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Waste Isolation Pilot Plant Overview

Prepared By LANL-CO
On behalf Of DOE/CBFO

Section 1
WIPP History

DOE and WIPP Missions

- The Department of Energy (DOE) Carlsbad Field Office (CBFO) mission is to ensure America's security and prosperity by addressing its energy, environmental and nuclear needs through transformative science and technology solutions.

- The mission of Waste Isolation Pilot Plant (WIPP) is to demonstrate the safe, environmentally sound, cost effective, permanent disposal of Transuranic (TRU) waste left from production of nuclear weapons.

WIPP HISTORY

1940s

1940 - TRU waste began accumulating with the beginning of the nation's nuclear defense program.

1942 - Manhattan Engineering District established.

1950s

1957 - The original concept for WIPP was a repository with 2 levels and included High Level Waste and Spent Fuel.

- The National Academy of Sciences (NAS) recommended deep-geological disposal of TRU waste in deep salt beds.

WIPP HISTORY (cont.)

1960s

1961 - Government scientists searched for an appropriate site for TRU waste disposal and they began testing the desert in southeast New Mexico.

1969 - The event that shattered the Atomic Energy Commission's (AEC) complacency and irrevocably made defense nuclear waste a public issue was the Rocky Flats fire on May 11, 1969.

- Congress passed National Environmental Policy Act (NEPA) which was the first U.S. environmental law applied to the WIPP.

WIPP HISTORY (cont.)

1970s

1970 - AEC defined TRU as > 10 nCi/g.

1973 - Carlsbad location was chosen.

1976 - Project was officially named the Waste Isolation Pilot Plant.

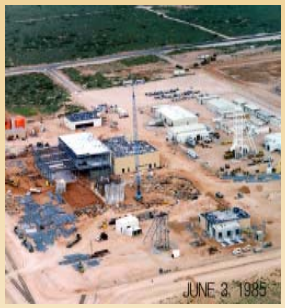
1978 - Environmental Evaluation Group (EEG) was contracted to provide a full time independent assessment of WIPP and to oversee the environment, public health and safety.

1979 - Congress re-defined TRU as > 100 nCi/g.

- Congress authorized the DOE WIPP facility.
- Congress defined the mission of WIPP in Public Law 96-164 for defense TRU waste only.
- The Institutional Programs were initiated.

WIPP HISTORY (cont.)

1980s



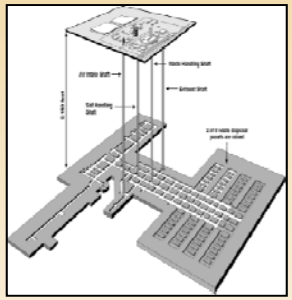
1980 - WIPP was constructed.
- DOE began selecting transportation routes
- WIPP trained more than 28,000 emergency responders and professionals.
- Transportation Tracking and Communication System (TRANSCOM) was established to track all WIPP shipments.

1981 - Final Environmental Impact Statement issued.

1989 - WIPP became subject to Resource Conservation and Recovery Act (RCRA).
- TRUPACT-II was certified by Nuclear Regulatory Commission (NRC).

WIPP HISTORY (cont.)

1990s



1990 - Construction of WIPP was complete.
- New Mexico was granted authority by the Environmental Protection Agency (EPA) to regulate radioactive mixed waste under RCRA.

1992 - Land Withdrawal Act (LWA), Public Law 102-579, was passed.

1993 - Re-promulgated 40 CFR 191
- WIPP Project Office (WPO) became the Carlsbad Area Office

1996 - Promulgated 40 CFR 194
- DOE submitted the Compliance Certification Application

1998 - The EPA certified WIPP

1999 - March 26, 1999, WIPP opened with its first receipt of non-mixed TRU waste coming from Los Alamos National Laboratory (LANL).
- October 1999, New Mexico Environment Department (NMED) issued WIPP hazardous waste facility permit.

WIPP HISTORY (cont.)

2000s

2000 - Carlsbad Area Office was elevated to a Field Office.

2002 - NRC certified the RH-72B cask for shipping Remote-handled (RH) TRU waste.

2002 - The first shipment of waste characterized by the Central Characterization Project (CCP) arrived at WIPP.

2004 - 1st Compliance Re-certification Application (CRA) submitted to EPA.

2005 - The final TRU waste shipment from Rocky Flats was received.

2006 - WIPP received the first EPA Compliance Re-certification.

2007 - The first shipment of RH-TRU arrived at WIPP.

2008 - WIPP safely disposed of 100,000 TRU waste containers.

2009 - 2nd CRA submitted to EPA.

2010 - TRUPACT-III was certified.

- WIPP received the second EPA Compliance Re-certification.

2011 - The first TRUPACT-III shipment arrived at WIPP

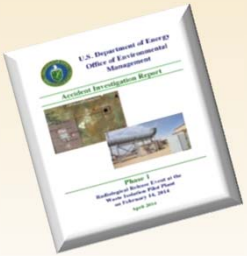
- A major wildfire near Los Alamos initiated the 3706 m^3 campaign. LANL agreed to clear the TA-54 area of legacy TRU waste on a rigorous schedule.

WIPP HISTORY (cont.)

2014

February 5 - **A** salt haul truck fire occurred in the repository at WIPP..

February 14 - A TRU waste container emplaced in Panel 7 Room 7 breached, causing a radiological release.



After the February 5th fire an Accident Investigation Board (AIB) was appointed.

March – 3rd CRA submitted to EPA

WIPP HISTORY (cont.)

2015

- Project Reach - was a specially designed and manufactured 90-foot composite boom, equipped with high-resolution photographic equipment, to complete photographic mapping of all waste stacks and packages in Room 7, Panel 7.
- WIPP began the cleanup/decontamination of the underground from the fire and radiological release.
- Interim ventilation system design and installation began.
- WIPP completed state-of-the-art emergency operations center.
- WIPP recovery continues today.

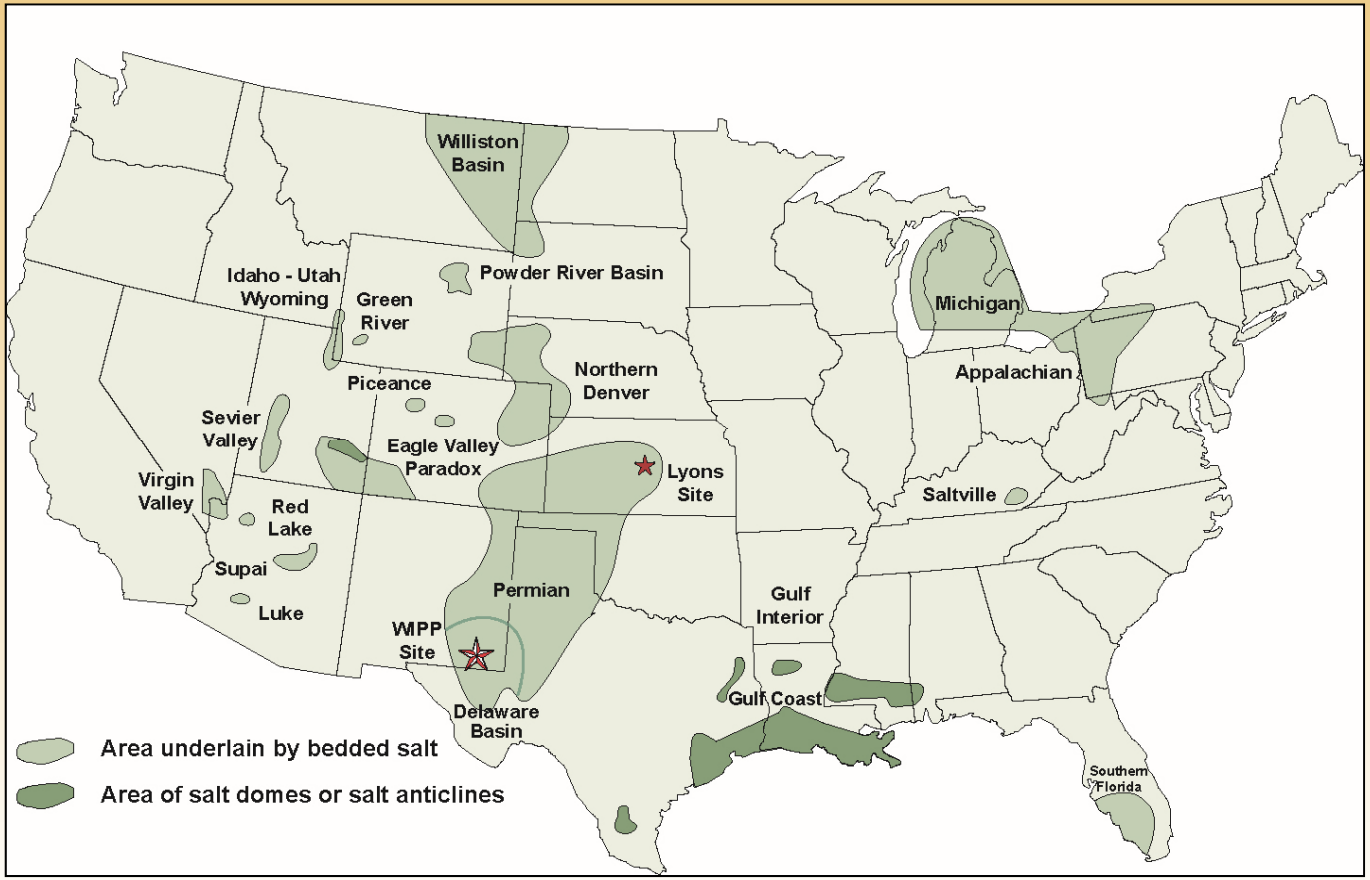
WIPP HISTORY (cont.)

2016

- Underground Personnel Notification and Tracking System Installed
- Interim Ventilation System Activated
- Work Begins on Permanent Ventilation System
- Revised Documented Safety Analysis (DSA) Approved
- New waste acceptance testing released
- WIPP Restart Activities Begun
- Operational Readiness Review Conducted
- WIPP is Authorized to Resume Waste Emplacement (Dec 23)

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
- High thermal conductivity

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

National Academy of Sciences, 1957

Site Selection Criteria

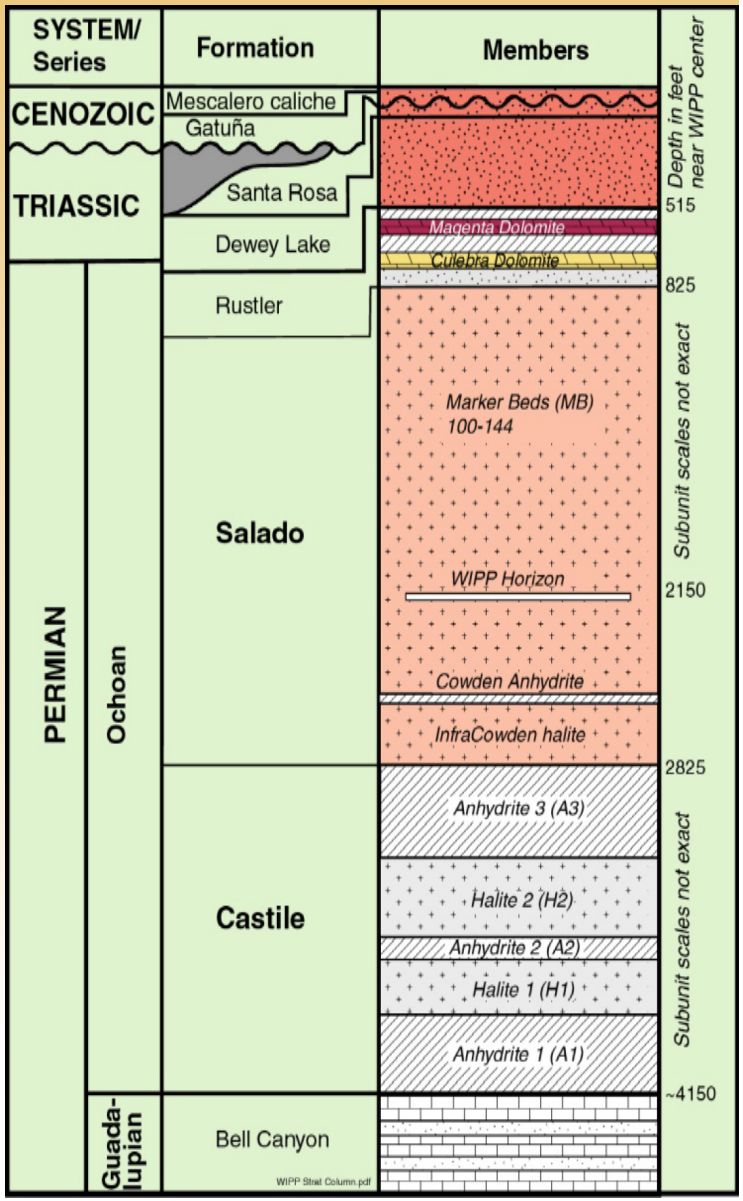
Geological Criterion - The geology must protect the repository from breaching by natural phenomena. The geology must also permit safe operation of the repository

Hydrology Criterion - The hydrology must provide high confidence that natural dissolution will not breach the site. Accidental penetrations (unintentional human intrusion) should not result in undue hazards to intruder or subsequent generations.

