



Savannah River
Nuclear Solutions, LLC
A Fluor Daniel Partnership

Blending Radioactive Waste

Sonny Goldston
Savannah River Nuclear Solutions

EFCOG WMWG March 3, 2011



What is Blending?

- Blending is the mixing of higher and lower concentrations of radionuclides into a final waste form or matrix.
- Performance of the blended wastes in a disposal facility is and should be the determining criteria for acceptability.
- If a blended (or non-blended) waste form can be demonstrated to meet the performance objectives required for the disposal facility, the waste form should be acceptable for blending and disposal.
- These objectives include groundwater, intruder, and public protection.



Blending vs. Dilution

- Blending is combining materials with different radionuclide concentrations into a single waste matrix to improve the ability to achieve final disposal that is protective of the environment and the public and reduce risk to workers.
- Dilution is mixing contaminated waste with uncontaminated material solely for the purpose of reducing the waste classification or perhaps to release it into the general environment.



Benefits of Waste Blending

- Disposal capacity for higher activity LLW and TRU are very limited and expensive.
- Blending of wastes from different sources can improve performance of disposal facilities by reducing high concentrations – reduce point sources.
- Consideration of waste blending at all stages (TSD) can reduce the hazards of handling and disposal.
- Dispersing high activity waste in lower dose matrix reduces dose rate and minimizes inert void filler to mitigate subsidence concerns.



The Issue: Blending of Radioactive Wastes

- Blending of radioactive waste should not only be formally recognized as an acceptable practice.
- It should be encouraged as a legitimate and practical solution to promote efficient use of available disposal capacity
- It should be encouraged to reduce risks of handling the wastes by workers.



Definitions

DOE G 435.1-1

II-64

7-09-99

"Waste Form. Waste acceptance requirements specify that wastes received at the facility are in a physically/chemically stable form. Acceptable waste streams or **waste forms** are specified by the waste acceptance requirements."

DOE G 435.1-1

III-1

7-09-99

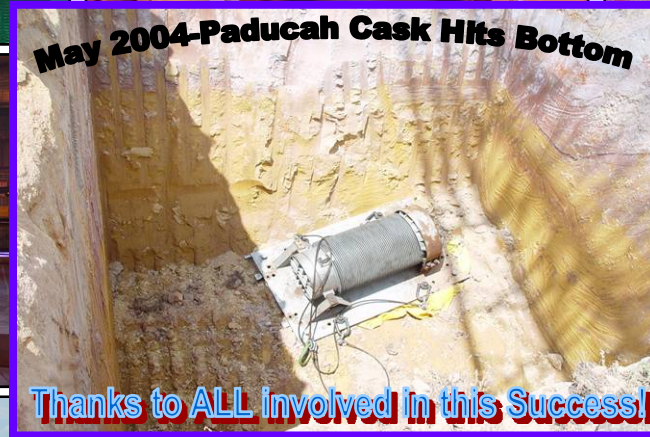
"The mass over which the activity is divided in making the waste determination is the **waste matrix**."

For the purposes of this presentation, the terms **waste form** and **waste matrix** are used interchangeably.

Background - Paducah Cask Waste Form/Matrix Disposal as LLW

- **Paducah Cask Waste Form/Matrix Consisted of:**
 - Cask
 - Contaminated, could not be reused, would be disposed
 - Also could serve as container to "process" and transport other wastes for disposal
 - Cask contained cobalt slugs, cobalt slabs, thulium slugs and curium (Pu239) sampler slugs
 - Actions to process this waste stream was to load out the slugs in the waste cask, then classify the waste form/matrix
 - DOE Order 435.1: Actions taken to process a waste stream for safety or technological reasons may result in the waste being reclassified after processing as LLW
 - The waste form (cask and contents) were 2.2 nCi/gm transuranics, thus LLW
 - 4,070 nCi/gm if Curium (Pu239) slugs were separately packaged

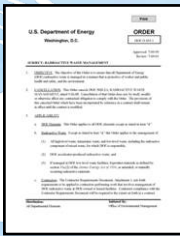
Paducah Cask Waste Form/Matrix



Paducah Cask
Cobalt slugs
Cobalt slabs
Thulium slugs
Curium (Pu239)
sampler slugs

DOE Order 435.1

Radioactive Waste Management



DOE G 435.1-1

III-1

7-09-99

Chapter III - Transuranic Waste Requirements

"III. A. Definition of Transuranic Waste.

