess materials, DOE is confident that it has identified essentially all those requiring canyon processing. Since no additional materials were identified that require the use of the F Canyon Plutonium Uranium Extraction (PUREX) process, and F Canyon can be shut down in the near future. H Canyon is expected to operate until about the 2008 time frame, and it provides a capability similar to F Canyon. Surplus materials will be tracked until they are either processed in H Canyon or dispositioned via some alternate path. (For more information, contact George Klipa, 803-952-2550)

## **CS/SR MANAGEMENT ALTERNATIVES TRADE STUDY**

The Department owns a large inventory of radioactive Cesium and Strontium, mainly material that was separated from waste at the Hanford Site. The purpose of this study was to determine whether there is a commercial market or if savings could be realized through consolidation or other changes in management practices. Throughout the DOE Complex, there are over 70,000,000 curies of cesium and strontium nuclear materials in storage. This study evaluated whether changes in management plans could result in:

- A reduction in risk to workers, the public, or the environment
- A reduction in cost of maintaining the inventory, or
- A reduction in the number of facilities and sites required for storage.

A formal trade study was commissioned to evaluate alternatives. A team of subject matter experts from Hanford, Idaho National Engineering and Environmental Laboratory (INEEL), Savannah River Site, Oak Ridge National Laboratory, Sandia National Laboratories, and DOE Headquarters developed alternatives for evaluation. The "Guidebook for Decision Support Methods" was used to provide transparency and defense in the decision approach. The trade study was completed in August 2001, and determined that no programmatic changes in inventory

management are required. In addition to affirming current management plans, it demonstrated the beneficial use of the "Guidebook for Decision Support Methods" on a practical problem. (For more information, contact Jim Low, 505-845-5458)

## **LIQUID TECHNICAL STANDARDS**

Many sites have nuclear materials in liquid form that do not have disposition plans. Treatment options are needed at sites with limited processing capabilities to stabilize liquid technical materials and standards for storage and disposition. Currently, this problem is most relevant at closure sites and small sites where limited facilities exist. However, some large sites have expressed interest in treatment alternatives for these materials as they anticipate reducing their facility capabilities in the future. An interim report was issued in September 2001 that recommends that DOE inform and educate all sites on state-of-the-art methods and practices in the treatment and disposition of these materials. Specific recommendations are:

- Conduct Liquid Technical Materials workshops to expand the participation of a greater number of sites
- Issue a handbook that describes and rates the most promising treatment options against various performance metrics

DOE facilities that are not experienced with existing disposition methods can leverage heavily off the experiences and expertise of those facilities that have successfully implemented such methods. Use of this existing expertise will facilitate disposition of materials and support site deinventory and closure.

(For more information, contact Jim Low, 505-845-5458)

## **IRRADIATED BERYLLIUM REFLECTORS WITH TRITIUM**

Beryllium reflectors used in nuclear reactors at INEEL and the Oak Ridge National Laboratory are problematic since they do not contain enough tritium to economically recover, and their tritium content makes them difficult to dispose. These reflectors are made from beryllium that has no reuse options, but they contain high levels of potentially useful tritium produced from neutron irradiation. A study was performed to examine the practicality and economics of recovering the tritium, and whether processing would improve disposal options for the reflectors. In addition to the tritium, the irradiated beryllium contains  $^{60}\text{Co}$  and  $^{14}\text{C}$ , which do not meet current on-site waste acceptance criteria. At-reactor storage space is extremely limited and requires removal of the beryllium items by 2003. Alternative disposal options were developed and examined for these materials including disposal as Low Level Waste (LLW), Transuranic Waste, or High Level Waste. Several alternative tritium extraction processes and facilities were also evaluated, and the economics of alternative processing options examined. Recovering tritium from irradiated beryllium reflectors is not economically feasible at current market prices, and does not simplify waste disposal issues for these materials. Therefore, disposal of these materials within DOE's waste management system is recommended. A decision to dispose of the reflectors will free up premium storage space and will reduce programmatic risk associated with long-term onsite storage of these materials. This recommendation does not simplify the disposal issues, but does provide guidance on a path forward.

(For more information, contact Jim Low, 505-845-5458)

## **SPECIAL PERFORMANCE ASSESSMENT REQUIRED (SPAR)**

Many DOE surplus materials are currently excess to program needs and reuse and recycle assessments have demonstrated that these materials should be disposed of as waste. Many of these materials are similar to wastes that qualify for LLW disposal except for a few characteristics that exceed the disposal requirements defined in the disposal site's waste acceptance criteria (WAC). Hanford and Nevada Test Site disposal sites provide disposal for these types of materials through implementation of a Special Performance Assessment Required (SPAR) process. An evaluation of the SPAR process is necessary to determine if an institutional framework and methodology should be established to support excess materials. DOE has developed and documented the methodology to examine the feasibility of using SPARs to demonstrate that some DOE surplus materials can be safely disposed as LLW, on a case-by-case basis, even though the material may exceed select requirements of the disposal site's waste acceptance criteria. Identification of acceptable disposition paths for surplus nuclear materials is critical to site closure (and to facility and site cleanup at non-closure sites). If these materials can be safely disposed at DOE's LLW disposal sites, then the disposition path becomes known and viable. In addition, establishing a methodology for the SPAR process will:

- Provide an institutional framework rather than each site developing independent SPAR evaluations
- Facilitate disposal of items currently exceeding WAC limits.