Tectonic Stability Criterion - Natural tectonic processes must not result in a breach of the site and should not require extreme precautions during the operational period of the repository.

Physical-Chemical Compatibility - The repository medium must not interact with the waste in ways which create unacceptable operational or long-term hazards.

Economic/Social Compatibility Criterion - The site must be operable at reasonable economic cost and should not create unacceptable impact on natural resources or the biological/sociological environment.



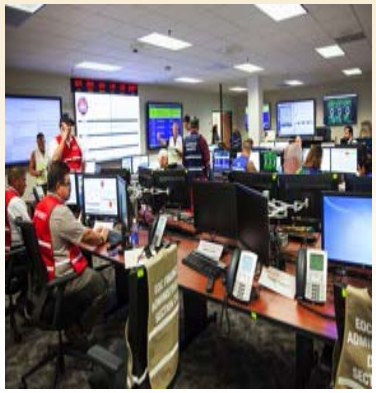
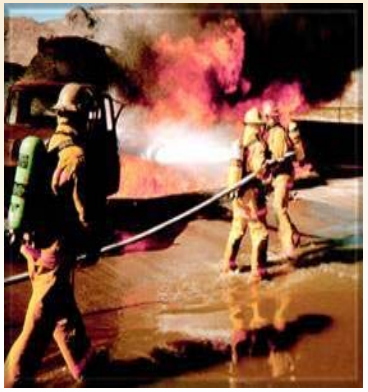
WIPP INSTITUTIONAL PROGRAMS

- Tribal Program
  - Shipments to the WIPP travel through 10 Native American Reservations (among 6 states)
  - Program enhances the safe transportation of TRU waste shipments to WIPP across tribal lands, while strengthening tribes' capabilities where they have jurisdiction
  - Formal government-to-government agreements with each tribe

WIPP INSTITUTIONAL PROGRAMS (cont.)

- States Training and Education Programs
  - First Responder
  - Command and Control
  - Mitigation
  - Train-the-Trainer



WIPP INSTITUTIONAL PROGRAMS (cont.)

- Western Governors Association
  - Established in 1984.
  - Represents the Governors of 19 western states and 3 U.S. flag islands.
  - An instrument of the Governors for bipartisan policy development, information exchange and collective action on issues of critical importance to the western U.S.
  - Memorandum of agreement with the DOE.
- Southern States Energy Board (SSEB)
  - Established in 1960.
  - Represents 16 states and 2 territories.
  - Has a cooperative agreement with DOE/CBFO.
  - Created a TRU waste transportation working group that assisted DOE with environmental management and clean-up activities.
  - Outlined policies and procedures necessary to safely transport shipments of TRU waste thru the South to WIPP.

WIPP INSTITUTIONAL PROGRAMS (cont.)

- Public Involvement
  - CBFO distributes information on all aspects of the project and solicits public comment and participation
  - Fact sheets are provided for information
  - CBFO established a Home Page at www.wipp.energy.gov
  - WIPP Information Center (1-800-336-WIPP) is available for questions
  - Public meetings are held with stakeholders, EPA, NMED, DOE, and WIPP Contractors
  - WIPP displays are located at the National Museum of Nuclear Science & History in Albuquerque, NM, and at the Skeen-Whitlock Building, which houses the DOE/CBFO in Carlsbad, NM

WIPP Team

U.S. Department of Energy
Carlsbad Field Office
- Leads the National Transuranic Waste Program
- Science Program

Nuclear Waste Partnership LLC
- Manages and operates the WIPP facility

Los Alamos National Laboratory
- Scientific advisor for waste characterization

Ma-Chis Lower Creek Indian Tribe Enterprises, Inc. – TRANSCOM
- Satellite Tracking

Visionary Solutions
- Transportation carrier

Sandia National Laboratories
- Scientific advisor for repository re-certification

CBFO Technical Assistance Contractor
- Technical and Quality Assurance support for the Carlsbad Field Office

CAST Specialty Transportation
- Transportation carrier

Section 2
WIPP
Regulatory Agencies
&
Regulatory Drivers

WIPP Regulatory Agencies

U.S. Congress

- Legislative Authority
  - Land Withdrawal Act
  - Nuclear Waste Policy Act

U.S. Nuclear Regulatory Commission

- Transportation Requirements

U.S. Environmental Protection Agency

- Repository Compliance and Certification

WIPP Regulatory Agencies (cont.)

New Mexico Environment Department (NMED)

- Resource Conservation and Recovery Act (RCRA)
  - Hazardous Waste Facility Permit
- Consultation and Cooperation (C&C) Agreement

U.S. Department of Energy (DOE)

- WIPP Documented Safety Analysis (DSA)
- Waste Acceptance Criteria (WAC)
- Radioactive Waste Management
- C&C Agreement

WIPP Regulatory Drivers (cont.)

U.S. Congress

- *WIPP Land Withdrawal Act*, Public Law 102-579, as amended by Public Law 104-201
  - Withdrew the land on which WIPP is located from public use
  - Performance Assessment Report
  - Transuranic Waste Limitations
  - Transportation
  - Emergency Response Training
  - Certification and Re-certification

WIPP Regulatory Drivers

U.S. Nuclear Regulatory Commission

- Title 10 Code of Federal Regulations (CFR), Part 71, *Packaging and Transportation of Radioactive Material*
  - Establishes requirements for packaging, preparation for shipment, and transportation of licensed material

WIPP Regulatory Drivers (cont.)

U.S. Environmental Protection Agency

- Title 40 CFR, Part 191, *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*
  - Environmental Standards for Management and Storage
  - Environmental Standards for Disposal
  - Environmental Standards for Ground-Water Protection

WIPP Regulatory Drivers (cont.)

U.S. Environmental Protection Agency

- Title 40 CFR, Part 194, *Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations*
  - Establishes Criteria for Compliance Certification and Re-certification Applications
  - Establishes Criteria for Compliance Certification and Re-certification

WIPP Regulatory Drivers (cont.)

U.S. Environmental Protection Agency

- Title 40 CFR, Part 261, *Identification and Listing of Hazardous Waste*
  - Establishes the Criteria for Identifying the Characteristics of Hazardous Waste and for Listing Hazardous Waste

WIPP Regulatory Drivers (cont.)

New Mexico Environment Department

- *Waste Isolation Pilot Plant Hazardous Waste Facility Permit, Waste Analysis Plan*
  - Title 40 CFR, Part 270, *EPA Administered Permit Programs: The Hazardous Waste Permit Program*

WIPP Regulatory Drivers (cont.)

U.S. Department of Energy, Carlsbad Field Office

- DOE/WIPP-07-3372, *Waste Isolation Pilot Plant Documented Safety Analysis (DSA)*
  - The purpose of the DSA is to demonstrate an acceptable level of safety for compliance with Title 10 CFR Part 830, *Nuclear Safety Management.*
  - Subpart B, Section 830.202, *Safety Basis Requirements*, Subsection (a) requires that the contractor responsible for a Hazard Category 1, 2, or 3 DOE nuclear facility must establish and maintain the safety basis of the facility. The WIPP facility is categorized as a DOE Nonreactor Nuclear Category 2 facility for all surface and underground operations.

WIPP Regulatory Drivers (cont.)

U.S. Department of Energy, Carlsbad Field Office

- DOE/WIPP-02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*

  Incorporates requirements from:

  – **NRC** Transportation Safety Requirements
  – **NMED** Hazardous Waste Facility Permit Requirements
  – **DOE/CBFO** WIPP DSA
  – **EPA** Compliance Re-certification Decision, Approval for PCB Disposal, RH Approval
  – **Congress** Land Withdrawal Act

WIPP Regulatory Drivers (cont.)

U.S. Department of Energy, Office of Environmental Management

- DOE O 435.1, *Radioactive Waste Management*
  - Ensures all Department of Energy radioactive waste is managed in a manner that is protective of worker and public health and safety, and the environment
    - DOE M 435.1-1, *Radioactive Waste Management Manual*, further describes the requirements in DOE O 435.1 and establishes specific responsibilities for implementation.

WIPP Regulatory Drivers (cont.)

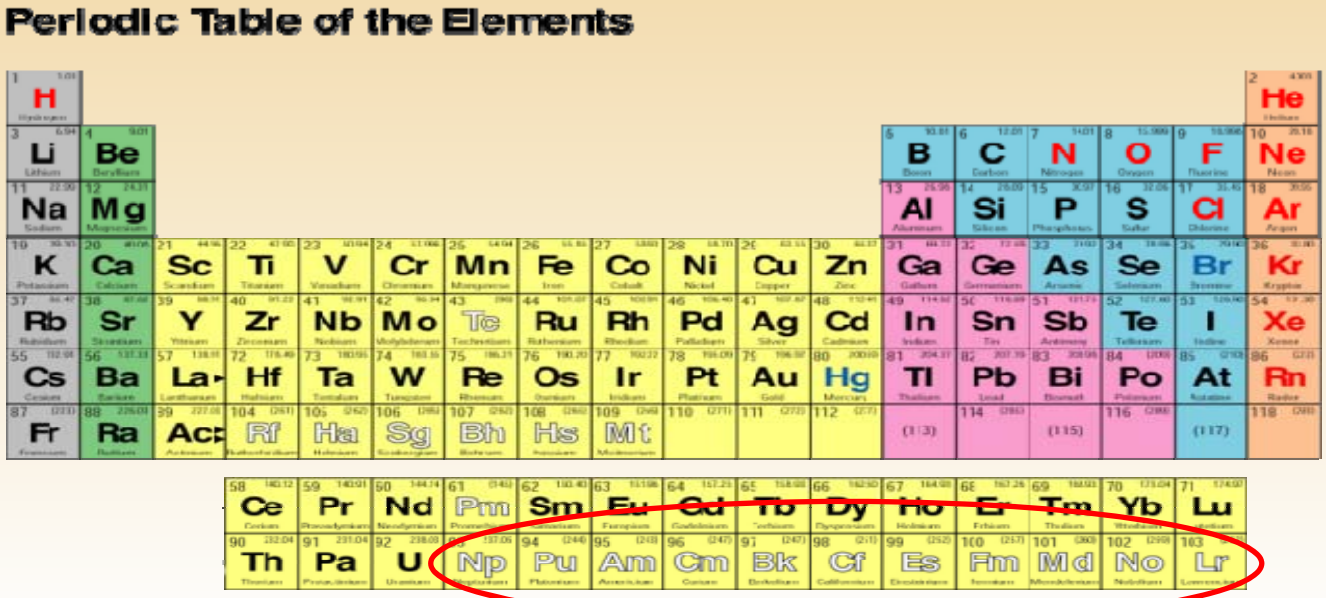
U.S. Department of Energy and The State Of New Mexico

- *Consultation and Cooperation (C&C) Agreement*
  - Affirms the intent of the Secretary of Energy to consult and cooperate with the appropriate New Mexico Officials with respect to the public health and safety concerns of the State
  - Limits the total volume of RH waste to be shipped to WIPP to 250,000 cubic feet (7,080 m^3)

Section 3
Transuranic Waste
and
Acceptance Criteria

TRU Definition

Transuranic - pertaining to elements that have atomic numbers greater than 92, including neptunium, plutonium, americium, and curium. All are radioactive, are not naturally occurring and are members of the actinide group.



Transuranic Waste

Transuranic (TRU) waste - radioactive waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for (a) high-level radioactive waste; (b) waste that the Secretary of Energy has determined, with the concurrence of the Administration of the Environmental Protection Agency, does not need the degree of isolation required by 40 Code of Federal Regulations (CFR) Part 191 disposal regulations; or (c) waste that the Nuclear Regulatory Commission (NRC) has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61. TRU waste consists of:

- **Clothing**
- **Tools**
- **Rags**
- **Debris**
- **Residues**
- **Soils**
- **Other items contaminated with TRU radioactive elements**

Mixed-TRU waste - is defined as TRU waste containing both radioactive and hazardous components

Category of TRU Waste

Contact-handled (CH) - TRU waste with a surface dose rate less than 200 millirem per hour.