Transuranic waste is radioactive waste containing more than 100 nanocuries (3700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years"

- The mass over which the activity is divided in making the waste determination is the waste matrix. (a mass of added shielding, the container, or rigid liners is not included in the calculation)
- The determination of TRU waste should be made each time the waste matrix is transferred to another person or facility (after processing)
- Actions taken to process a waste stream/matrix for safety or technological reasons may result in the waste being reclassified after processing as LLW
- A waste container that fails (becomes contaminated or rejected to waste) can be, but does not need to be, included in the TRU determination

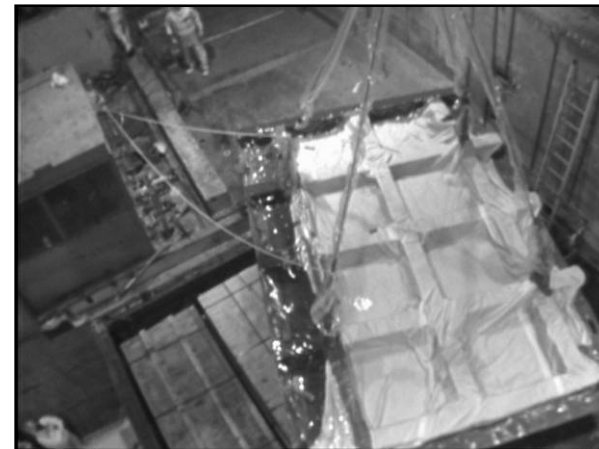
Black Box Repackaging in F-Canyon



F-Canyon Truck Well Door



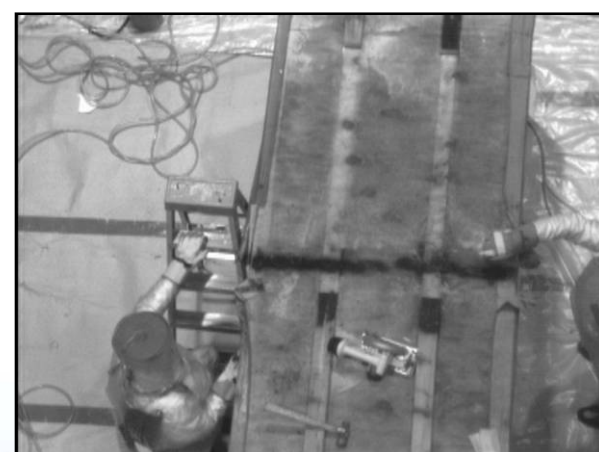
Delivery of Black Box to Truck Well



Removing Black Box lid in truck well

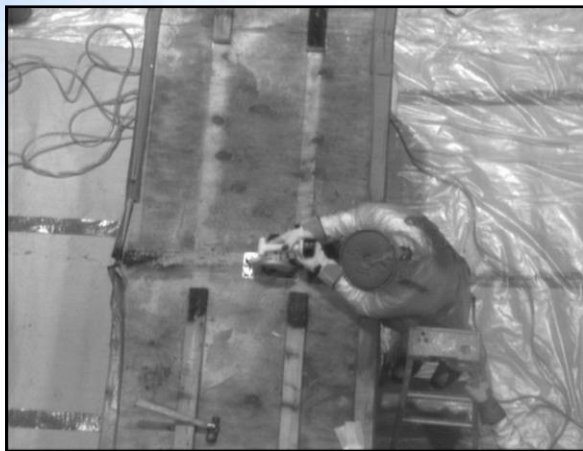


Removing plywood boxes



Painting first cut line to fix contamination

Black Box Repackaging in F-Canyon



Making first cut



Cutting around top of box



Cutting access window for contamination check



First section of top removed
Savannah River
Nuclear Solutions, LLC SRNS
A Fluor Daniel Partnership