(For more information, contact Jim Low, 505-845-5458)

## **URANIUM DISCARD CRITERIA**

DOE completed a Trade Study on the Consolidation and Management of Low Enriched Uranium, Natural Uranium, and Depleted Uranium (LEU/NU/DU). Subsequently, the Uranium Management Group in Oak Ridge prepared a Retain Discard Criteria to guide decisions on dispositioning excess DOE-owned LEU/NU/DU. Excess inventories (more explicitly, those inventories identified as "excess to National Security") are broken down into Surplus and Programmatic. However, many of the programmatic activities, for which these materials were designated, are no longer active. Therefore, most of the total excess LEU/NU/DU identified in current inventories is presently considered to be available for future use or disposal, even though a portion may be presently designated as Programmatic. The criteria provides guidance to DOE sites for the disposition decisions regarding excess unirradiated LEU/NU/DU materials owned by or under the responsibility of DOE.

Material managers should validate whether the activities associated with items listed as "Programmatic" are still valid. After determining unequivocally that a batch or item of material is no longer part of a known governmental use, the key decision for material managers is "Does the material have potential future Government or commercial use?" The answer to this key question will determine a path toward retaining the material or discarding it. In evaluating the retain/discard decision, the sites must consider a number of factors. Some of these can be quantified and measured while others are more subjective. Included among these factors are physical condition; form; purity; enrichment; quantity; site; packaging and shipping; availability of disposal options; economics of disposal; availability

of storage; economics of storage; and unique applications. The Uranium Management Group and/or DOE program offices should also evaluate other factors more global in nature and out of the site's control from a complex-wide viewpoint. Some of these additional factors are material ownership, market, the availability of HEU blend material, and the availability of facilities for and economics of purification/blending.

(For more information, contact Carl Sink, Office of Nuclear Materials and Spent Fuel (EM-21), at 301-903-5131, or Judy Stroud, Uranium Management Group, at 865-576-7710)

## NEUTRON SOURCE TRADE STUDY

DOE sites hold approximately 700 large ( $>0.1\text{mCi}$ ) and nearly 500 small neutron sources, most of which are excess. Identified disposition paths for many of these sources are no longer available, and there are no established disposition paths for neutron sources other than alpha-emitting radionuclides, such as polonium or radium. The Neutron Source Trade Study Working Group is developing recommended options for disposition of DOE sealed neutron sources. Existing programs provide disposition options, and a method for selecting the proper option (reuse or disposal) will be developed. Identification of acceptable disposition paths is critical to site closure and to facility and site clean up at non-closure sites. At non-closure sites and/or facilities, source removal can improve productivity by reducing record keeping and freeing up valuable secure Special Nuclear Material storage space. In addition, excess sources pose an ES&H risk in the complex as numerous incidents of loss of control, loss of accountability, and unintended worker exposure are reported. Consolidating and/or disposing of excess source materials will reduce the chance of such incidents. Recommendations will provide a path forward for dispositioning excess neutron sources. This study is expected to be complete during FY2002.

(For more information, contact Jim Low, 505-845-5458)

## SMALL SITES WORKSHOP

Many small sites have unique excess materials but do not have capability to:

- Characterize
- Stabilize
- Store
- Transport or
- Disposition.