- Primarily emits alpha radiation (less penetrating)
- Can be handled without any shielding beyond the container

Alpha radiation can be stopped with a piece of paper or a layer of human skin.

Category of TRU Waste (cont.)

Remote-handled (RH) - TRU waste with a surface dose rate of 200 millirem per hour or greater.

- Emits more penetrating radiation than CH-TRU
- Transported and handled in certified casks that provide additional shielding
- About four percent of waste to be disposed at WIPP

Up to 1,000 R/hr

Category of TRU Waste (cont.)

Defense TRU waste - (1) Radioactive waste from any activity performed in whole or in part in support of the Department of Energy (DOE) atomic energy defense activities. Excludes waste under the purview of the NRC or generated by the commercial nuclear power industry.

(2) Nuclear waste derived mostly from the manufacturing of nuclear weapons, weapons-related research programs, the operation of naval reactors, and the decontamination of nuclear weapons production facilities.

- CH Disposed of on the Drift Floor
- RH Disposed of in the Walls

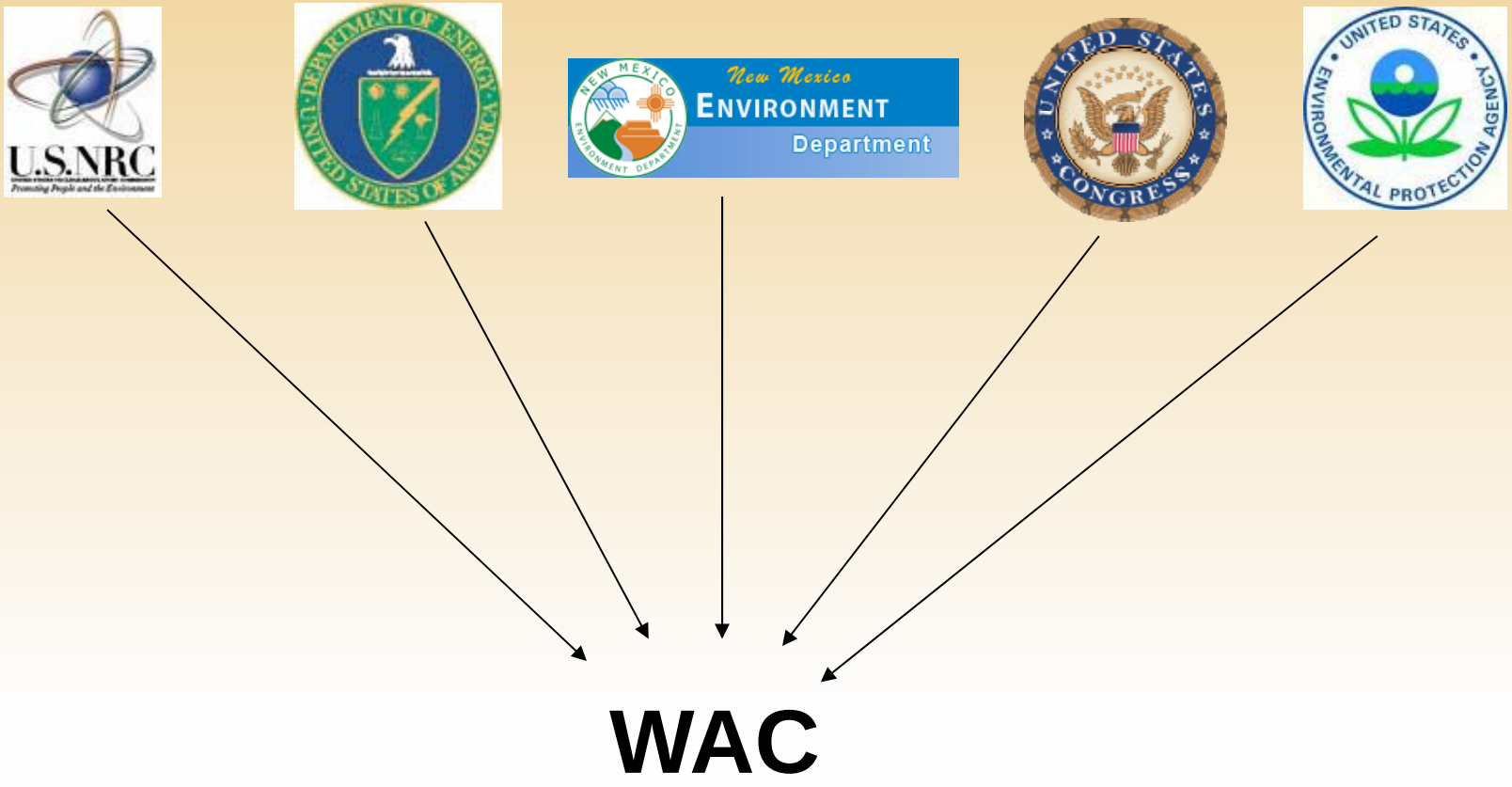
Waste Analysis Plan

- Section C of the Hazardous Waste Facility Permit includes test methods and the details of planned waste analysis for complying with state (20.4.1.500 New Mexico Administrative Code) and federal (40 CFR § 264.13) regulations
- The federal regulations state:

  "Before an owner or operator treats, stores, or disposes of any hazardous wastes…..

  he must obtain a detailed chemical and physical analysis of a representative sample of the wastes"

Basis for the Waste Acceptance Criteria (WAC)



WAC

Basis for the WAC

- WIPP Land Withdrawal Act Requirements
- NRC Transportation Safety Requirements
- EPA Compliance Recertification Decision
- EPA Approval for PCB disposal
- NMED Hazardous Waste Facility Permit Requirements
- DOE Operations and Safety Requirements

Radiological Properties

- Report the activities and masses of radionuclides found in the waste in particular the “ten WIPP tracked radionuclides”
  - Am-241, Pu-238, Pu-239, Pu-240, Pu-242, U-233, U-234, U-238, Sr-90 and Cs-137
  - Alpha Activity Concentration
    - Must be > 100 nCi/g to be TRU
    - Used in release calculations for the repository

- Measure Radiation Dose Equivalent
  - CH: < 200 mrem/hr
  - RH: ≥ 200 mrem/hr and ≤ 1000 rem/hr
- Determine that limit of Pu-239 Fissile Gram Equivalents (FGE), Pu-239 equivalent curies (PE-Ci) and decay heat are not exceeded for each payload container being certified

Physical Properties

- Observable Liquid in containers
  - < 1% by volume of the outermost container
  - Internal containers with more than 60 milliliters or 3 percent by volume observable liquid are prohibited
- Sealed containers > 4 liters are prohibited
- Physical Form
  - Debris
  - Solids
  - Soils and Gravel

Chemical Properties

- WIPP maintains a list of hazardous constituents that are allowed as part of the hazardous waste facility permit
- Waste must not contain explosives, corrosives and compressed gases
- Ignitable(D001), corrosive (D002) and reactive (D003) wastes are not acceptable at WIPP
- Chemical Compatibility
  - Waste must be composed of chemically compatible materials
  - Waste must be compatible with shipping container materials, other wastes, repository backfill, seal and panel closure materials
  - Pyrophoric materials limited
    - Radioactive only
    - ≤ 1% by weight in payload containers

Quality Assurance (QA)

- A measure of how well we know the waste
- Is used to certify waste containers for shipment and emplacement using characterization data before waste is shipped to WIPP
  - Data Review, Verification and Validation
  - Quality Assurance Objectives
  - Data Quality Objectives (DQO)

Data Review, Validation, and Verification Requirements

- Data review (at data generation, project and Permittee levels)
  - determines if raw data have been properly collected and ensures raw data are properly reduced.
- Data validation (at project and Permittee levels)
  - verifies that the data reported satisfy the requirements of the Hazardous Waste Facility Permit and is accompanied by signature release.
- Data verification (at Permittee level)
  - authenticates that data as presented represent the sampling and analysis activities as performed and have been subject to the appropriate levels of data review.

Quality Assurance Objectives

- Precision: measure of mutual agreement between data points
- Accuracy: degree of agreement with a true value
- Completeness: measure of amount of valid data to total data obtained
- Comparability: degree to which one data set can be compared to another
- Representativeness: degree to which data represents the entire population sampled

Data Quality Objectives

- Each of the confirmation techniques has associated DQO.
  - NDA

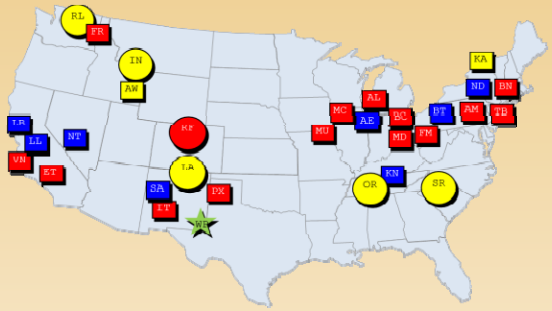
Table A-3.1. Data Quality Objectives for Radioassay

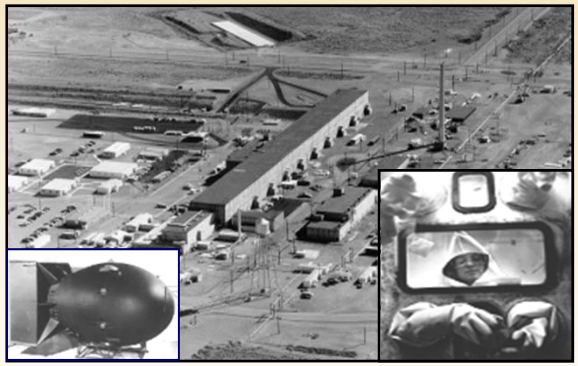
Requirement	DQO	Confidence[a]
TRU α-activity concentration > 100 nCi/g[b]	A > LLD	N/A
Fissile mass ≤ FGE limit	FGE + $2\sigma_{TMU}$(FGE) ≤ FGE limit	97.5%
Decay heat ≤ CH-TRAMPAC limit	DH + $1\sigma_{TMU}$(DH) ≤ $L_{CH\text{-}TRAMPAC}$	84%

  - NDE
    - To determine the physical waste form, the absence of prohibited items, and additional waste characterization techniques that may be used based on the Summary Category Groups (i.e., S3000, S4000, S5000).

Section 4
Generator Sites

Defense TRU Waste Generation





- Waste generated at 6 Large Quantity Sites (LQS) and 24 Small Quantity Sites (SQS)
- TRU waste was generated during the production of nuclear weapons at DOE facilities across the country

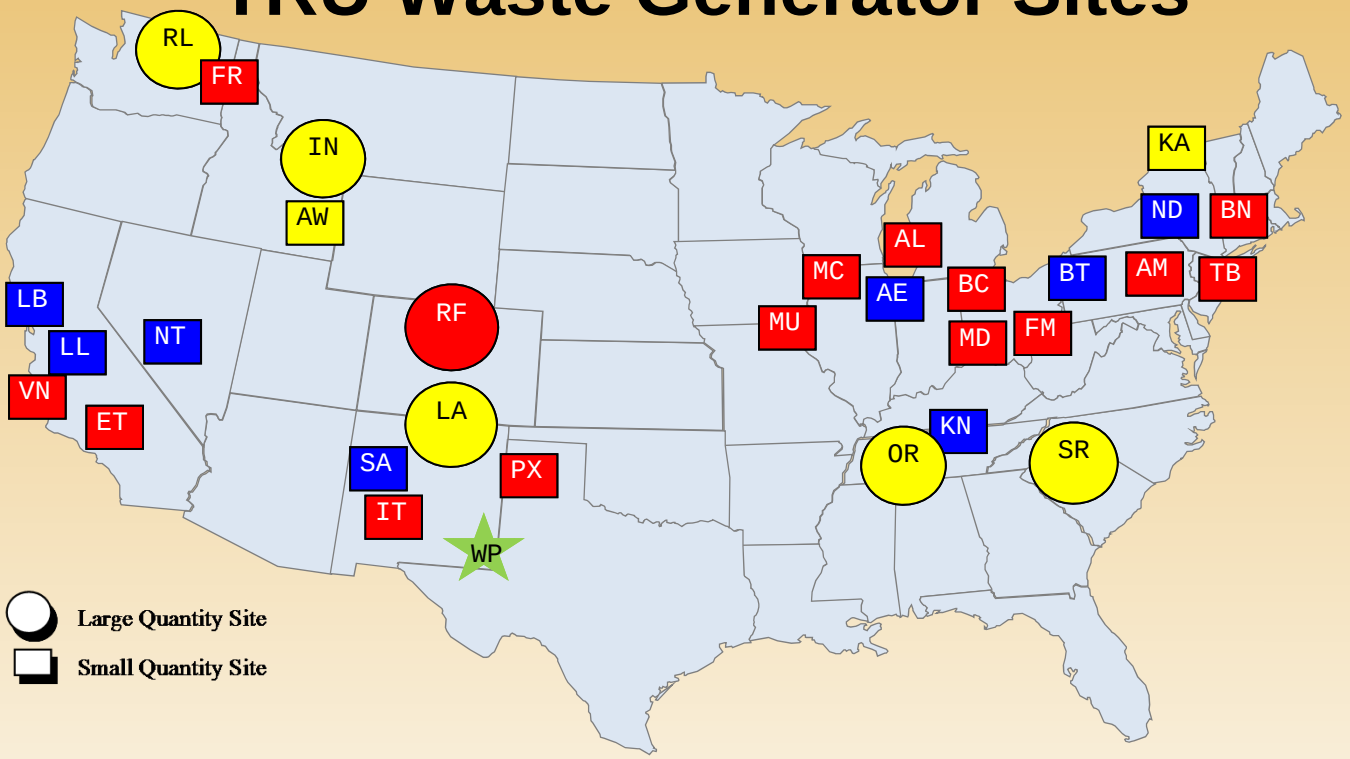
Generated In Whole Or In Part By:

- Naval reactor development
- Weapons activities
- Verification and control technology
- Defense nuclear materials production
- Defense nuclear material by-products
- Defense nuclear material safeguards and security
- Defense research and development

TRU Waste Generation

- After 1970, TRU waste was put into containers such as 55-gallon drums and stored in above-ground and shallow-burial facilities for eventual retrieval and disposal
- Waste consists of clothing, tools, rags, residues, debris, soil and other items contaminated with radioactive elements, mostly Plutonium

TRU Waste Generator Sites



Yellow – Active TRU Waste Sites **Red – De-inventoried of all TRU Waste** **Blue –De-inventoried of Legacy TRU waste**

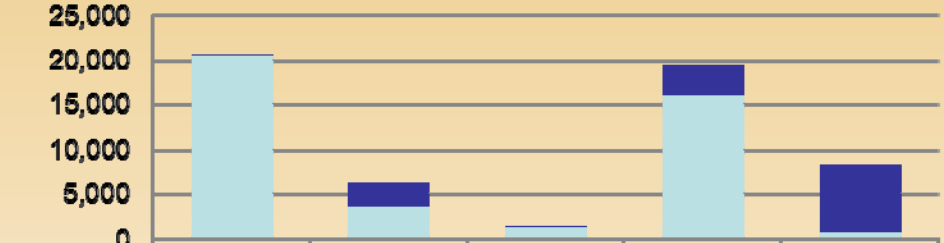
AE	Argonne National Laboratory
AL	Ames Laboratory
AM	ARCO Medical Products: de-inventoried-shipped to OSRP*
AW	Materials and Fuels Complex
BC	Battelle Columbus Laboratories: de-inventoried-shipped to RL & SR
BN	Brookhaven National Laboratory: de-inventoried-shipped to OSRP*
BT	Bettis Atomic Power Laboratory
ET	Energy Technology Engineering Center: de-inventoried-shipped to RL
FM	Fernald Environmental Management Project: de-inventoried-shipped to OSRP*
FR	Framatome: de-inventoried-shipped to RL
IN	Idaho National Laboratory
IT	Lovelace Respiratory Research Institute: de-inventoried-shipped to SA
KA	Knolls Atomic Power Laboratory-Schenectady
KN	Knolls Atomic Power Laboratory-Nucler Fuel Services
LA	Los Alamos National Laboratory
LB	Lawrence Berkeley National Laboratory
LL	Lawrence Livermore National Laboratory (includes Site 300)
MC	U.S. Army Materiel Command
MD	Mound Plant: de-inventoried-shipped to SR
MU	University of Missouri Research Reactor
ND	Nuclear Radiation Development Site
NT	Nevada Nuclear Security Site
OR	Oak Ridge National Laboratory
PX	Pantex Plant
RF	Rocky Flats Environmental Technology Site
RL	Hanford (Richland) Site
SA	Sandia National Laboratories
SR	Savannah River Site
TB	Teledyne Brown Engineering
VN	General Electric Vallecitos Nuclear Center
WP	Waste Isolation Pilot Plant
*OSRP	Offsite Source Recovery Program (LA)

Role of Sites' Inventory in TRU Waste Management

- Accurate CH and RH inventory is essential for effective program planning and scheduling for characterization, transportation and disposal
- Inventory collection process is constantly evolving to increase the value of the data to support end users in WIPP's compliance re-certification and strategic planning
- Identification of future TRU waste (e.g. Office of River Protection, Babcock and Wilcox Nuclear Energy Services etc.)
- Inventory reporting is standardized to facilitate achieving National Transuranic Program disposal objectives and commitments

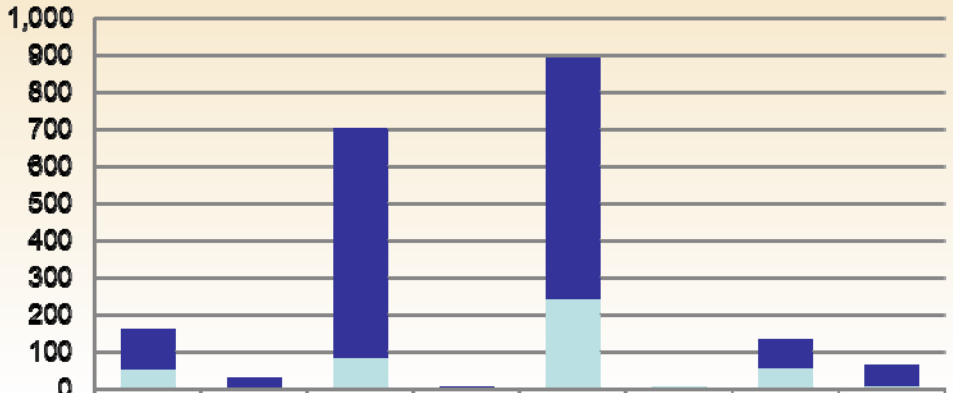
Volume (m^3) of CH Waste Remaining at Sites (12/31/14)

Large Quantity Sites



	IN	LA	OR	RL	SR
Projected	66	2,686	95	3,529	7,472
Stored	20,501	3,445	1,222	15,882	731

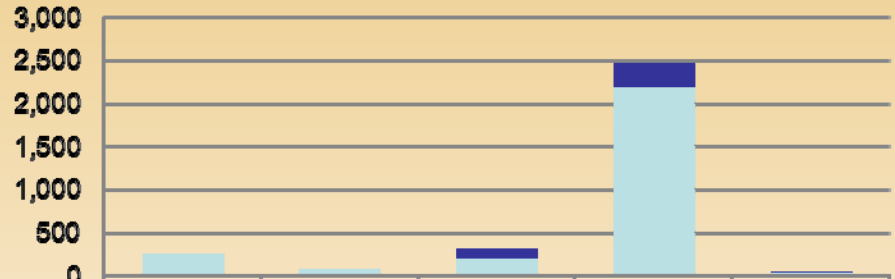
Small Quantity Sites



	AE	AW	KN	LB	LL	ND	NT	SA
Projected	112	28	620	0.42	651	0.00	79	57
Stored	49	2.91	82	0.42	241	2.08	55	6.09

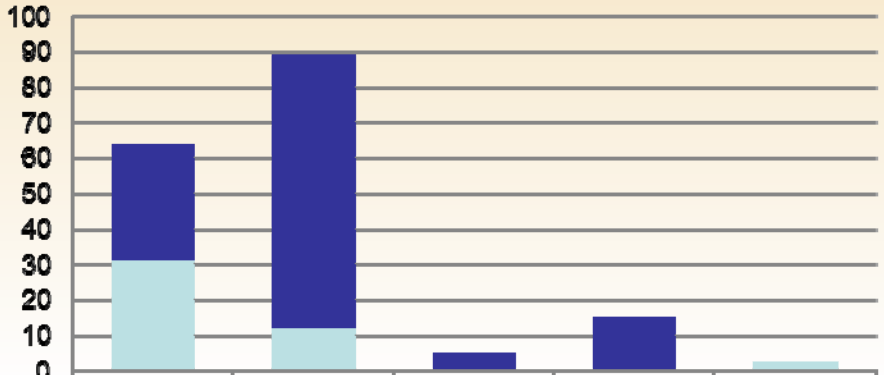
Volume (m^3) of RH Waste Remaining at Sites (12/31/14)

Large Quantity Sites



	IN	LA	OR	RL	SR
Projected	0.00	0.00	128	286	11
Stored	256	79	186	2,175	34

Small Quantity Sites

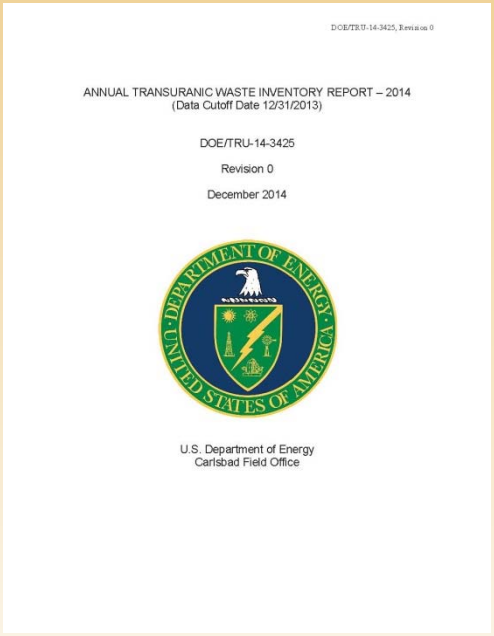


	AE	AW	BT	KA	SA
Projected	33	77	4.99	15	0.00
Stored	31	12	0.00	0.00	2.50

Application of Sites' TRU Inventory

- Provide DOE/CBFO an accurate, complete and consistent TRU waste inventory
- Help define the size and extent of specific issues and problems in TRU waste retrieval, characterization, certification and transportation
- Aid in planning and assessing difficulties as they are identified and reported by the sites
- Assist DOE/CBFO in technical reviews of the sites' programs.
- Set priorities on which waste containers are most likely to be shipped once WIPP resumes operations.
- Provide data for WIPP re-certification.

Annual TRU Waste Inventory Report (ATWIR)


DOE/TRU-14-3425, Revision 0

ANNUAL TRANSURANIC WASTE INVENTORY REPORT – 2014
(Data Cutoff Date 12/31/2013)

DOE/TRU-14-3425

Revision 0

December 2014

U.S. Department of Energy
Carlsbad Field Office

- Contains the most current qualified estimate of TRU waste throughout the DOE complex
- Describes the radiological, physical and volumetric aspects of waste expected to come to WIPP
- Maintained in the Comprehensive Inventory Database
- Published on DOE/CBFO Website at:

  http://www.wipp.energy.gov/Documents_NTP.htm

Waste Control Specialists (WCS) Near Andrews Texas

- TRU waste sent to WCS when WIPP was shut down due to fire and radiological release in February 2014
- Approximately 385 m^3 in temporary storage
- Majority of volume from LANL (≈96%) with the remainder from INL
- Will be shipped to WIPP upon resumption of disposal operations and re-evaluation to ensure that it meets more stringent requirements established as a result of the LANL event at WIPP.

Section 5
Characterization

Acceptable Knowledge (AK)

- AK is the first and primary method of chemical and radiological characterization of transuranic waste generated by atomic energy defense activities that will be shipped to WIPP for permanent disposal.
- Every drum of waste disposed at WIPP must have chemical and radiological AK information before it can undergo physical characterized by CCP.
- AK is responsible for assigning EPA hazardous waste numbers to the waste in accordance with 40 CFR Part 261 and the WIPP Hazardous Waste Facility Permit.
- AK is responsible for assigning isotopic distributions to the waste for the purposes of further nondestructive assay (NDA) characterization.
- AK Experts write peer-reviewed reports that are supported by the historical data that has been collected, researched, and reviewed. Reports are used as the starting point for WIPP certified characterization activities that are required by the WIPP Hazardous Waste Facility Permit and demonstrate compliance with 40 CFR Part 194.