Exposure of ductwork in plywood box



Ductwork moved to SLB for disposal

Black Box Waste Has Been Disposed as Both LLW and Repackaged for Shipment To WIPP

- **Black boxes (107) containing radioactive waste have been stored in E-Area as TRU waste for many years**
- **Several (11) black boxes have been determined to contain waste that was less than 100 nCi/gm TRU and thus disposed as LLW**
- **Black boxes once empty have been evaluated for reuse and determined to be waste, thus need to be classified and are expected to be LLW**
- **Boxes used for TRU storage as part of the F/H-Canyon or E-Area Program to repackage TRU waste have not been able to be cleared for free release, therefore have been determined to be waste and must be discarded/disposed as LLW**

Black Box disposal in E-Area as LLW
March 2004



Black Boxes and Their Contents are Radioactive Waste

- **If the boxes will not be reused and will no longer be needed as storage containers the entire waste matrix (box and contents) will be discarded as waste**
- **At the time of discard, the waste matrix (waste box and contents) must be characterized as waste and the waste type must be determined (LLW or TRU)**
- **This need to characterize the waste matrix is required whether you separate the waste contents from the waste box, return the contents to the box, or decide to not to remove the contents from the box due to safety or technological reasons**
- **If the contaminated, discarded box and contents (the waste matrix) are below 100 nCi/gm, then the waste matrix would be classified as LLW or Mixed LLW**

Actions to Process or Not Process The Waste Matrix Can Result in Reclassification As TRU or LLW

DOE G 435.1-1

III-3

7-09-99

"It is also recognized that actions taken to process a waste stream for safety or technological reasons that are justified, may result in the waste being reclassified after processing as low-level waste."

- **This is the case with the contaminated black box waste form**
- **If the box is emptied of its contents as part of the TRU repackaging program and then the box is determined to be discarded, the box will be radioactive waste and must be classified as TRU or LLW.**
- **The discarded contaminated box was then an integral part of the waste matrix before its contents were removed**
- **Therefore, emptying the waste black box and generating a separate TRU waste stream does not reduce the volume of the black box to be disposed and the repackaging/reprocessing will generate both radiological and industrial risks that would be avoided by not repackaging**

Risk to Separate a TRU Waste Form from a LLW Matrix is Counter to DOE 435.1 Guidance

- **Risk would be significantly reduced if the waste matrix was not repackaged and was disposed as LLW**
 - If the matrix is less than 100 nCi/gm and meets LLW or MLLW disposal criteria
- **Avoiding the segregation not only reduces the risk of handling the waste form, it also reduces the total cost of waste disposition by avoiding the creation of a TRU waste stream**
- **Even though the boxes were used to store the waste, the boxes have been determined to be no longer useful, contaminated and thus part of the waste matrix to be disposed**



Summary

- **Black boxes that are contaminated or that cannot be free released will be discarded as radioactive waste**
- **Risk reduction can be attained by not repackaging these black boxes consistent with DOE Order 435.1**
- **The waste matrix that should be classified for disposal included the waste box and its contents for safety and technological reasons, and to avoid creation of a TRU waste stream**
- **Should the contaminated black box waste matrix be less than 100 nCi/gm TRU, the matrix would be determined to be LLW**



Conclusions

- Blending can be a beneficial and necessary part of optimizing the waste management process.
- It will in most cases, reduce the risk of handling wastes.
- Blended wastes must meet the performance objectives for protection of human health and the environment before it is exercised and blended waste is disposed.
- Blending will in most cases reduce the cost of handling and disposal.