Public Hearing on Safety Management of Waste Storage and Processing in the Defense Nuclear Facilities Complex

June 20, 2019

Publicly available references at www.DNFSB.gov/public-hearings-meetings/public-hearing-safety-management-waste-storage-and-processing-defense

Exhibit 1

Photographs from WIPP and Idaho events

February 2014 WIPP event

Source: DOE Phase 2 Accident Investigation Report, Radiological Release Event at WIPP

April 2018 Idaho event

Source: RPT-1659, Formal Cause Analysis for the ARP V (WMF-1617) Drum Event at the RWMC

Chemical reactions can cause drums to rupture and release radioactive contents. Exposures to personnel were limited by fortuitous circumstances.

Overview of Waste: Idaho National Laboratory

Legacy Transuranic and Low-Level Waste at Idaho National Laboratory

Status of Waste	Amount, cubic meters
Shipped to disposal sites	65,300 (86% of total)
Certified for WIPP, but not shipped	2,100 (3% of total)
Yet to be processed or certified	7,600 (10% of total)
Yet to be exhumed*	800 (1% of total)

About 40,000 drums

* Per DOE agreement with the State of Idaho, only "targeted" waste will be exhumed.

Source: DOE-Idaho, May 2019

The legacy solid waste mission at Idaho is nearing completion, but risk remains. Thousands of drums have not yet been certified or shipped.

Overview of Waste: Complex-Wide

Estimated Transuranic Wastes at Selected DOE sites

DOE Generator Site	Waste Volume, cubic meters	Projected Future Waste up to 2033, cubic meters
Hanford	13,230	7250
Los Alamos	3790	4800
Oak Ridge	1315	370
Savannah River	755	11,510

- Does not include low-level waste
- Includes most recently available data (December 2017)
- One cubic meter of waste yields at least five 55 gallon drums

Source: DOE/TRU-18-3425, Annual Transuranic Waste Inventory Report, 2018

While the Department is making progress, the solid waste mission will continue into the coming decades.

Exhibit 3

Board Concerns with DOE Standard 5506

"Given that a WIPP-like event may challenge the [criterion for safety control selection] for TRU waste facilities, DOE Standard 5506 should provide guidance on when such an event needs to be considered to ensure appropriate control selection."

Source: DNFSB/TECH-43, *Deficiencies in DOE Standard 5506-2007, Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities*, February 2018.

The WIPP event showed that chemical reaction events can result in releases that are larger than anticipated, and DOE has not updated its standard accordingly.

Exhibit 4

Schedule Pressure and Waste Events

The oversight of the NNSA Los Alamos Field Office "focused more on budget and schedule performance versus operational oversight…"

Source: DOE Phase 2 Accident Investigation Report, Radiological Release Event at WIPP

The overall project approach was "focused on processing waste to meet milestone requirements rather than compliance with requirements." "Schedule pressure was felt by contractor personnel over the entire period evaluated." There was "reluctance to raise issues that could affect schedule performance."

Source: RPT-1659, Formal Cause Analysis for the ARP V (WMF-1617) Drum Event at the RWMC

The investigations into the WIPP and Idaho events found that schedule pressure was a factor.

Exhibit 5

Common Issues from DOE Generator Site Technical Reviews

DNFSB staff found multiple Generator Site Technical Reviews with similar issues:

- Insufficient specificity provided in procedures and procurement controls.

Example: "The procurement procedure does not impose any conditions that would require a higher quality for items important to waste performance, such as absorbents."

Source: Generator Site Technical Review for Lawrence Livermore National Laboratory, September 2018

- Deficiencies with respect to worker knowledge.

Example: "This issue addresses a lack of knowledge relative to waste management programs and requirements."

Source: Generator Site Technical Review for Idaho National Laboratory, May 2017

Exhibit 6

Generator Site Technical Review for Idaho National Laboratory

A Generator Site Technical Review for Idaho National Laboratory, including the Accelerated Retrieval Project, was performed in January 2017, prior to the April 2018 drum event.

- "It does not seem unreasonable that schedule pressures will increase during this time."
- "There is high confidence that the waste will be WIPP-compliant."

This review did not identify the chemical hazards that caused the Idaho event.

Adequacy of Federal Technical Expertise for Solid Waste Operations

"This is a common concern by [Carlsbad Field Office] of all sites that have undergone the [Generator Site Technical Review]. There is heavy reliance on [Facility Representatives] to provide oversight to protect WIPP… This issue will have to be addressed complex wide for sites that ship waste to WIPP."

