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Title: What REALLY Happened at WIPP? The Tale of Two Fires Course 43441

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What REALLY Happened at WIPP?

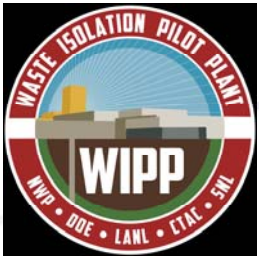
The Tale of Two Fires

Christina Poulos NPI-7 AKS; Jerri McTaggart NPI-7 AKS;
Phillip Hypes, NPI-7 FLM; Stephen Schreiber, NPI-DO

Course 43441

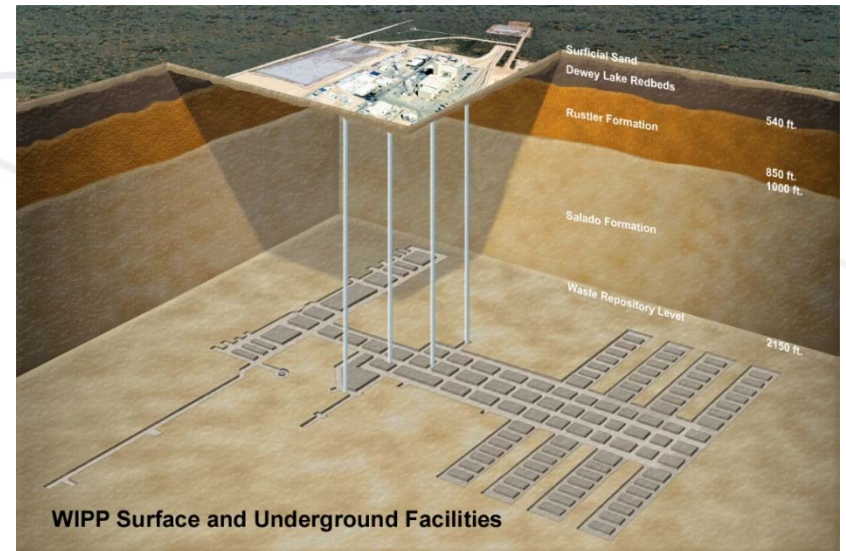
Objectives – what will be discussed

- Discuss WIPP's role with regards to TRU Waste
- Describe the events associated with the 2014 Fire at WIPP
- Discuss the CAM Alarm Event at WIPP that occurred 9 days after 2014 Fire Event
- Explain how Basis of Knowledge interacts with TRU waste activities
- Discuss LANL and WIPP actions taken from WIPP events



WIPP Overview

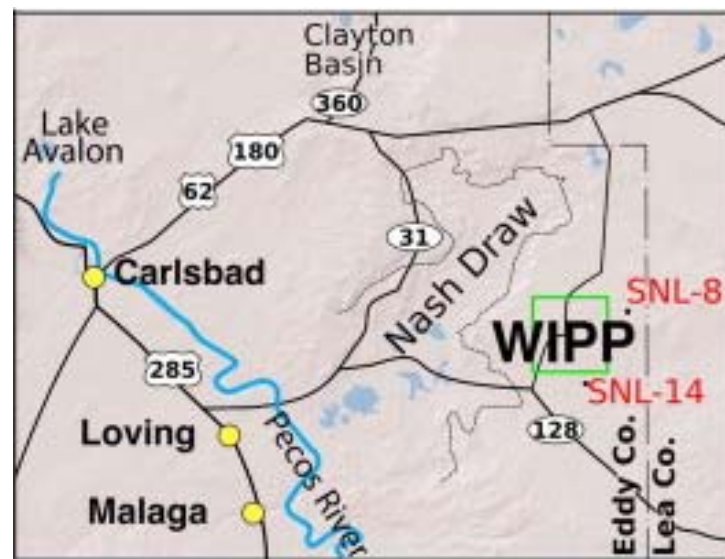
- Salt Layer in Permian Basin
 - Salado Formation 2,000 ft thick
 - 250 Million Years Ago
- TRU waste disposed at 2,150 feet deep
 - Absence of H_2O
 - Geologic Stability
 - Easy to Mine
 - Encapsulates Waste
 - “Salt Creep”





Evolution of WIPP

- 1940's U.S. Nuclear Defense Program
 - creating Transuranic (TRU) radioactive waste
- 1957 National Academy of Sciences
 - recommended deep disposal salt deposits to protect human health and environment
- 1974 U.S. Atomic Energy Commission
 - Chooses salt bed 26 miles SW of Carlsbad, New Mexico
- 1979 U.S. Congress
 - Authorized DOE to build WIPP
- 1981 WIPP Construction Begins
- 1998 U.S. DOE and EPA
 - Certified WIPP for safe and long-term disposal of TRU wastes
- 1999 WIPP Open!



Slide 3

Transuranic (TRU) Elements

- U.S. Nuclear Regulatory Commission
 - Radioactive elements (isotopes) with atomic # greater than Uranium (92)

Transuranic elements in the periodic table

The diagram illustrates the periodic table, focusing on the transuranic elements (elements with atomic numbers greater than 86). The main table shows elements 1 through 86, with the transuranic elements (87-103) shown in a separate 3D block structure below the main table. The transuranic elements are labeled with their atomic number, symbol, and name in a 3D perspective view.

