

# EFCOG Best Practice # 170

**Best Practice Title:** Effective Management and Disposal of Radioactive Wastes through application of Consolidation Approaches

**Facility:** All DOE Sites

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**Brief Description of Best Practice:** With respect to radioactive wastes, consolidation of wastes means combining, mixing, or accumulating radioactive wastes of different concentrations into a single, waste stream, tank or container. Consolidation of radioactive waste streams must be considered at all stages of waste management. The waste resulting from consolidation of multiple waste streams must be characterized. Consolidation of wastes must be demonstrated to reduce exposure/risk, promote cost effective life-cycle management, or render the waste more suitable for storage, treatment, or disposal.

However, dilution of waste is prohibited (i.e., purposeful mixing of waste with uncontaminated material or non-waste solely for the purpose of reducing the concentrations of contaminants or changing the waste classification). It is important to distinguish between consolidation and dilution. Dilution occurs when contaminated waste is mixed with uncontaminated material solely for the purpose of reducing the waste classification of the resulting waste - or even to allow its release into the general environment. Dilution increases the total quantity of contaminated waste that needs to be managed and is prohibited by DOE.

Use of the best practices documented herein has previously demonstrated reduction in risk and cost of disposal at DOE sites around the Complex.

**Why the best practice was used:** Combining wastes with different physical, chemical, or radiological characteristics can be beneficial. Consolidating different radioactive wastes produces benefits such as dispersing high-activity waste in a larger matrix and reducing container dose rates, minimizing inert void-filler required to mitigate subsidence concerns, reducing localized concentration of high activity in disposal facilities, and reducing the amount of disposed wastes that require unique engineering controls for stabilization or other forms of isolation. Combining radioactive wastes allows waste to be disposed in the most protective and cost effective manner possible. This may provide a path to disposal that was not available prior to consolidation. Unnecessary segregation of waste can increase risks to workers and handling costs.

**What are the benefits of the best practice:** The benefits of waste consolidation include reducing the variability in process inputs, providing a more consistent and stable feed which gives the operator greater process control. The results of waste consolidation should be known in advance to avoid unintentional consequences such as creating larger quantities of radioactive or mixed waste. It is also important to consolidate radioactive wastes when practical, to optimize waste management processes. Unnecessary segregation of waste can increase risks to workers and handling costs.

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*Example 1: A treatment facility uses a thin film drier to remove dissolved solids from radioactive effluents. A new waste stream received by the facility contains transuranic radionuclides in concentrations that could result in drier residue with concentrations of transuranic radionuclides greater than the 100 nCi/g definition of TRU waste. To avoid generating a TRU waste residue from the drier, the facility combines the new influent with other compatible feeds so the resulting drier residue does not exceed the TRU concentration definition.*

*Example 2: A researcher needs to dispose of numerous archived samples that were accumulated over several years. The transuranic concentration in some of the samples is known to be above the 100 nCi/g threshold. The researcher determines through process knowledge and records that none of the samples are incompatible and that consolidating all the samples together results in a low-level waste, which is suitable for onsite disposal.*

In the examples above, consolidation is an efficient means to reduce the different types of waste that need to be managed. Other applicable requirements, including those promulgated by the EPA, DOT, the host state or DOE itself may place conditions or restrictions on waste consolidation that have to be taken into consideration.

**What problems/issues were associated with the best practice:** Creating a homogeneous mixture is often the ideal situation when performing waste treatment or stabilization. Safety requirements, technological limits, ALARA considerations, and process limitations present constraints that often make homogenization impractical when dealing with radiological waste. A graded approach should be used when determining the extent of mixing needed when waste is consolidated.

When performing treatment, it may be necessary to ensure the treatment agent interacts with the waste to the extent that the hazard being treated is mitigated by the treatment process. When consolidating wastes during the packaging process it is generally unnecessary to produce a homogeneous final waste form. However, the degree of waste homogenization required should be sufficient to satisfy the performance requirements of the disposal facility. Methods used for demonstrating compliance with the homogenization requirements for specific radioactive wastes can be documented in the generator's waste certification program.

*Example1: A facility needs to prepare a high activity waste for disposal. The facility determines the contact handled dose limits of the disposal facility can be achieved if the waste is consolidated with low dose waste in a large steel box. In this case the degree of waste homogeneity is unimportant to the disposal facility. The performance measure that needs to be achieved by consolidating the waste is the dose rate of the waste package. Compliance with the requirement is verified by measuring the external dose rate and confirming the radionuclide concentrations and inventory of the final waste form to be shipped meet the waste acceptance criteria for the disposal facility.*

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**How the success of the Best Practice was measured:** Consolidation Requirement will improve worker safety and reduce costs of disposal (LLW vs TRU) (Potential Cost Avoidance of \$6 million or \$8,000 per cubic meter)