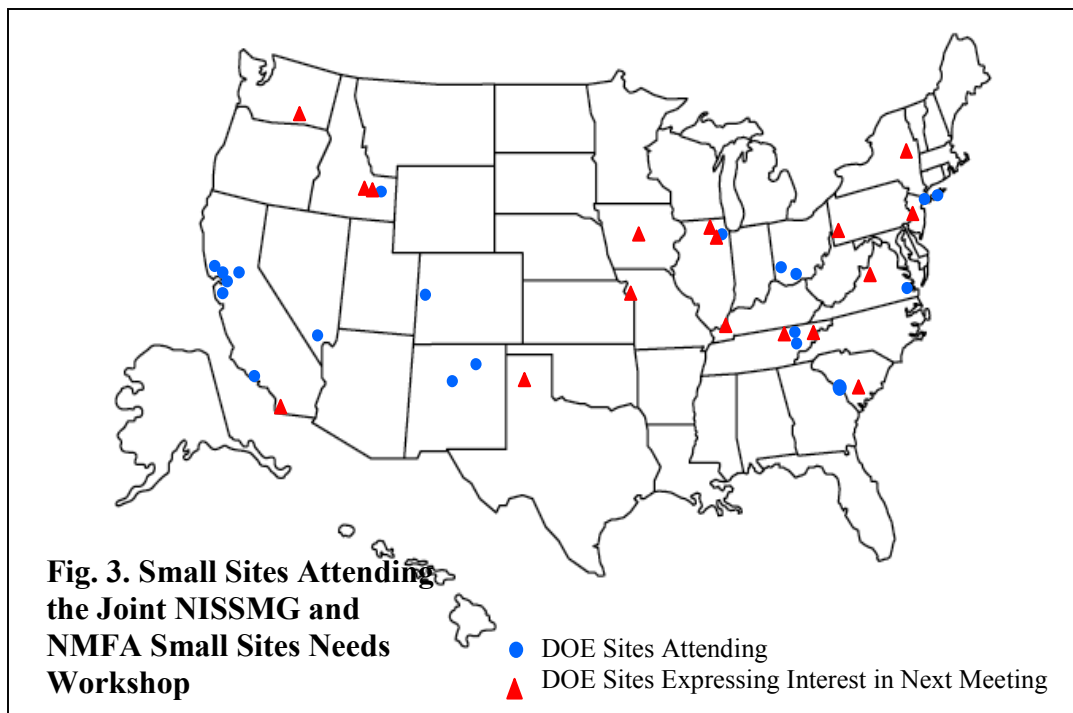
Fig. 1. Excess materials



Fig. 2. Excess materials

A workshop was held, as a joint effort among the Nonactinide Isotopes and Sealed Sources Management Group (NISSMG), the Nuclear Materials Focus Area (NMFA), and other service providers, to provide assistance to DOE's small sites (sites with small nuclear material inventories). The sites with difficulties managing their materials are primarily the closure sites and small sites. To date, the NISSMG has focused its efforts on closure sites, specifically Mound, Fernald, Rocky Flats, and Ashtabula. Given the preponderance of issues with DOE sites holding large inventories of nuclear material, sites with smaller holdings may not be adequately

understood and supported in their management of nuclear materials. The first Small Sites Needs Workshop was conducted on September 11<sup>th</sup> and 12<sup>th</sup>, 2001 in Las Vegas, Nevada. This workshop was coordinated and hosted by Lawrence Livermore National Laboratory (LLNL) with support from the Idaho National Engineering and Environmental Laboratory (INEEL) and Sandia National Laboratories (SNL). Small sites with accountable amounts of nuclear materials were expressly invited to attend, and larger sites with similar needs were also welcomed to participate. Forty-eight participants attended the workshop, representing 19 small sites, eight service providers, various DOE offices, and the workshop organizers. Twenty-seven other small sites indicated an interest in the workshop, but that they were unable to participate at this time due to budgetary and travel restrictions. Both service providers and sites gave presentations at



the workshop. At breakout sessions, sites had time to interact one-on-one with the service providers to discuss their specific needs in more detail. These discussions were documented, and, by the end of the workshop, they identified 49 specific site need and service provider capability matches. Several sites were given guidance that allowed for the establishment of a disposition path that did not exist prior to their attendance at the workshop. As indicated by surveys, the sites were highly satisfied with the workshop. Ninety-five percent of those responding indicated that they were “satisfied” with the direction received from the workshop for their site’s materials issues” and 100 percent recommended a future workshop be conducted for those sites that were unable to attend. Based on sites' survey comments, the workshop was highly successful in initiating and enhancing communication between the sites and DOE/EM organizations. The meeting proceedings provide a first step in the identification and resolution of small site nuclear material management issues.

(For more information, contact Jim Low, 505-845-5458)

## PLANNED FUTURE ACTIVITIES

The authors of this paper continually review progress within the EM program and identify new barriers/issues. Activities to resolve these barriers are prioritized and work is assigned to the various Material Management Groups and site personnel. Some of the future activities being planned include:

- Plutonium Storage Study – An update to an earlier study that would respond to any changes that may be made in the Plutonium disposition strategy.
- Packaging Standards – Standards have been developed for certain materials such as Pu-239 greater than 40% Pu, U-233, etc. The need for additional standards for materials such as Np-237 is being reviewed.
- Nuclear Material Disposition Handbook – Some procedures, processes, and criteria have been developed to disposition excess materials. A handbook may be developed to assist site personnel in planning disposition of their excess materials.
- Pu-244 recovery or disposition. A decision was made to recover the valuable Pu-244 contained in MK-18A targets at Savannah River pending identification of funding. Future effort will probably focus on disposition at Savannah River or recovery at Oak Ridge
- U-233 disposition – There are two primary inventories of U-233. Uranium mixed with thorium in fuel forms at Idaho and Uranium in a variety of forms at Oak Ridge. The DOE is proposing to use the U-233 at Oak Ridge through a commercial procurement to recover valuable daughter products. After this procurement process is resolved, it may be necessary to further consider any materials at Oak Ridge or Idaho that are not managed through disposition by the procurement activity.

## REFERENCES

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