Nondestructive Assay (NDA)

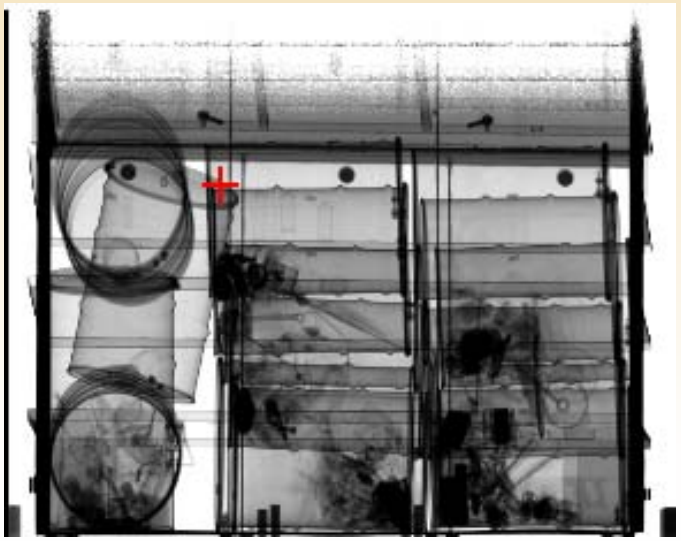
- NDA is the application of external radiation detecting instrumentation to estimate the amount of radioactivity in a payload container.
- It is performed to:
  - corroborate the AK estimates of key radioisotopes of interest to the EPA
  - demonstrate that each transport package complies with the fissile mass, decay heat and activity limits stipulated by the NRC
  - demonstrate that each payload container complies with the PE curie limit stipulated in the WIPP DSA
- These measurements are performed by the waste generators (or CCP) according to procedures approved by the EPA and CBFO at the waste generator site prior to loading a transport package for shipment to the WIPP.

Nondestructive Examination (NDE)

- Real Time Radiography (RTR) - typically refers to x-ray examination of waste
- Visual Examination (VE) - includes visual examination of the entire contents of a container
  - In some cases VE is used in lieu of RTR

Real Time Radiography (RTR)

- RTR is the use of radiographic (x-ray) instruments to image the contents of payload containers.
- The WIPP Hazardous Waste Facility Permit requires NDE or VE (visual examination) confirmation that:
  - the amount of free liquid present in wastes is within stipulated limits,
  - there are no containerized gases, and
  - the physical form of the waste matches its waste stream description
- These examinations are performed by the waste generators (or CCP) according to procedures approved by the NMED and CBFO at the waste generator site prior to loading a transport package for shipment to the WIPP.



Solid Sampling and Analysis

- Solid sampling and analysis is the analysis of cores (or other EPA approved sample types) taken from *randomly* selected *homogeneous* and *soil/gravel* waste containers.
- Prior to the WIPP Hazardous Waste Facility Permit modification approval (March 13, 2013), the permit required representative Solid sampling and analysis to:
  - assign EPA hazardous waste numbers for those *homogeneous* and *soil/gravel* waste streams without an approved AK Sufficiency Determination Request, and
  - corroborate those assigned by acceptable knowledge.
- Analyses including Totals or TCLP analyses for VOCs, SVOCs, and RCRA-regulated metals are currently included in AK for many TRU waste generator sites.

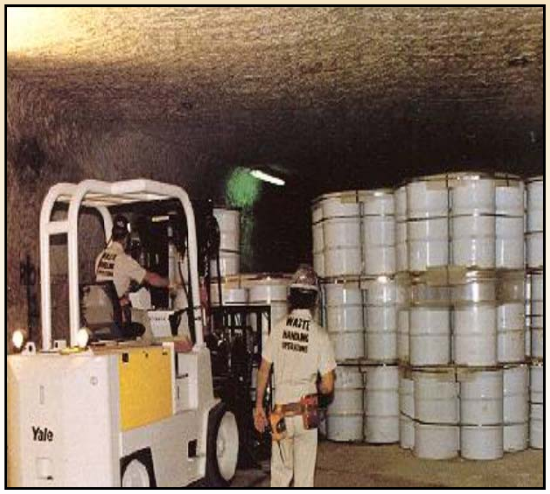
Flammable Gas Analysis

- Flammable Gas Analysis is the analysis of gases extracted from the easily accessible void volume of each payload container prior to shipment
- According to the CH-TRAMPAC section 5.2.1:

  "CH-TRU wastes to be transported in the TRUPACT-II and HalfPACT are restricted so that no flammable mixtures can occur in a layer of confinement during shipment." (There is an identical statement in section 5.1.1 of the RH-TRAMPAC for the RH TRU 72B)
- Gas sampling and analysis is performed by the CCP according to procedures approved by the NMED and CBFO.

WIPP's Waste Data System (WDS)

- Tracks the data obtained on containers from certification through emplacement and during temporary storage
- Data obtained during characterization is used to:
  - Certify containers for emplacement in WIPP
  - Build payloads for shipment
  - Track containers through the emplacement process
  - Document container location and contents at the time of emplacement

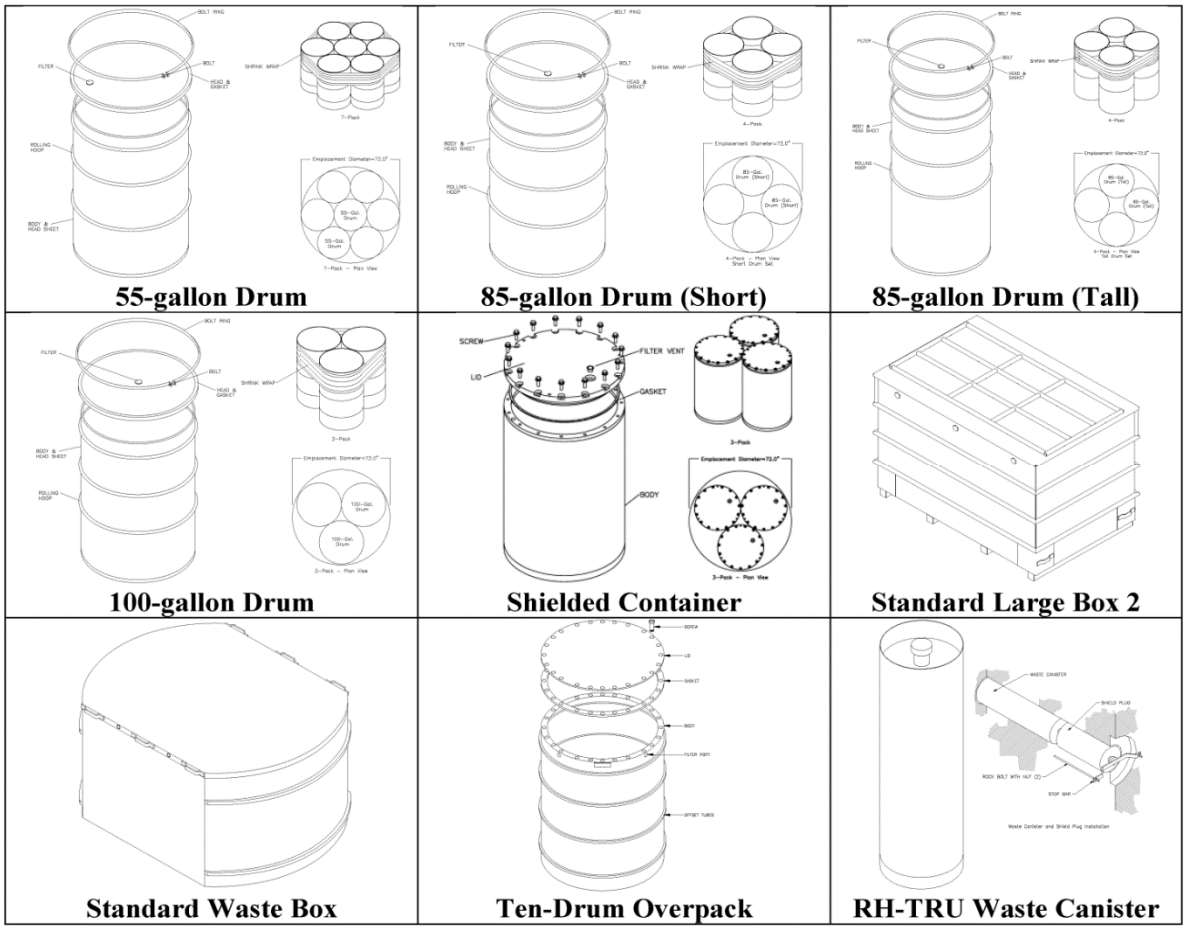


How Much Waste Has Been Emplaced to Date?

Parameter	Contact-Handled	Remote-Handled
Volume (m3)	90,627	357
Activity (Ci)	2,297,123	57,261
Waste Material Mass (kg)	28,320,268	63,912

Section 6
Transportation

WIPP Approved Waste Containers



- Department of Transportation (DOT) Type A containers
- Drums are shipped in packs
  - 7-pack
  - 4-pack
  - 3-pack
- 55-gal drum can also contain a pipe overpack component (POC)
  - 6 inch POC
  - 12 inch POC
- Shielded Container shields waste to < 200 mrem/hr
- Ten-Drum Overpack (TDOP) can be overpacked with up to 10 55-gal drums
- RH Canister can be direct loaded or up to 3 drums

Transportation Cask

TRUPACT-II (CH)

TRUPACT-III (CH)

HalfPACT (CH)

RH 72-B (RH)

- NRC Type B Shipping Containers
- TRUPACT-II can ship
  - (2) 7-pack
  - (2) 4-pack
  - (2) 3-pack
  - (2) Standard Waste Box (SWB)
  - Combination of above
  - (1) TDOP
- HalfPack
  - (1) 7-pack
  - (1) 4-pack
  - (1) 3-pack
  - (1) SWB
- TRUPACT-III
  - Standard Large Box 2 (SLB2)
- RH 72-B
  - RH canister

Transportation Cask Testing

- ✓ Free-Drop Test - the transportation cask is dropped from 30 feet onto a flat, unyielding surface

- ✓ Puncture test - the transportation cask is subjected to a 40-inch free drop onto a six-inch diameter steel bar at least eight inches long.

- ✓ Burn Test - the transportation cask is drenched with jet fuel and ignited, subjecting it to a temperature of 1,475 degrees Fahrenheit for 30 minutes.

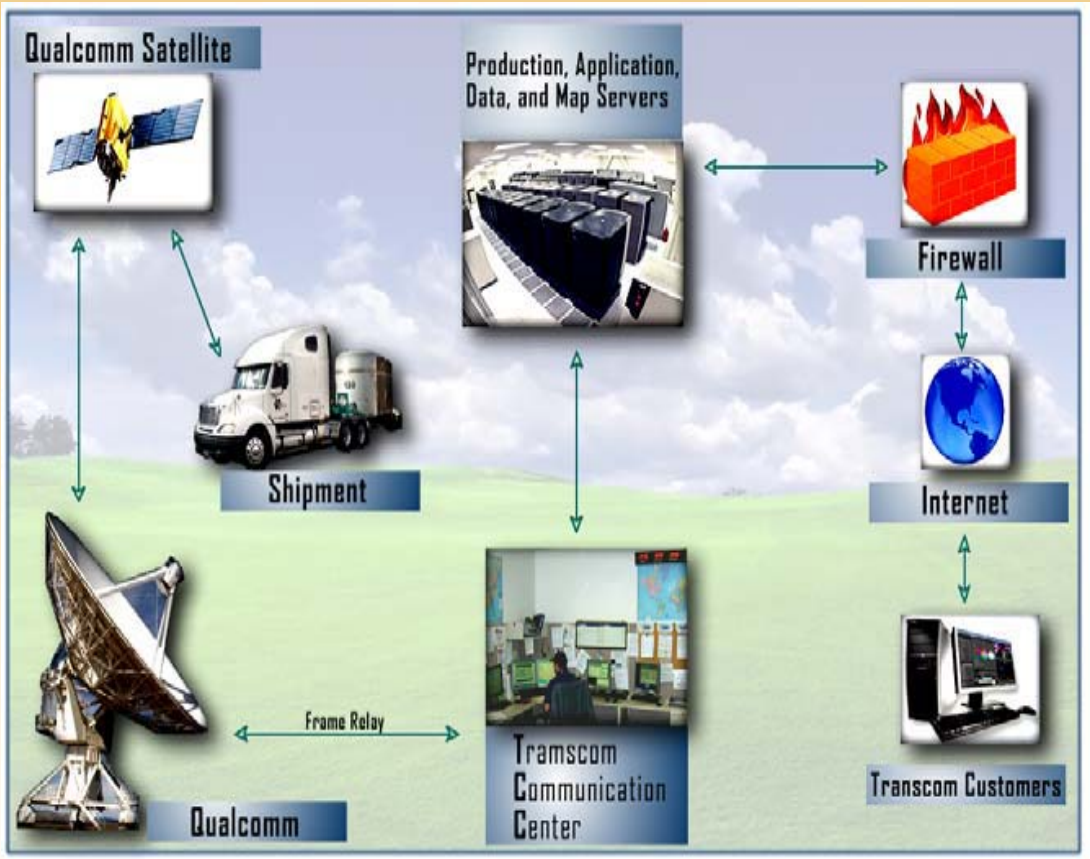
- ✓ Immersion Test - using specialized analyses, a separate transportation cask of the same design is subjected to external pressure equivalent of being immersed under 50 feet of water.

