

**U.S. DEPARTMENT OF ENERGY (DOE) NUCLEAR MATERIAL DISPOSAL
ORPHANS**

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ABSTRACT

The DOE-EM nuclear material orphan identification initiative was established in December 2000. The goals of this paper are to: 1) describe recent DOE efforts in the definition, categorization and identification of disposal orphan materials, and 2) describe the DOE actions to evaluate suitable disposition plans and select disposal options.

The DOE has prepared a preliminary report on "Disposal Orphans Material Categories and Inventory Status" that defines "disposal orphans" and lists known inventories based on current information available to the DOE-EM Office of Nuclear Material and Spent Nuclear Fuel. The list of disposal orphans was created to help any long-term planning for disposal of such materials. The analysis in the report is focused on elucidating disposal options. However, reuse options are recommended in general for all surplus nuclear materials, i.e., waste disposal options should be pursued only after all reuse options have been exhausted.

The nuclear material disposal orphans are a subset of "surplus" DOE nuclear materials that, were they to be declared waste, and would be a challenge to disposition (reuse or dispose of) in the current framework. As a result, some disposal orphans could become part of the critical path schedule for DOE site closures, causing increased costs and significant delays.

Their material characteristics or programmatic use do not make them readily acceptable for disposal in DOE low-level waste (LLW) sites, the Waste Isolation Pilot Plant (WIPP), or a geologic repository for High-Level Waste (HLW) and Spent Nuclear Fuel (SNF), for re-use (e.g., within the Isotopes Sales Program). Their material characteristics do not make them readily acceptable for joining other stored inventories at major storage facilities (e.g., Y-12 for HEU inventories), or for programmatic acceptance into the DOE Office of Fissile Materials Disposition, which has developed acceptance criteria to specify the material forms of highly-enriched uranium (HEU) and plutonium that it can receive.

For most the orphan materials, programmatic reuse has been or may be exhausted in the next several years and it is therefore prudent to assess waste disposal. However, no disposal option is readily available, for reasons of a technical (i.e., the material does not meet facility or programmatic acceptance criteria), legal, regulatory, and/or DOE policy nature.

The disposal orphan inventories will likely grow over time as a result of information-gathering activities that are intended to include informal contacts with DOE nuclear material managers and knowledgeable waste management individuals. Such activities will likely build the list

sufficiently so that the inventories represented therein can be a starting point for appropriate disposition planning efforts.

INTRODUCTION

Nuclear material disposal orphans are typically those materials from the back end of the weapons or fuel cycles within DOE that are relatively challenging to re-use or dispose of (i.e., to disposition) at present. The disposal orphans study was initiated to determine the nature and magnitude of these challenges for DOE-EM.

The DOE-EM disposal orphan materials described in this paper are not to be confused with materials in the DOE Offsite Source Recovery Project (radioactive sealed sources) orphans program.

RECENT ACTIVITIES AND PROGRESS

During 2001, DOE defined and categorized the known disposal orphan materials. Applicable DOE nuclear material managers have made attempts to find suitable disposition plans or to select disposal options for further evaluation. The initial surveys to identify orphan materials were prepared without the formality of a traditional DOE data call.

The identification of the disposal orphans has been closely integrated with the DOE-EM Nuclear Material Stewardship (NMS) Program and the DOE-EM National Spent Nuclear Fuel Program (NSNFP). This relationship allows the timely exchange of general information, updates on waste management policy, and DOE-complex lessons learned. The disposal orphans team consists of representatives from DOE and contractors at DOE-HQ/EM, the INEEL, and SRS.

The orphans identification effort began with a search of the DOE Spent Nuclear Fuel Database, coupled with insight from the staff at the INEEL who provided expertise in the area of reactor fuels materials. They provided much of the basic information about the lightly irradiated (contact handled) SNF materials, unirradiated but significantly radioactive (contaminated) reactor fuels, unirradiated reactor fuel forms, and miscellaneous reactor items from operations or R&D.

The EM Nuclear Material Stewardship program has provided coordination with all of the Material Management Groups. Visits to the major sites with surplus nuclear materials were scheduled and coordinated. The primary purposes of the site visits were to confirm that all the nuclear materials and the associated disposition baselines were identified, review the nuclear materials disposition considered as to-be-determined (TBD) and resolve disposition questions where possible, review programmatic risk scores, develop integration opportunities, and identify cost-effective alternatives for planned disposition pathways.

