

# Treatment of Remediated Nitrate Salts (RNS)

Dave Funk, Deputy Associate Director  
for Environmental Programs

November 18, 2015



# Waste Generation TA-55



- 1979: TA-55 begins operations
- A wide variety of actinide research and development is performed at the plutonium facility at TA-55
- Operations at TA-55 can generate transuranic waste from activities in the glovebox lines throughout the facility; some produce nitrate salt waste



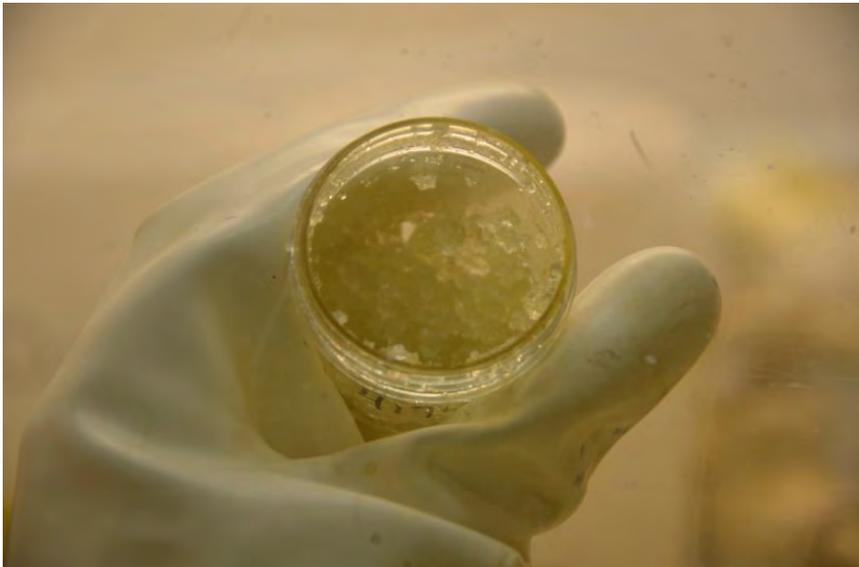
# Waste Generation TA-55 (cont.)

- Evaporator salts and evaporator bottoms were generated continuously from nitrate recovery operations at TA-55, Plutonium Facility 4 between 1979 and 1991
- When evaporator bottoms cooled to room temperature, they were filtered and the nitrate solution would crystallize or “salt” out
- Salts were then washed, vacuum dried to reduce moisture content, double (or triple) bagged and placed in lead and polyethylene-lined 55-gallon drums
- Drums were placed in storage for decades



# LANL Evaporator Bottoms

- Evaporator bottoms are mainly hydrated nitrate salts of Na, K, Ca, Mg, Al
- Bagged-out nitrate salts were packed in drums with poly liners
- Non-cemented nitrate salts were identified for remediation based on records and Real Time Radiography (RTR)



# Nitrate Salt Issue

- Report FR 10-13 Results of Oxidizing Solids Testing issued by New Mexico Tech Energetic Materials Research and Testing Center
  - Determined amount of inert material that must be mixed into the most reactive sodium nitrate-potassium nitrate ratio in order to classify the mixture as a non-oxidizer
  - Documented in a LANL-Carlsbad Office Difficult Waste Team white paper, “Amount of Zeolite Required to Meet the Constraints Established by the EMRTC Report RF 10-13: Application to LANL Evaporator Nitrate Salts”
  - Recipe: for every liter of nitrate salt present at least 1.2 liters of zeolite/kitty litter must be added



# Waste Remediation at WCRRF

- Drums were remediated at the Waste Characterization, Reduction and Repackaging Facility (WCRRF)
- Remediation required to meet Waste Isolation Pilot Plant's (WIPP) waste acceptance criteria
- Remediation included:
  - Testing for pH and neutralization as necessary;
  - Absorption of liquids; and
  - Mixing the waste with kitty litter



# RCRA Permitting

- New Mexico Environment Department (NMED) Authorizes Permitted Activities
- LANL Hazardous Waste Permit
  - Site – wide permit
  - Treatment is not permitted in TA-50 or TA-54
- Permit Modification will be required for:
  - Neutralization and/or sorption of free liquids in Unremediated Nitrate Salts (UNS) to eliminate “corrosivity” (D002)
  - Eliminate the characteristic of “ignitability” (D001) from UNS and Remediated Nitrate Salts (RNS) waste
- Waste stream also contains chromium, lead, and mercury (D007, D008, D009)