Transportation Fleet

- 2 CONTRACT CARRIERS
  - CAST Specialty Transportation
  - Visionary Solutions, LLC
- Tractors owned by Carriers
- Trailers owned by DOE

Driving Route

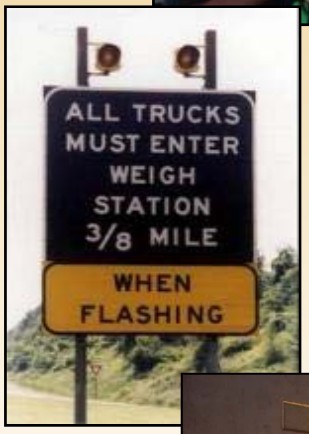
TRANSCOM



- For safety and security reasons, shipments are tracked throughout their journey using a satellite system (TRANSCOM)
- Fully automated, nation-wide tracking
- Five-minute updates
- States and tribes have access to password-protected Web site
- Drivers in constant communication with WIPP's Central Monitoring Room

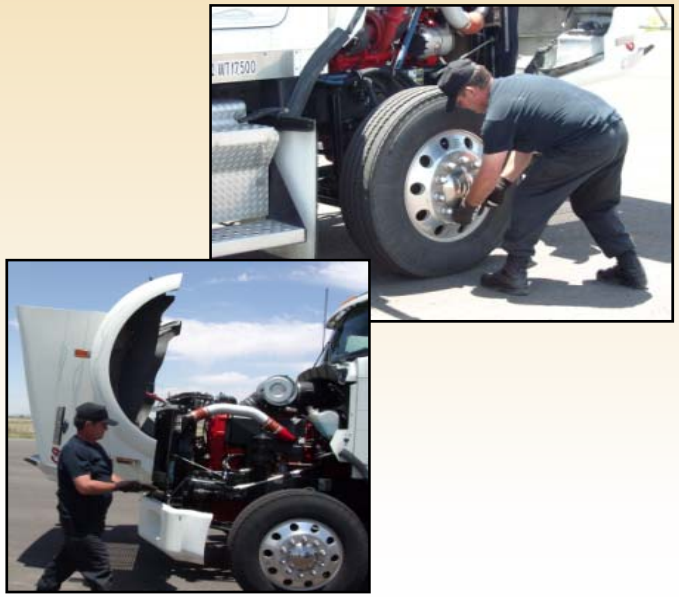
Shipment Checks

- Dose Rates
  - <200 mrem/hr on contact
    <10 mrem/hr at 2 meters
- Weight Limits
  - <80,000 lbs. gross weight for Tractor, Trailer, and Payload combination
- Leak Test
  - Pre-shipment Leakage Rate Test (Helium Leak Detection Method or Pressure Change Leak Test Method)



Shipment Checks (cont.)

- Inspections
  - CVSA (Commercial Vehicle Safety Alliance)
    Level VI Inspection at Point of Origin (2-3 hours)
  - Drivers inspect rigs and loads every 3 hours or 150 miles. Some states require added inspections at their ports of entry.



Shipment Checks (cont.)

- Inspections
  - CVSA Level VI Inspection Protocol

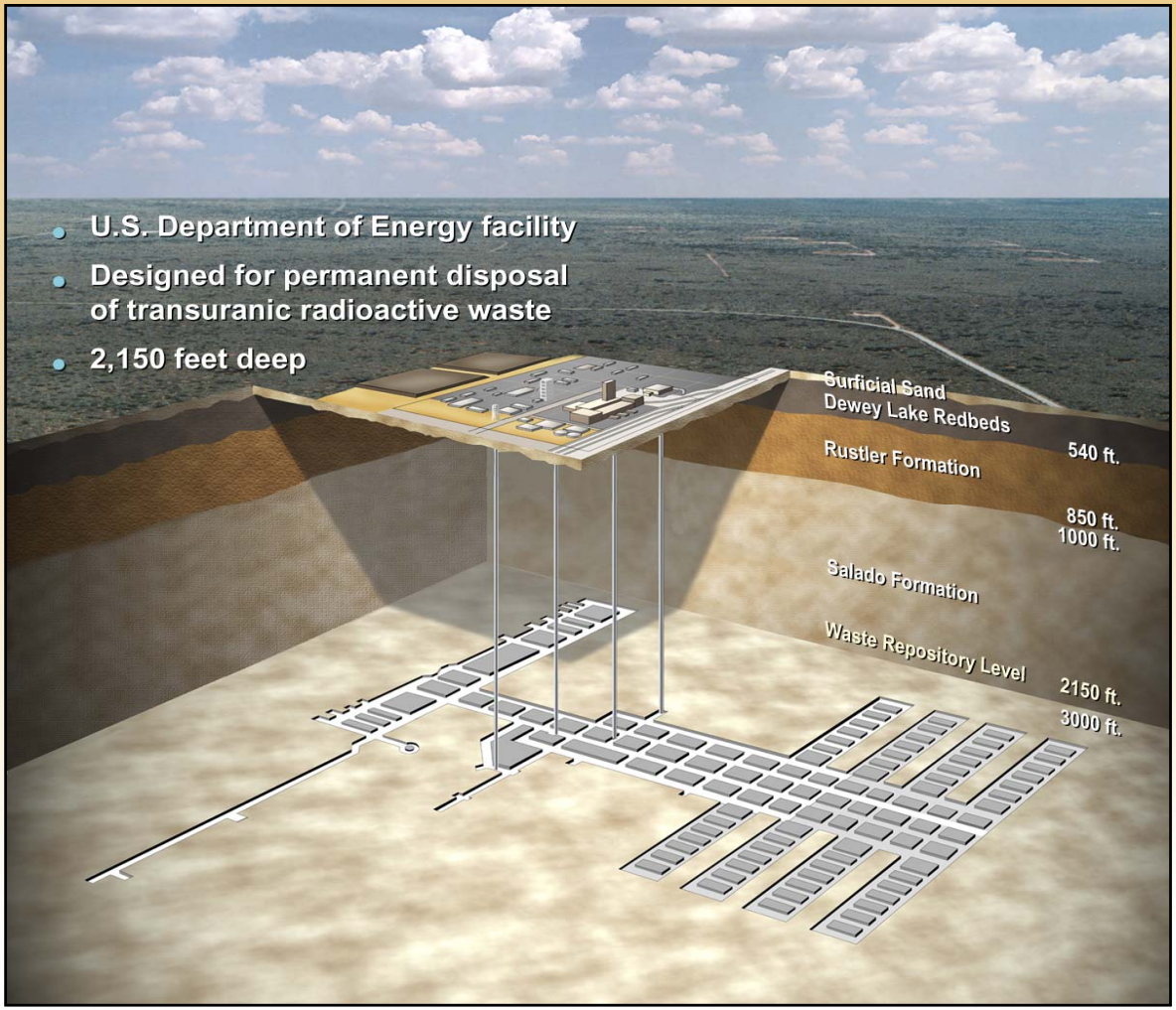
- **Coupling devices**
- **Exhaust system**
- **Brake system**
- **Fuel system**
- **Suspension**
- **Tires/wheels/rims/hubs**
- **Lighting: headlamps, tail, brake, running, instrument, turn signals**
- **Trailer interconnection systems**
- **Windshield and wipers**
- **Emergency equipment**
- **Cargo securement**
- **Electrical system**
- **Frames/supports**
- **Steering linkage**