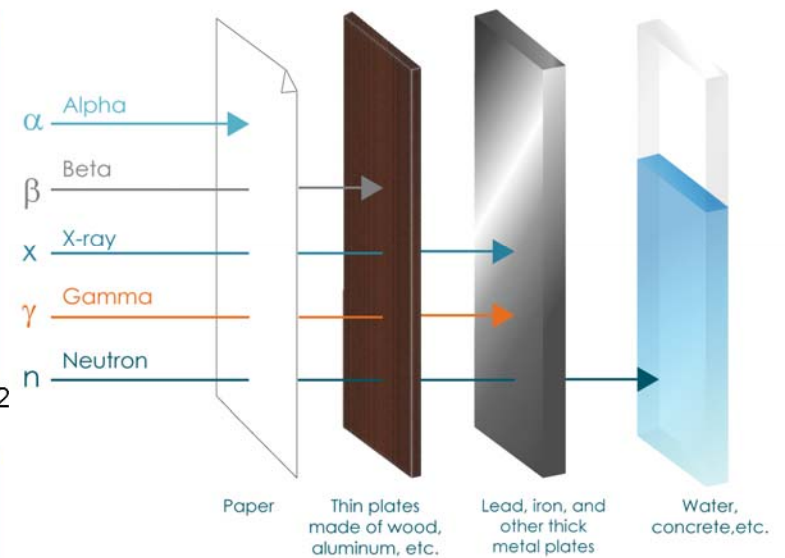
1																	2
3	4																
11	12																
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
87	88	89															

Elements higher than Uranium 92 are transuranic elements

104	105	106	107	108	109	110	111
Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg
(261)	(262)	(266)	(264)	(269)	(268)	(271)	(272)

58	59	60	61	62	63	64	65	66	67	68	69	70	71
90	91	92 U 238	93	94	95	96	97	98	99	100	101	102	103
			Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
			(237)	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(262)