Consolidation allows compatible waste types to be combined to reduce costs of disposal (LLW vs. TRU) and improve safety of handling of the waste by no longer requiring segregation. A conservative estimate of the savings from having waste classified as TRU vs. LLW is that characterization and disposal costs for LLW are over \$8,000 per cubic meter while those for TRU are about \$1,700/m<sup>3</sup> and for TRU are about \$10,000/m<sup>3</sup>. The National TRU Waste Management Plan, Rev 1, (8/2013) indicates that over 8,000 m<sup>3</sup> of TRU waste is stored in the DOE Complex as potential TRU waste for WIPP disposal. If only 10% of that inventory were to be classified as LLW, a savings of over \$6 million would be achieved. This does not count cost avoidance from not generating new TRU waste through use of Consolidation techniques.

Draft DOE Order 435.1A "Radioactive Waste Management" Revision: The WMWG supported the efforts to resolve comments from the review of the revised DOE Order by EFCOG members, as well as DOE's internal review. A substantial number (over 15) of WMWG members participated in an active role in the drafting of several sections of the new Order, Guidance, and Disposal Authorization Technical Standard. WMWG members are serving on specific Order requirement rewrite teams and preparing drafts for acceptance by DOE. A considerable cost savings to the Complex could result from implementation of a new Consolidation requirement that was proposed by the WMWG and is in the new draft Order 435.1A.

## **Description of process experience using the Best Practice:**

At SRS, wastes in large boxes were consolidated (and not segregated) to reduce the risk to workers from performing segregation of TRU waste items. A paper was written that describes the classification of contaminated large boxes and other containers containing radioactive wastes. A comparison with DOE Order 435.1 "Radioactive Waste Management" requirements and guidance was documented, and demonstrates that upon discard of contaminated containers and their contents, were characterized as waste to determine the appropriate classification and disposal path. The discarded waste matrix subject to classification (as LLW or TRU) will then be the container and the container contents. If the contaminated, discarded container and contents are below 100 nCi/g, then the waste form would be classified as LLW or Mixed LLW and be disposed in a disposal unit based on the disposal unit's Waste Acceptance Criteria. The documentation was provided in the facilities Radioactive Waste Management Basis to clarify the application of DOE 435.1 to discarded contaminated containers as they are combined into a waste matrix.

The consolidation of waste in the contaminated waste large boxes avoided the high risk and cost of segregation of TRU items, long term storage, and maintenance. Disposal savings as LLW vs. TRU are over \$8,000 per cubic meter and much more if the waste were to be stored indefinitely. (TRU Storage at \$92/m<sup>3</sup>/yr).

## **Conclusion/Summary:**

Transuranic Waste Consolidation Guidance

One of the reasons for transuranic waste classification is to ensure materials with elevated levels of long-lived alpha emitting transuranic isotopes in their final waste form are disposed in a manner that provides suitable isolation from the environment. Because disposal capacity for transuranic wastes is expensive and limited, it is important that generation of transuranic wastes be minimized to the

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extent possible and even reduced through waste consolidation. The results of waste consolidation should be known in advance to avoid unintended consequences such as creating larger quantities of transuranic or mixed waste. It is also important to consolidate radioactive wastes in accordance with, when practical, to optimize waste management processes. Unnecessary segregation of waste can increase risks to workers and handling costs.

The degree of waste homogenization required in the final waste form should be driven by the performance requirements of the final disposal facility. Compliance with the homogenization requirements for TRU waste can be demonstrated in the generator's WIPP certification program.

*Example: A facility needs to dispose of a contaminated jet removed from a tank system. The upper portion of the jet is contaminated with supernate and the lower portion of the jet is contaminated with sludge. If the upper and lower portions of the jet were disposed separately, the lower portion would be classified as TRU. The facility determines that combining both portions of the jet with job control waste from the jet removal work in a large disposal container will result in a final waste form which can be disposed as LLW.*

### Low-Level Waste Consolidation Guidance

The degree of waste homogenization required in the final waste form should be driven by the performance requirements of the final disposal facility. Compliance with the homogenization requirements for the low-level waste can be demonstrated in the generator's waste certification program.

*Example: A site needed to dispose of an excess shielded cask that was used to ship fuel elements and was internally contaminated. The site also needed to dispose of remote-handled irradiated targets that were not considered spent nuclear fuel. Packaged separately, some of the items would have been classified as remote-handled transuranic waste. The performance requirements of the intended disposal facility required the transuranic content in the final waste form be less than 100 nCi/g. Compliance with this requirement was documented in an engineering analysis which demonstrated the final waste form was classified as low-level waste when the waste items were combined with the waste shipping cask.*

Implementation of this consolidation best practice is demonstrated by the existence of a program or procedure that evaluates the merit of waste stream consolidation at each stage of waste management and is documented in the Radioactive Waste Management Basis for the facilities involved.