WIPP Overview
A Department of Energy Facility

Lessons Learned From the
Waste Isolation Pilot Plant
9+ years operating a deep geologic
repository for radioactive waste in America

Nuclear Integration
Project (NIP) Workshop
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“The Back-end: Healing the Achilles Heel of the Nuclear Renaissance?”
Transuranic (TRU) waste cycle

TRU waste was generated during the production of nuclear weapons at DOE facilities across the country

After 1970, transuranic waste was put into containers such as 55-gallon drums and stored in above-ground and shallow-burial facilities for eventual retrieval and disposal

The WIPP Mission

Characterization  Transportation  Disposal

Lessons learned from 9 years operating the Waste Isolation Pilot Plant

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What is TRU waste?

- Clothing, tools, rags, debris, residues and other items contaminated with man-made radioactive elements that are heavier than uranium.
- >100 nCi/g (>3700 Bq/g ~1ppm):
  - alpha emitting isotopes
  - t½ > 20 years
- Two types of TRU waste
  - Contact-handled (<200 mrem/hr)
  - Remote-handled (>2 mSv/hr)
- Legacy inventory ~700,000 drum equivalents

Lessons learned from 9 years operating the Waste Isolation Pilot Plant

Z > 92 (transuranic)
Salt is the reason for WIPP’s location

“Salt at great depth ‘flows.’ It will encapsulate waste and isolate it from the surface for eons.”

- NAS 1957 Recommendation
- Stable geology (~250 million years)
- Lack of water
- Easy to mine
- Self-healing fractures
- Salt “creep” will encapsulate the waste

“The great advantage is that no water can pass through salt. Fractures are self healing….”

National Academy of Sciences, 1957

Lessons learned from 9 years operating the Waste Isolation Pilot Plant
Characterization

Process for determining the physical, chemical and radiological contents of TRU waste containers with sufficient accuracy to ensure that waste is acceptable for disposal at WIPP.

Acceptable Knowledge
- Use documented waste stream knowledge to identify waste contents

Radiography
- Look for prohibited items, such as aerosol cans or liquids

Non-destructive assay
- Determine radiological contents

Statistical headspace gas analysis
- Determine volatile organic compound contents

Statistical solids sampling & analysis
- Performed on samples of homogeneous waste to analyze for chemical hazards

Lessons learned from 9 years operating the Waste Isolation Pilot Plant
Central Characterization Project
(deploying mobile waste characterization systems to sites around the complex)

- Mobile systems perform waste characterization at sites that lack equipment, and to supplement sites with their own facilities
- Systems currently deployed at:
  - Savannah River Site (SRS)
  - Idaho National Laboratory (INL)
  - Los Alamos National Laboratory (LANL)
  - Oak Ridge National Laboratory (ORNL)
  - Argonne National Laboratory (ANL)
- Mobile systems can characterize ~180 waste packages/week (5 - 6 shipments/week)
- Eliminates need to build costly fixed facilities, saving taxpayers millions
- Systems are cost effective: currently per-package characterization cost is ~$2,500 (significantly cheaper than many fixed facilities)

Lessons learned from 9 years operating the Waste Isolation Pilot Plant
Transportation

Waste containers are loaded into protective shipping containers (such as TRUPACT-II).

Shipping containers are loaded onto specially designed flatbed trailers. State personnel inspect load before departure.

Drivers inspect their rigs and loads every 3 hours or 150 miles. Some states require additional inspections at their ports of entry.

For safety and security reasons, shipments are tracked throughout their journey using a satellite system (TRANSCOM).

WIPP-trained state and local emergency responders (~30,000) along all shipping routes, with frequent exercises.

Lessons learned from 9 years operating the Waste Isolation Pilot Plant
Only the safest drivers work for WIPP

- Partial requirements:
  - Meet or exceed federal requirements
  - 325,000 accident-free miles in semi-tractor trailer
  - No repeated chargeable incidents or moving violations in their private vehicles
  - Must pass a background check (security clearance)
  - Frequent Fitness for Duty checks (drug dependency and health requirements)

2 private commercial carrier contracts

Lessons learned from 9 years operating the Waste Isolation Pilot Plant
Over 7 million loaded miles

Total shipments as of February 14, 2008

13 sites completed

Lessons learned from 9 years operating the Waste Isolation Pilot Plant
TRUPACT-II shipping container
For Contact Handled waste

- Licensed by NRC -1989
- Extensive testing
- Multiple payload options
- Double containment
- 3 m³ capacity
- 12,500 lbs (5700 kg)
Remote Handled waste shipped in shielded packages

- Extensive testing
- Tested to same specifications as CH waste shipping packages

Lessons learned from 9 years operating the Waste Isolation Pilot Plant
Disposal Operations

Upon arrival at WIPP, each shipment undergoes a security inspection, a radiological survey, and a documentation review.

Shipping containers are unloaded and taken into waste handling building via forklift.

Health physics technicians perform radiological surveys during unloading of shipping containers.

Waste handling technicians lift waste containers out of shipping container using overhead cranes.

Lessons learned from 9 years operating the Waste Isolation Pilot Plant
CH Disposal

--continued

Waste containers are placed on waste hoist for 2,150 feet journey into underground.

