Waste Isolation Pilot Plant



WIPP Overview

A Department of Energy Facility

Nuclear Integration Project (NIP) Workshop Vanderbilt University March 3, 2008

> Roger Nelson Chief Scientist Carlsbad Field Office US DOE

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



"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



What is TRU waste?



Landia

Setters



Es Fm Md No Lr

Z > 92 (transuranic)

•	'n			P	eri	o	lic	:1	a	ble	8					-	-	He
2	ч	Be		o	[t]	he	E	le	m	en	ts		5	°c	N	°.	F	Ne
1	Ha	Mg	-	nt.	10	-	-	_	-14 -				-	51	P	5	CI	Ār
+	t9 K	Ca.	Se	H TI	ta V	Cr	l5 Mn	Fe	Co	N	a Cu	Zn	54 Ga	Ge	33 Ag	Se	35 Br	30 Kr
5	APP APP	38 57	×.	27	HID	e Mo	ts Te	Ru	e Ah	Pd	a Ag	ca	al In	Sn	51 Sb	S2 Te	5	SH Xe
6	Cs.	89	57 41.8	72 14	70 73	w	Re	08	*	70 PL	14	Ha	"ŋ	PD	BI	Po	es Al	Ra
	E/ Fr	na.	• Ác	104 Df	Ha	69	107	His	M	110		112	10		_	_		-

CO Pr Nd Pm Sm Eu Gal TO DV HO ET TM TO LU

P Pu Am Cm

1
e
Э

- >100 nCi/g (>3700 Bq/g ~1ppm):
 - alpha emitting isotopes
 - t¹/₂ > 20 years
- Two types of TRU waste
 - Contact-handled (<200 mrem/hr)
 - Remote-handled (>2 mSv/hr)
- Legacy inventory ~700,000 drum equivalents

Salt is the reason for WIPP's location



- 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

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



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)



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

Only the safest drivers work for WIPP



2 private commercial carrier contracts

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)



TRUPACT-II shipping container

Plant

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



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

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

RH Disposal

--continued





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 predrilled into the walls of disposal rooms, and a concrete shield plug is inserted afterwards

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

Decommissioning

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

700 m





WIPP Surface Facilities

Photo: Oct. 2006

New lined active salt pile

Salt shaft and,hoist

Waste

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

> Exhaust air shaft and filter

Air handling building All stormwater runoff is collected in lined evaporation ponds Air handling building Shaft WIPP is a zero discharge facility Waste shaft and hoist



Snapshot

~9	vears of ope	eration

- 6,424 shipments received
- ~265,000 loaded drum equivalent containers disposed
- 53,285 cubic meters of TRU waste disposed
- 7,368,000 loaded miles

20

- ~5 waste panels mined
- ~3 ¹/₂ waste panels filled
- 13 storage sites cleaned of legacy TRU waste
- 0 releases to the environment
- 0 contaminated WIPP personnel
 - consecutive years NM "Mine Operator of the Year"

Through February 14, 2008

People and Equipment





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

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 WIPP

- Early and frequent interaction at local transportation authority levels <u>ALL</u> 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