Source: Generator Site Technical Review for Los Alamos National Laboratory, March 2018

Adequacy of Federal Technical Expertise for Solid Waste Operations

"[NNSA Los Alamos Field Office] needs to strengthen its oversight … to ensure that … [o]n the ground operational oversight expands beyond that performed by the Facility Representatives to include adequate subject matter expertise."

Source: DOE Phase 2 Accident Investigation Report, Radiological Release Event at WIPP, April 2015

"There is [no training for Facility Representatives] specific to WIPP, TRU waste, or the WIPP [waste acceptance criteria] identified… This is the same system and training that was in place at the time of the accident."

Source: Generator Site Technical Review for Los Alamos National Laboratory, March 2018

Enhanced Chemical Compatibility Review

- Purpose: to identify "potential adverse chemical reactions … that stem from combining potentially incompatible chemicals" as a part of the "process for characterizing and certifying TRU waste for disposal at WIPP."

Source: Transuranic Waste Acceptance Criteria for WIPP, Rev 8.0, July 2016

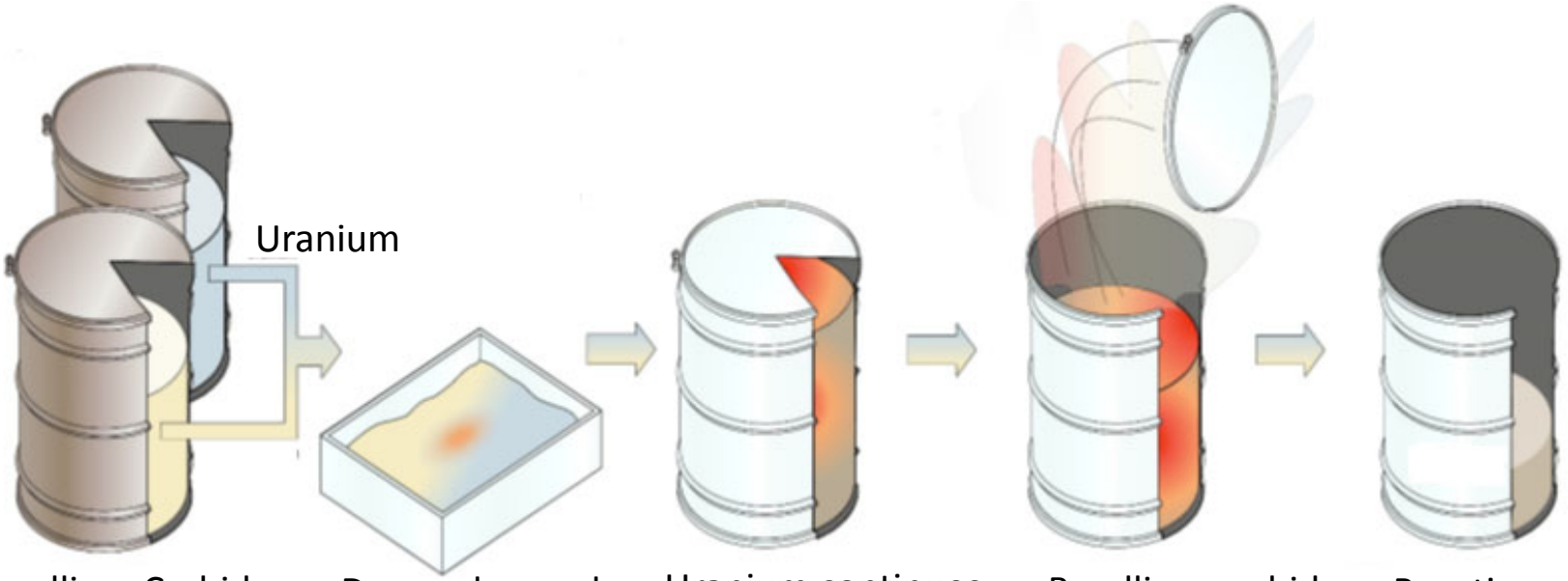
- Based on the protocol identified in Environmental Protection Agency (EPA)-600/2-80-076, *A Method for Determining the Compatibility of Hazardous Waste*.

Challenges with Chemical Compatibility Evaluations

- Uncertainty in chemical composition of legacy wastes
- Exclusion of trace chemicals from evaluation
- Aging of waste
- Uncertainty in visual examination
- Assumed ambient temperature

Exhibit 9

April 2018 Event at Idaho National Laboratory: DOE Contractor Assessment of Progression



Beryllium Carbide

Drums dumped onto sorting table and loaded into trays. Uranium oxidation begins.