In underground, waste is removed from the hoist and transported to a disposal room.

Waste is emplaced in rooms mined out of ancient saltbeds. Magnesium oxide is placed on waste stack to control solubility of radionuclides.

Lessons learned from 9 years operating the Waste Isolation Pilot Plant.
Remote Handled waste canisters are pulled from the shipping cask behind shield doors and placed into a shielded facility cask for handling at WIPP.

In the underground, the facility cask is removed from the hoist and transported to a disposal room by a 41-ton fork lift.

RH waste in the canister is emplaced in boreholes pre-drilled into the walls of disposal rooms, and a concrete shield plug is inserted afterwards.

Lessons learned from 9 years operating the Waste Isolation Pilot Plant
Disposal

--continued

Once a panel is filled with waste containers, it is closed by sealing it off from rest of mined area.

When WIPP waste disposal mission is complete, surface buildings will be decommissioned and the underground will be sealed.

Permanent markers will be placed on surface to warn future generations about presence of radioactive material almost ½ mile below.

Lessons learned from 9 years operating the Waste Isolation Pilot Plant
Permanent Marker

Conceptual Design

Lessons learned from 9 years operating the Waste Isolation Pilot Plant
WIPP Surface Facilities

Photo: Oct. 2006

New lined active salt pile

Salt shaft and hoist

The old salt pile covered with membrane liner and 3-ft of topsoil

Exhaust air shaft and filter

Waste shaft and hoist

Air Intake Shaft

Waste handling building

All stormwater runoff is collected in lined evaporation ponds

WIPP is a zero discharge facility

WIPP is a zero discharge facility
Repository Layout and Operation

Salt Removal Shaft
Air Intake Shaft
Waste Entry Shaft
Air Exhaust Shaft

2150 feet

Each salt pillar left in place is about the same size as a football field

Lessons learned from 9 years operating the Waste Isolation Pilot Plant
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<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years of operation</td>
<td>~9</td>
</tr>
<tr>
<td>Shipments received</td>
<td>6,424</td>
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<tr>
<td>Loaded drum equivalent containers</td>
<td>~265,000</td>
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<tr>
<td>Cubic meters of TRU waste disposed</td>
<td>53,285</td>
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<tr>
<td>Loaded miles</td>
<td>7,368,000</td>
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<tr>
<td>Waste panels mined</td>
<td>~5</td>
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<tr>
<td>Waste panels filled</td>
<td>~3 ½</td>
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<tr>
<td>Storage sites cleaned</td>
<td>13</td>
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<tr>
<td>Releases to the environment</td>
<td>0</td>
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<tr>
<td>Contaminated WIPP personnel</td>
<td>0</td>
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<tr>
<td>Consecutive years NM “Mine Operator of the Year”</td>
<td>20</td>
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</tbody>
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Through February 14, 2008
People and Equipment

- 40 tractor trucking fleet (2 private carriers)
- 112 shipping containers (84+15+12+1)
- 4 mobile characterization lines deployed at TRU sites
- 984-employee workforce:
  - 50 Carlsbad Field Office of DOE (CBFO)
  - 45 Carlsbad Field Office Technical Assistance Contractor (CTAC)
  - 38 Los Alamos National Laboratory-Carlsbad (LANL-CO)
  - 75 Sandia National Laboratories-Carlsbad (SNL-C)
  - 630 Washington TRU Solutions (WTS) – M&O Contractor
  - 146 WTS subcontractors (records, security, environmental, information systems)
Success and safety are inseparable

Achieved Voluntary Protection Program recertification at the “Star” level
- January 2006

4 million safe work hours reached for the first time
- November 13, 2006

Achieved low injury rates
- 90% below national average
- 52% below DOE average

Achieved lowest recordable case rates
- 3.6 mining industry average
- 0.3 WIPP average

Lessons learned from 9 years operating the Waste Isolation Pilot Plant
Bottom line

- TRU waste program is a complex effort involving multiple DOE sites, states, regulators, and oversight organizations.

- WIPP faces regulatory and technical challenges, but continues to get the job done with excellence:
  - Increased waste shipments
  - Meeting and exceeding disposal goals
  - Continuous focus to eliminate low-value procedures and reduce cost
  - Sterling safety and compliance record “enables” changes to be made

Lessons learned from 9 years operating the Waste Isolation Pilot Plant
Lessons Learned from WIPP

- Early and frequent interaction at local transportation authority levels ALL along transportation routes
- Do not take local community support for granted
  - Continue full and open communication
  - Fulfill commitments to the community - “No surprises”
- Redundant U/G access for waste (2 disposal shafts)
- Avoid backfill as an engineered barrier or assurance measure
- Simple shielding for RH waste disposal (no boreholes – floor or wall)
- Simple disposal unit closures
- Simple repository closures
- Avoid multiple regulatory structures (inconsistent overlap)
- Loud and frequent reminders that retrieval is not easy (or even advisable)
WIPP is healing Achilles Heel for a nuclear renaissance

Lessons learned from 9 years operating the Waste Isolation Pilot Plant