# EPA “D” Codes

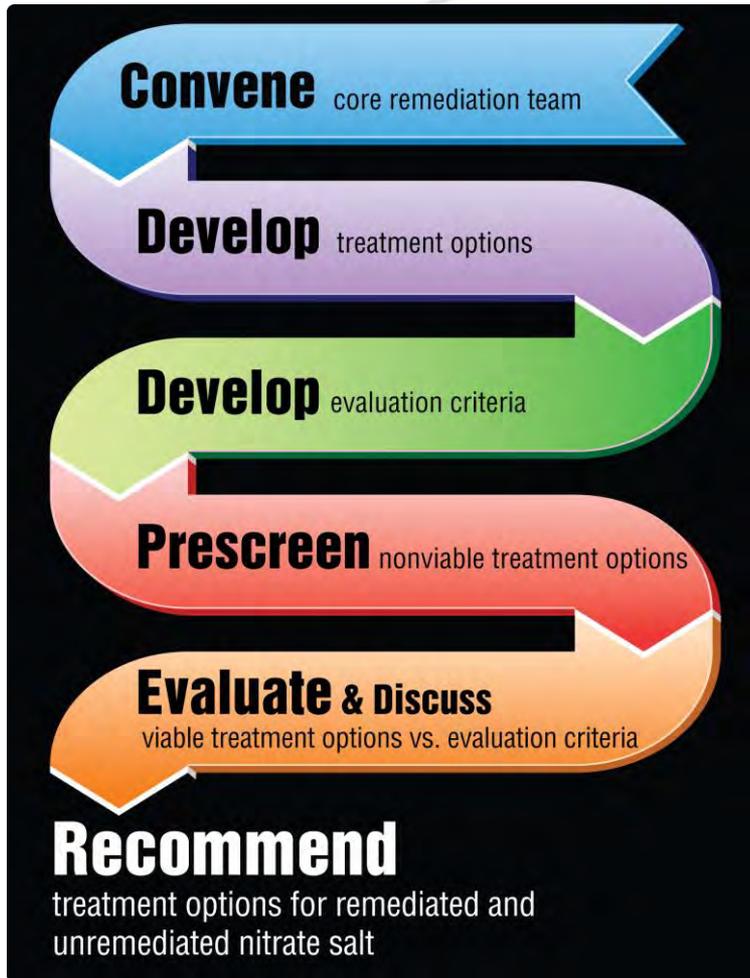
- D001 – Ignitable (Liquids with low flash points, solids that burn vigorously once ignited, ignitable gas, oxidizer)
- D002 – Corrosive (pH less than or equal to 2 or greater than or equal to 12.5; or corrodes steel at a rate of greater than 0.250”/yr)
- D007 – Chromium (5 mg/L)
- D008 – Lead (5 mg/L)
- D009 – Mercury (0.2 mg/L)



# Assessment of Treatment Options for Nitrate Salt Waste



# Core Team Process



# Core Team



**Bruce Robinson**

**Lead**

**David Clark**  
**David Funk**

**Technical Advisor**  
**Technical Advisor**

Enrique Torres  
Philip Leonard  
Stephen Yarbro  
Robert Wingo  
Scotty Miller  
Steve Clemmons  
Gian Bacigalupa  
John Hopkins  
Faris Badwan  
Randall Erickson  
Kapil Goya  
Jeff Carmichael  
Andrew Baumer  
Charles Conway  
Rick Alexander  
Robert Stokes  
Ronald Selvage  
Timothy Burns  
Christopher Chancellor  
Patrice Stevens

Benchmarking  
Energetic Chemistry  
Actinide Chemistry  
Cementation  
Operations  
Operations  
Regulatory  
Regulatory  
Quality Assurance  
ADEP  
TA-55 Waste Expert  
TA-55 Waste Expert  
FOD  
FOD  
FOD  
ES&H  
Safety Basis  
Carlsbad RSO  
Carlsbad RSO  
Project Management