Section 7
WIPP Facility

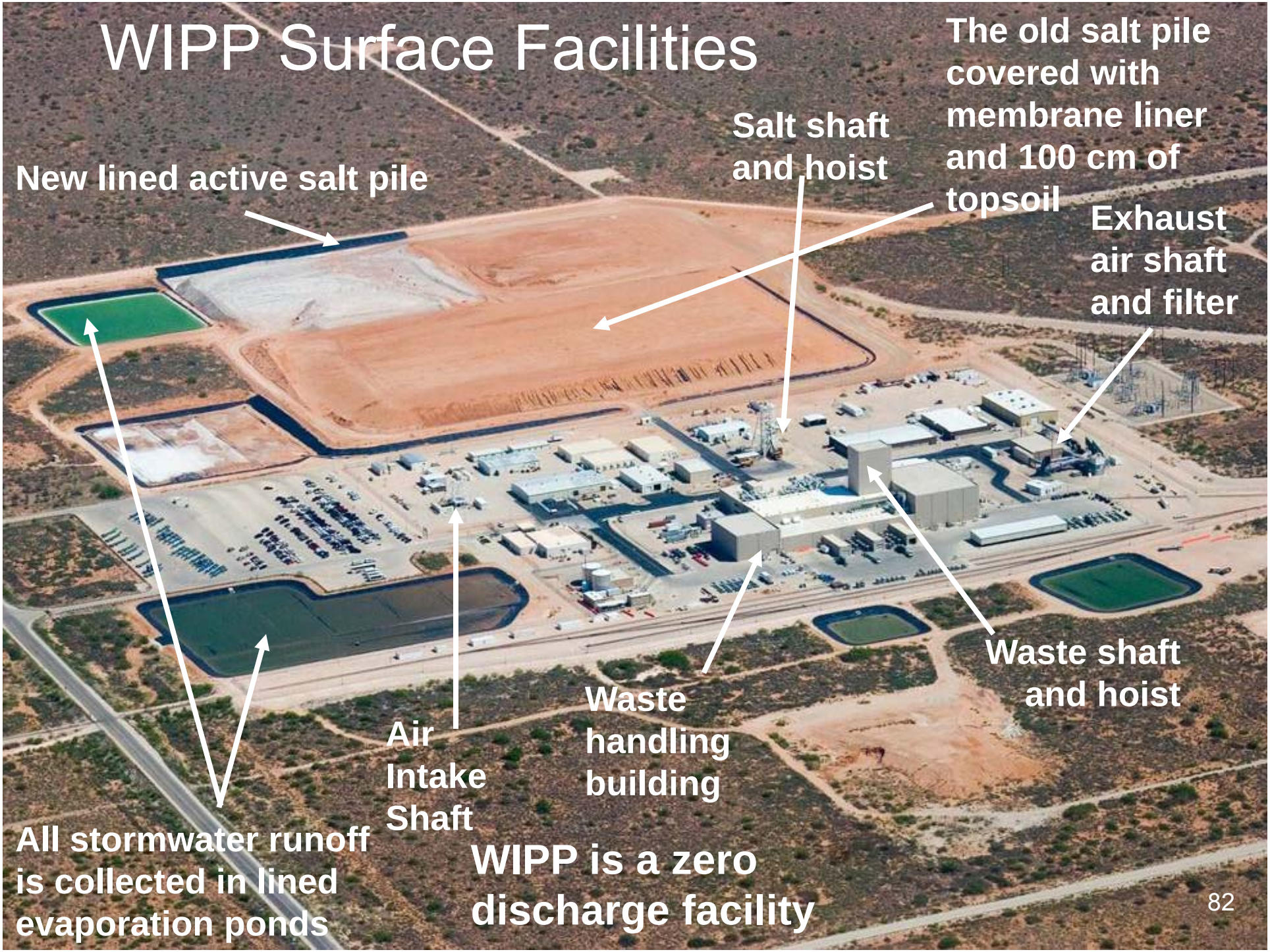
WIPP Site Facility

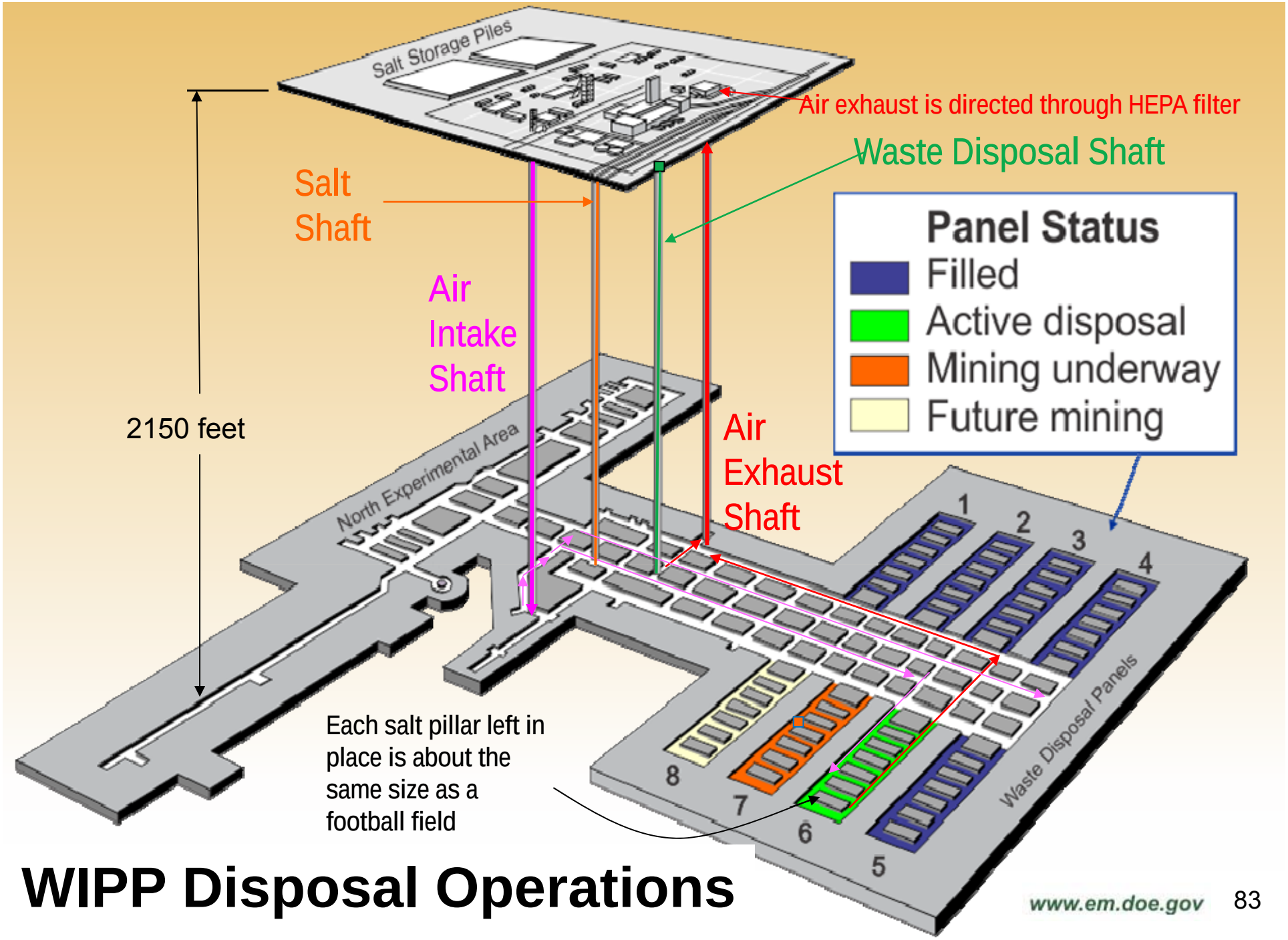
- WIPP Site facility, located 26 miles southeast of Carlsbad, N.M
- 16 square miles of land and resources was withdrawn and reserved for the WIPP Site
- WIPP's capacity by volume is 6.2 million ft^3 (175,564 m^3) of transuranic waste and of that 250,000 ft^3 (7079 m^3) can be RH
- WIPP Site "Owner" is the Department of Energy
- Site Operations are conducted by a Management and Operating Contractor

WIPP Site



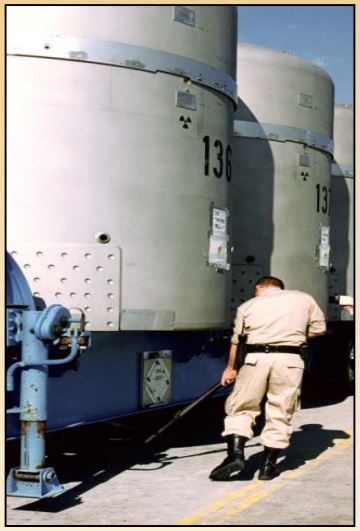
- 2,150 feet deep
- Eight disposal panels
- Four vertical shafts
- Controlled ventilation
- North Experimental Area


WIPP Surface Facilities
The old salt pile covered with membrane liner and 100 cm of topsoil
Salt shaft and hoist
New lined active salt pile
Exhaust air shaft and filter
Waste shaft and hoist
Waste handling building
Air Intake Shaft
All stormwater runoff is collected in lined evaporation ponds
WIPP is a zero discharge facility



WIPP Disposal Operations

Waste Receipt and Emplacement Process (CH)



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

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

Health physics technicians perform radiological surveys during unloading of shipping containers

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

Waste Receipt and Emplacement Process (CH)

Waste containers are placed on the waste hoist for the 2,150 ft journey into the underground

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

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

Waste Receipt and Emplacement Process (RH)

RH 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

RH & CH Waste Compete for Disposal Resources

WIPP'S Compliance Highlights

- Compliance Certification Application (CCA)
  - DOE submitted the Compliance Certification Application to the EPA October 1996
  - EPA certified that WIPP complied with the final disposal regulations May 1998
  - Requires re-certification every five years from first receipt of waste until closure
- Compliance Re-certification Application (CRA)
  - First re-certification application, CRA-2004 submitted to the EPA in March 2004
  - EPA recertified WIPP in March 2006
  - Second re-certification application, CRA-2009 submitted to the EPA in March 2009
  - WIPP was recertified in November 2010
  - Third re-certification application CRA-2014 submitted to the EPA in March 2014
  - EPA's re-certification pending

WIPP'S Compliance Highlights

- Compliance Re-certification Application Process
  - DOE/CBFO prepares the application by using all necessary resources including new scientific, performance assessment and inventory data
  - Application submitted to EPA by March 26, 2014, and every five years there after
  - EPA reviews the submittal and requests additional information as needed
  - EPA may request DOE to run a performance assessment baseline calculation (PABC)
  - EPA declares completeness
  - Once completeness is declared EPA has six months to recertify or revoke certification

- Hazardous Waste Facility Permit Renewal Application
  - Ten-year permit issued in October 1999
  - Renewal application delivered to the New Mexico Environment Department on May 28, 2009
  - NMED renewal approved April 15, 2011

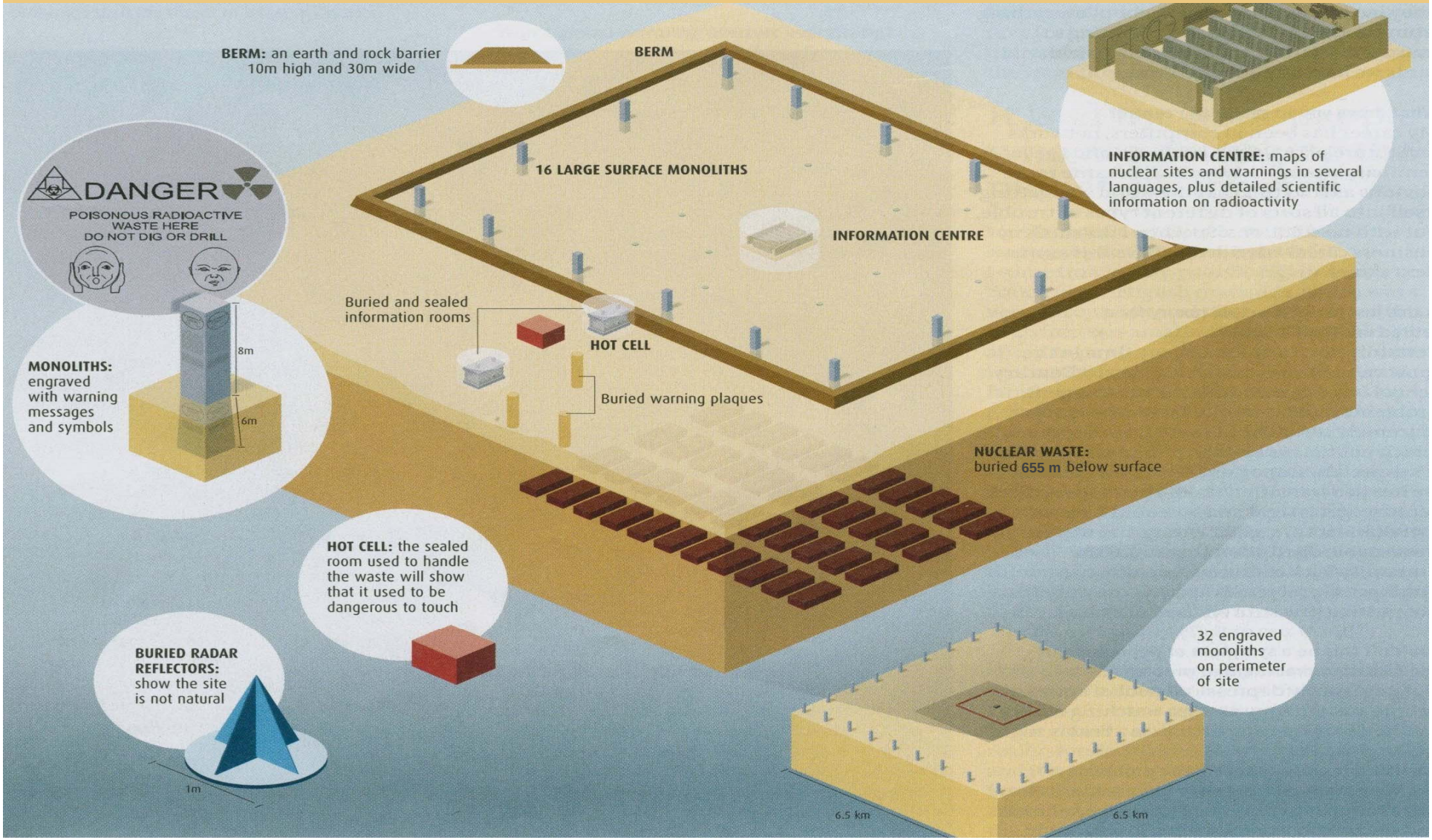
WIPP'S Closure

Once a panel is filled with waste containers, it is closed by sealing it off from remaining 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 655 m below