Some of the disposal orphan materials were identified during these site visits. 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. In addition, in December 2001 the Savannah River Site staff completed a self-

assessment “site visit” and that included a TBD decision analysis. A surplus nuclear material for which the disposition stream has not been evaluated is not considered to be a disposal orphan.

To date twelve well-defined categories of disposal orphans were developed and populated with known items, and each significant group of similar items was assessed. This approach has enabled DOE to develop disposition recommendations for many items. To pursue this effort, an informal DOE-EM disposal orphans team was created. The disposal orphans team has identified disposal orphans that cannot be cost-effectively reused or disposed of and that therefore need the development of a suitable disposition option. Example items are Uranium-233 forms, technetium-contaminated uranium, and tritium-contaminated beryllium reflectors from reactor operations. The twelve nuclear materials disposal orphan categories are listed below.

DISPOSAL ORPHAN CATEGORIES

The DOE-EM nuclear material disposal orphan categories currently include:

1. Lightly irradiated reactor fuels
2. Unirradiated but significantly radioactive fuel forms
3. Unirradiated, contact-handled (CH) LEU/NU fuel forms
4. Miscellaneous reactor items from operations or R&D
5. Activated Structural Reactor Components
6. Non-defense Actinides
7. Defense Actinides not meeting MD or WIPP acceptance criteria
8. HEU not meeting MD or waste acceptance criteria
9. NISS items not able to be reused and that fail waste acceptance criteria
10. LEU/NU/DU not able to be reused and that fail waste acceptance criteria
11. U-233
12. Waste Orphans (shown for comparison and perspective)

FUTURE ACTIVITIES

As disposition plans for all nuclear materials continue to mature in the nuclear material stewardship program, some additional disposal orphan nuclear materials will likely be identified that will not be compatible with any current disposal techniques and will need special studies to determine the optimal solutions for disposal. Trade-off studies will be conducted as required to determine the best alternatives.

Some of the nuclear materials treatment technologies under consideration are still being proven. Some of the orphans candidate alternative treatment technologies that are planned to be implemented for the disposition of some nuclear reactor fuels include melt-dilute technology at the Savannah River Site (SRS) and electrometallurgical treatment (EMT) at the Argonne National Laboratory-West. The melt-dilute technology demonstration was in progress during 2001 using the L-Experimental Facility (LEF) at SRS, but progress was recently suspended due to DOE budget constraints. The electrometallurgical technology has been successfully demonstrated at the Argonne National Laboratory-West site.

Some orphan materials may require changes in low-level waste acceptance criteria, or changes in DOE policy, regulations, or law. Each orphan candidate material is screened against applicable waste disposal criteria to verify that a conventional cost-effective waste disposal option has been ruled out. Some materials thought to be eligible for LLW disposal may have significant contaminants that cause them to require special treatment. The DOE-EM Project Management Team (PMT) resources might become an integral part of the disposition review and planning efforts in the near future. The characterization of cold war legacy materials will be a significant challenge for some DOE sites.

DOE-EM representatives will work with non-EM DOE program representatives where possible to find common solutions. Some nuclear materials disposition options will have limited time opportunities. For example, operations at the F-Canyon reprocessing facility at SRS will be suspended beginning in 2002. Some proposed large-scale treatment facilities might be delayed or cancelled due to near-term federal budget constraints. The costs and schedule for the operation of the planned geologic repository may have impacts on some disposal alternative evaluations.

Some orphan materials may be dispositioned by finding unexpected programmatic use options by innovative commercial vendors and researchers for the development of applications that were previously unknown or thought to be impossible.

CONCLUSIONS

Since December 2000, DOE-EM has been successful in establishing a mechanism for identifying and tracking DOE surplus nuclear materials that are disposal orphans and currently do not have a defined viable disposition path.

The DOE staff will continue working with relevant DOE nuclear material managers to find workable solutions to some of the most difficult disposal problems within DOE. DOE has demonstrated the potential benefits of applying this expertise throughout the DOE complex.

The DOE-EM disposal orphans team has initiated the critical steps in expediting the identification of cost effective alternatives for disposition at DOE sites, with lessons learned from the closure sites. The DOE-EM disposal orphans team will continue to work with fellow DOE site representatives and complex-wide nuclear material managers to identify ultimate disposition opportunities for disposal orphans in a cost-effective manner.