**Independent peer review is important to ensure success**



# Evaluation Criteria

- Robust to waste stream variability
- “Permittability” (Permitting Difficulties)
- Safety Basis challenges
- Extent of testing required
- Reduction of toxicity and mobility
- Reduction of volume
- Short term and long term effectiveness
- Waste Control Specialists implications
- Facilities challenges
- Schedule
- Cost (not a primary evaluation criterion; was used as a final discriminator)



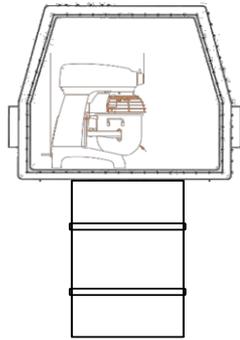
# Zeolite addition or cementation are top recommendations for both unremediated and remediated nitrate salts

RCRA Stabilization Options	
Stabilization Using Zeolite	Mix waste into inorganic natural mineral to eliminate ignitability potential of the waste
Stabilization Using Zeolite With Cementation	Option 1 followed by production of cement waste form
Stabilization Using Dry-Process Cementation	Production of cement waste form with water added only at the time of cementation
Stabilization Using Wet-Process Cementation	Initial water addition to eliminate potential thermal runaway reactions, followed by production of cement waste form
Salt Dissolution With Cementation/Stabilization	Water addition followed by filtration and cementation process of Swheat™ cake and nitrate salt solution
Other RCRA Options	
Incineration	Burning of waste in a radiological incinerator
Thermal Oxidation of Organics	Treatment of waste in air to oxidize without flame
Biodegradation	Biological breakdown of organics or non-metallic inorganics under aerobic or anaerobic conditions
Chemical or Electrolytic Oxidation	Breakdown of organics through the addition of oxidation reagents
Chemical Reduction	Breakdown of nitrate constituents through the addition of reducing reagents
Vitrification	Incorporation of waste into a glass waste form
Alternate Macro-Encapsulation	Coating of the waste with an organic polymer to reduce surface exposure
Neutralization	Reagent addition to neutralize the pH
Controlled Reaction or Leaching	Removal of soluble salts by leaching with water

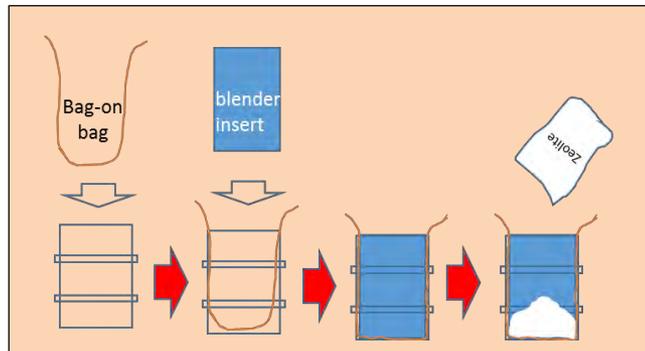


# Treatment Options require engineered implementation

- Blending with zeolite
  - Batch Blending



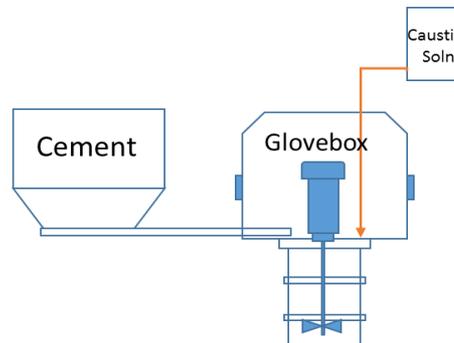
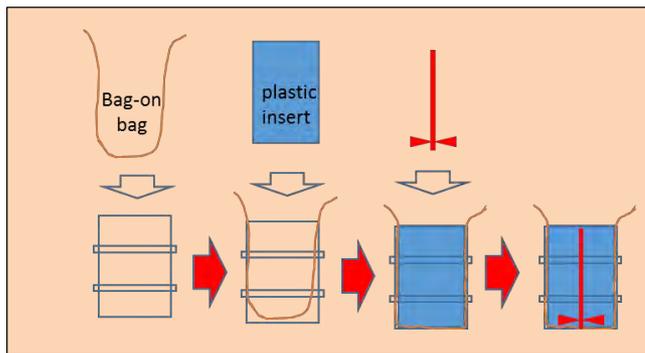
- Bulk blending