WIPP'S Permanent Marker Conceptual Design

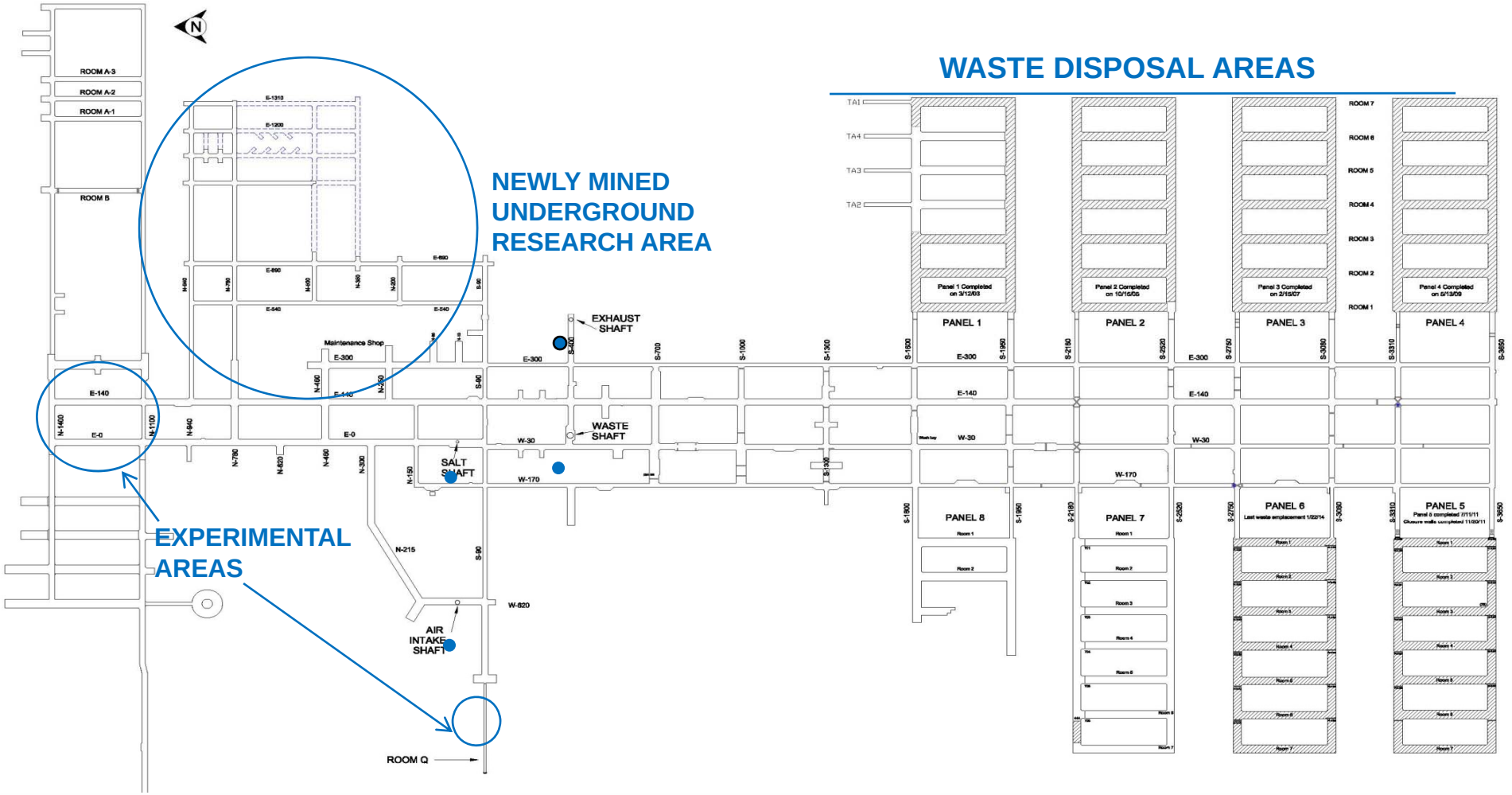


Section 8
Underground Experimental Programs

Underground Experimental Programs Background

- June 2000, DOE formally allowed use of WIPP for research purposes unrelated to the prime mission of waste disposal
- Underground Research Laboratory (URL) at WIPP offers:
  - High quality excavations
  - Existing infrastructure
  - Skilled workforce
  - Extremely low background radiation
- Over the years, several experimental programs have taken advantage of the WIPP URL
  - Enriched Xenon Observatory (EXO) experiment
  - Low-Background Radiation Experiment (LBRE)
  - Segmented Enriched Germanium Assembly (SEGA) and Multiple Element Germanium Array (MEGA) experiments
  - Dark Matter Time Projection Chamber (DMTPC) experiment
  - Initial Thermal Testing activities in the Salt Disposal Investigations Area

Overview of the Underground Research



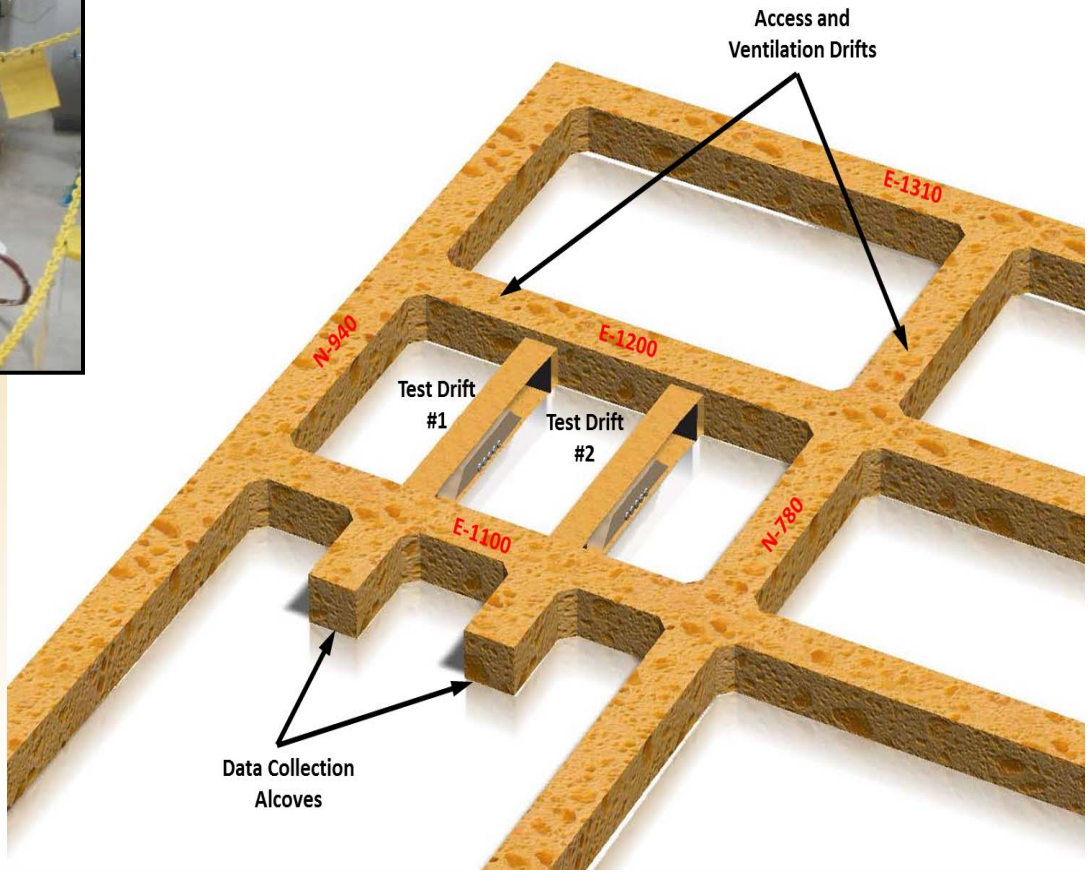
Underground Research – Low Background Radiation

Physics, biology and other low-background radiation experiments were in progress in the north area of WIPP at the time of the incidents and are recovering.

- **Enriched Xenon Observatory (EXO) Experiment (above), designed to identify neutrinoless double beta decay of the Xe-136 isotope in a detector located in a class 100 clean-room.**
- **The Low Background Radiation Experiment (LBRE) (right) investigating the effects of low levels of radiation on biological systems.**

Underground Research – Thermal Testing

- One test concept for the newly mined URL is the demonstration of a proof-of-principle concept for in-drift disposal of thermally hot waste (defense high-level)
- The prototype canister heater to be used in the test is shown above



Underground Research – Test Coordination

- Work at the WIPP site requires a high-level of formality and disciplined operations
- In 2013, the DOE-CBFO established a Test Coordination function at WIPP through an Integrated Project Team Charter
- Purpose is the coordination and implementation of testing programs in a construction and mining environment to rigorous quality and safety standards
- Brings a level of formality and disciplined operations to the science community commensurate with the operations side of WIPP while advocating for the science staff within the framework of an operating repository
- Essential for multi-organizational test programs

Section 9
Current Events

Current Events

- 2014 Significant Events
- Contamination Mitigation
- Roof Bolting
- Initial Panel Closure
- Supplemental Ventilation
- Look Ahead to Recovery

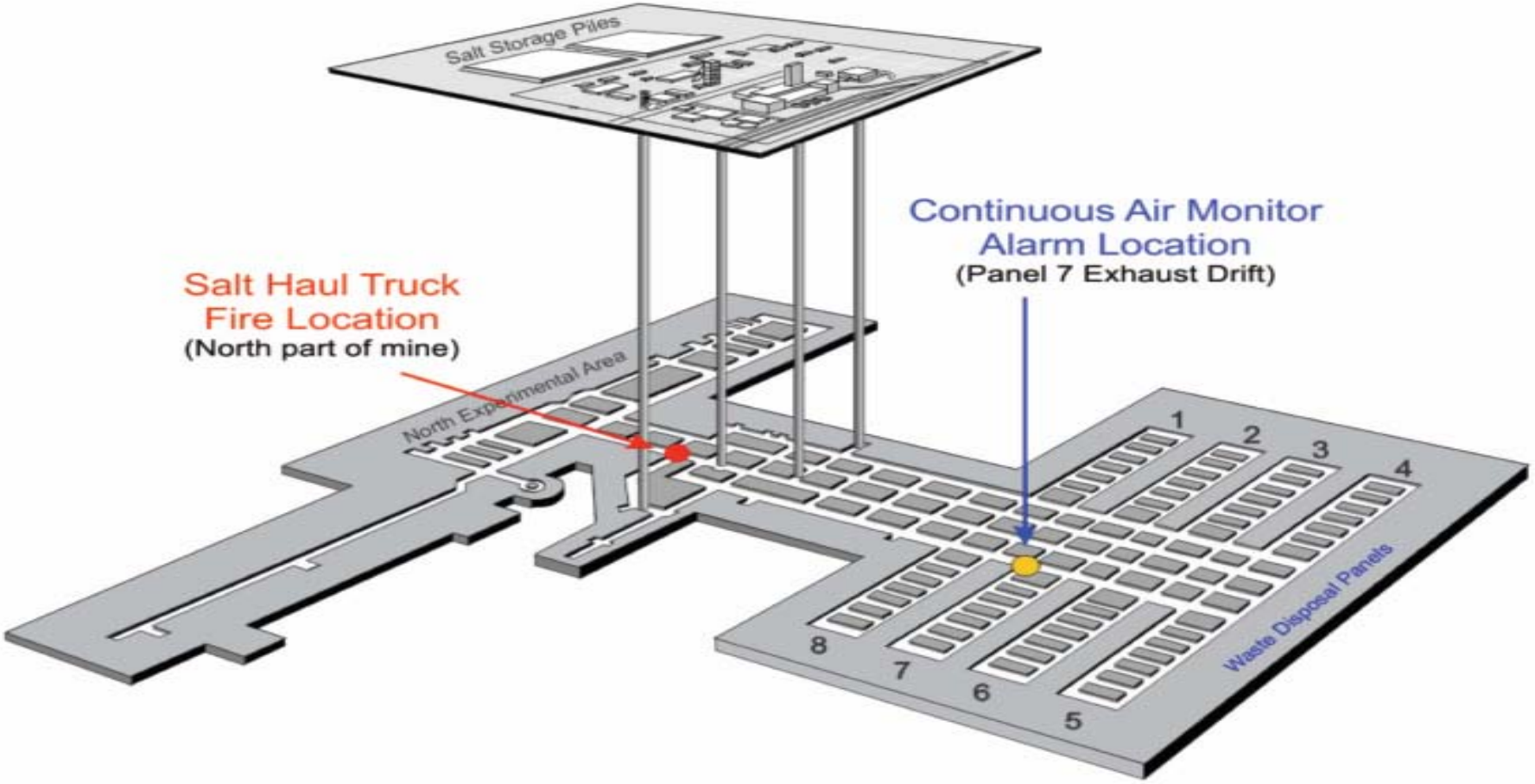
2014 Significant Events

February 5: Underground Fire

February 14: Radiological Release

2014 Significant Events

Event Locations



Contamination Mitigation

- Equipment decontamination completed
- Water wash effective for ffixing contamination on salt
- Brattice cloth is being placed on the floor and covered with run of mine salt
- Contamination mitigation work is on-going
- 65% of the contamination areas (dosimetry required) have been down posted to controlled areas (no dosimetry required).

Ground Control – Roof Bolting

- 85% Complete
- Over 4,900 new bolts installed
- New hybrid (diesel/electric) bolter procured to bolt in reduced air flow underground

Initial Panel Closure

- Panel 6 – Initial closure
  - Complete April 4, 2015 (entrance side)
    - Chain link
    - Brattice cloth
    - ROM salt
    - Bulkhead
- Room 7, Panel 7
  - Complete May 29, 2015

Supplemental Ventilation

- Interim Ventilation Project
  - HEPA skids and fans installed on surface
  - Duct work being installed
  - Will add 54,000 cfm of filtered airflow
- Supplemental Ventilation Project
  - Fan unit installed in S-90
  - Electrical work and bulkhead work ongoing
- Permanent Ventilation
  - Following DOE 413.3B critical decision (CD) process

Recovery

- Zone 7 Underground Decontamination and Remediation
- DSA 3009-2014 Development and Implementation
- Interim Ventilation Project
- Supplemental Ventilation
- Integrated Cold Operations
- Contractor Operational Readiness Review
- DOE Operational Readiness Review
- Authorization to Proceed – Commence Waste Emplacement Operations