Uranium continues to oxidize, producing heat, which accelerates beryllium carbide hydrolysis.

Drums packaged: 2:36 pm to 3:17 pm

Beryllium carbide hydrolysis releases methane, pressurizing drum.

Lid losses: 10:35 pm to 3:00 am

Reaction products ejected, with some remaining in drum.

Modified from: RPT-1662, Technical Analysis of Drum Lid Ejections- ARP V

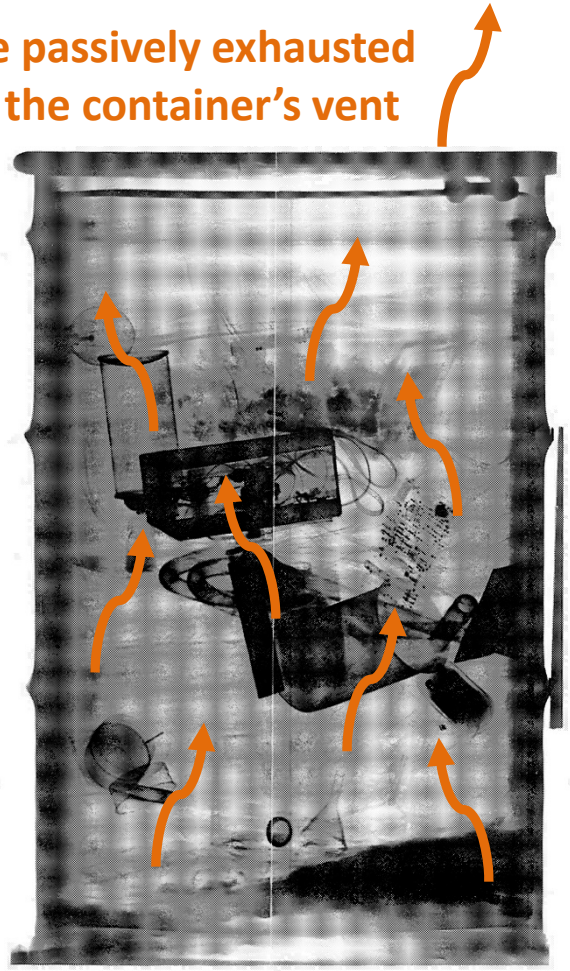
Exhibit 10

DNFSB Concerns with Flammable Gas

Preventing flammable headspace in waste containers:

- Flammable gas generation mechanisms and rate must be correctly understood for the type of waste
- Filter path must be open and sized appropriately to ensure exhaust rate exceeds flammable gas generation rate

Even vented drums can reach flammable conditions.



Graphic assumes the gas is not heavier than air

Defense-in-Depth at Defense Nuclear Facilities

"Defense-in-depth is a fundamental approach to hazard control for nuclear facilities that is based on several layers of protection to prevent the release of radioactive or other hazardous material to the environment. These protective layers are generally redundant and independent of each other to compensate for unavoidable human and mechanical failures so that no single layer, no matter how robust, is exclusively relied upon."

Source: DOE Standard 3009-2014, *Preparation of Nonreactor Nuclear Facility Documented Safety Analysis*

Comparison of Controls for Waste Containers

Material Inside Facility

1. Waste container with passive filter
2. Real-time airborne radiation monitors
3. Fire detection and suppression system
4. Building ventilation system
5. Building structure

Waste Outside

1. Waste container with passive filter

Waste containers stored outside often have fewer layers of controls.

Exhibit 12

DNFSB Staff Survey of Controls for Waste Containers at Los Alamos National Laboratory

	Control	NNSA					EM
		Plutonium Facility		Transuranic Waste Facility	Radioassay and Nondestructive Testing Shipping Facility	Chemistry and Metallurgy Research Building (Inside)	Area G
		Outdoor Pads	Inside				
Mitigation	Confinement Ventilation	No	Yes	No	No	Yes	No
Detection	Continuous Air Monitoring	No	Yes	No	No	Yes	No
Detection	Frequency of Contamination Surveys during Storage	None	Monthly	Quarterly	Quarterly	Monthly	Monthly

- Table includes controls most applicable to a hypothetical release from a container
- Each facility also has visual inspections using different criteria and periodicities
- All facilities conduct a contamination survey as part of container movement and receipt processes
- Environmental air samplers in some areas provide data, but would not necessarily drive an alarm response

The survey indicates opportunities to apply further defense-in-depth and provide a more consistent control strategy across the facilities.