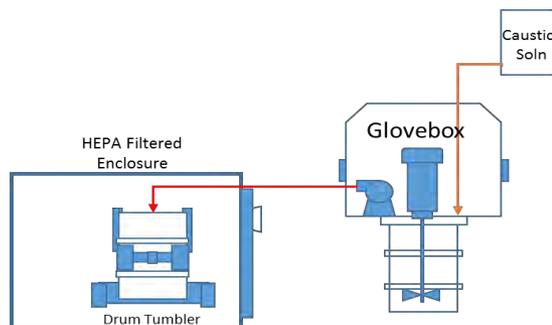
# Treatment Options require engineered implementation

## ■ Cementation

### — In glovebox



### — Drum mixing



# Summary of the Overall Steps for Treatment of Nitrate Salt Wastes

- Temperature Control - Safing
  - Implement supplemental cooling to cool waste and evaluate use of refrigeration/freezers
  - Evaluate and finalize temperature control process for unpacking containers and treatment – safety basis impacts
- Treatment of Waste
  - Treatment Study
    - Complete testing of treatment option and final waste form using surrogates
    - Sample unremediated nitrate salt waste, make samples of remediated nitrate salts (comparison studies)
  - Treat the nitrate salt wastes (temperature control followed by zeolite addition or cementation)



# RCRA Permit Modification

- Requires permit modification based on final proposed treatment methodology
- NMED fully engaged prior to submittal



# Safety Basis

- Waste Characterization, Reduction, and Repackaging Facility (WCRRF) safety basis changes are needed to remediate nitrate salts
- Area G safety basis changes are required to cold safe and de-nest the waste containers
- Possible changes required in the Transportation Safety Document to allow transport to WCRRF for treatment



# Procedures & Qualifications

- “Procedure on procedures” has been updated to ensure proper technical reviews
- Detailed & extensively reviewed processing procedures
- All WCRRF procedures will be reviewed and revised
- All Area G waste handling procedures reviewed and revised
- All qualification standards updated
- Resolution of weaknesses that were identified as Lab-wide/complex-wide issues prior to treating



# Minor Construction

- TA-54-375 freezer addition
- WCRRF camera
- WCRRF operations center
- Assuming no modifications to WCRRF glovebox



# Readiness

- Early, independent reviews of Safety Management Programs
- IVR for safety basis page changes
- Combined Area G & WCRRF MSA/CRA/FRA



# Safing followed by reprocessing will lead to inert TRU waste, protecting workers and the public

- Safing minimizes the potential for additional events
  - Mitigate the chemical and biological processes that could be ongoing within the drums
- “Cold” waste is in a state that minimizes hazards to workers that will be treating the waste
- Treating waste eliminates the potential for a release to the environment



# Backup



# D001 (Ignitibility) and D002 (Corrosivity) are defined in 40 CFR Part 261 Subpart C

A solid waste exhibits the characteristic of ignitability if a representative sample of the waste has any of the following properties:

1. “It is a liquid, other than an aqueous solution containing less than 24 percent alcohol by volume and has flash point less than 60 °C (140 °F), as determined by a Pensky-Martens Closed Cup Tester...”
2. It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.
3. It is an ignitable compressed gas.
4. It is an oxidizer. An oxidizer for the purpose of this subchapter is a substance such as a chlorate, permanganate, inorganic peroxide, or a nitrate, that yields oxygen readily to stimulate the combustion of organic matter (see Note 4).

A solid waste exhibits the characteristic of corrosivity if a representative sample of the waste has either of the following properties:

1. It is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5, as determined by a pH meter using Method 9040C in “Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,” EPA Publication SW-846, as incorporated by reference in § 260.11 of this chapter.
2. It is a liquid and corrodes steel (SAE 1020) at a rate greater than 6.35 mm (0.250 inch) per year at a test temperature of 55 °C (130 °F) as determined by Method 1110A in “Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,” EPA Publication SW-846, and as incorporated by reference in § 260.11 of this chapter.

Note 4: The DOT regulatory definition of an oxidizer was contained in § 173.151 of 49 CFR, and the definition of an organic peroxide was contained in paragraph 173.151a. An organic peroxide is a type of oxidizer.