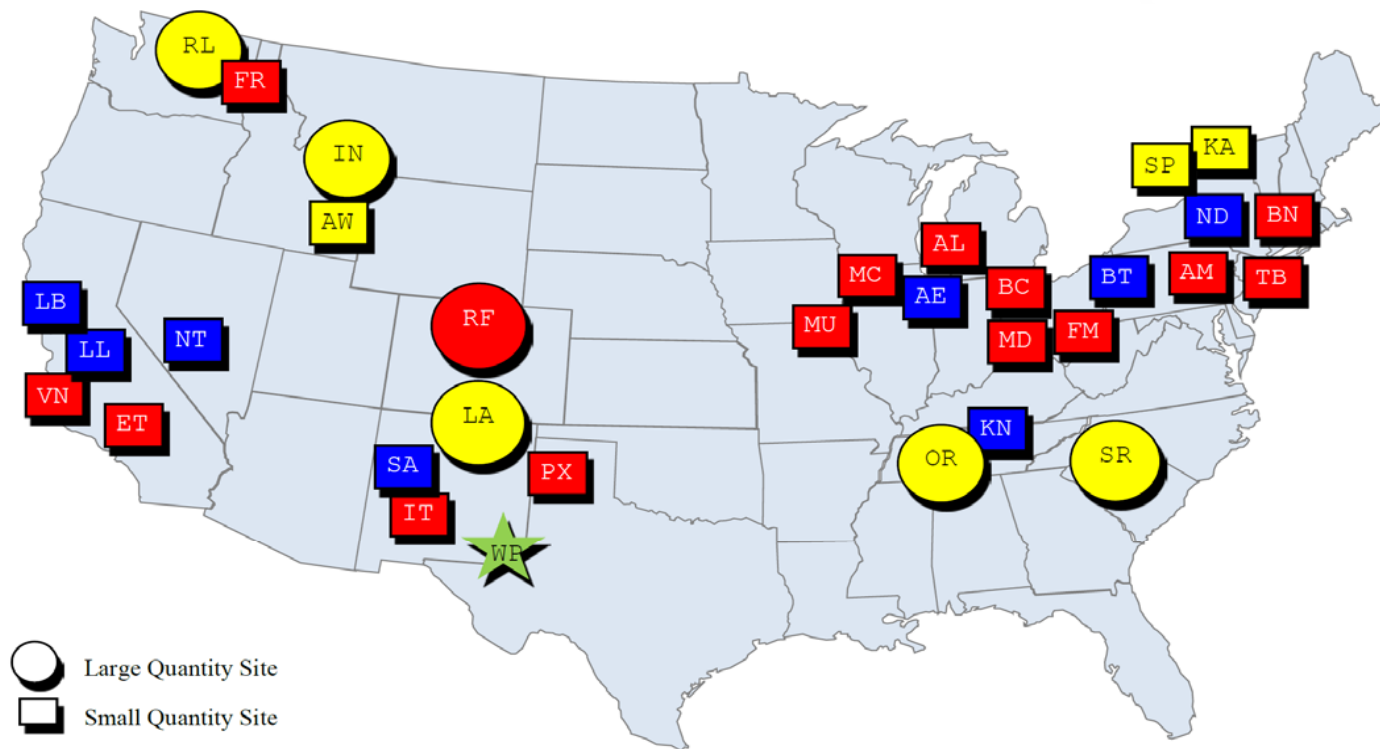
TYPES OF RADIATION AND PENETRATION





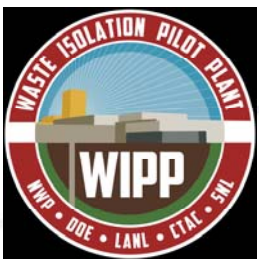
WIPP's Mission

- Safe disposal of defense-generated TRU waste from DOE sites around the country. www.wipp.energy.gov

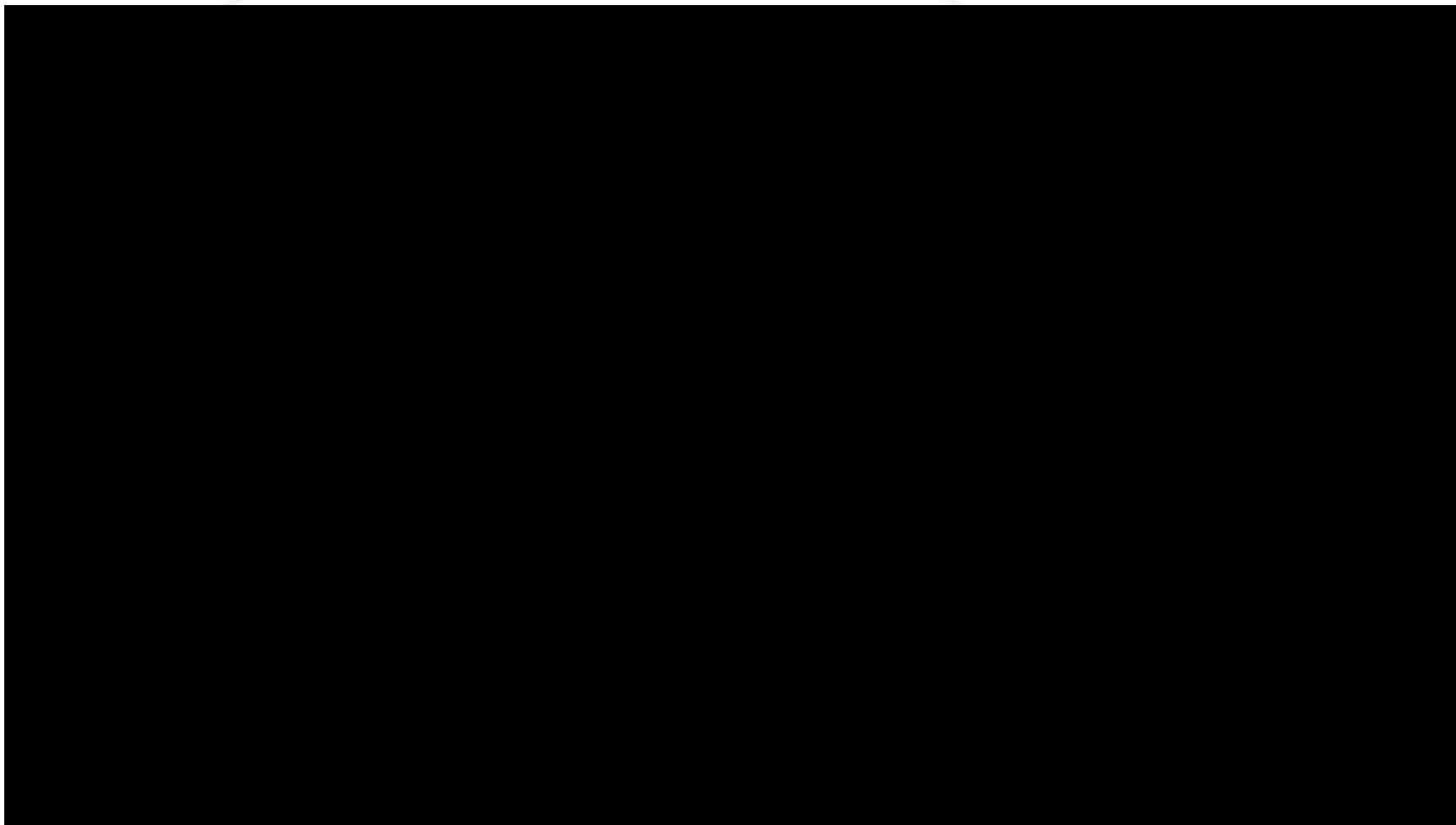


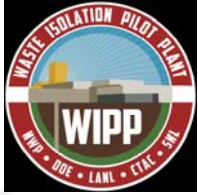
○ Large Quantity Site
□ Small Quantity Site

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



WIPP Overview





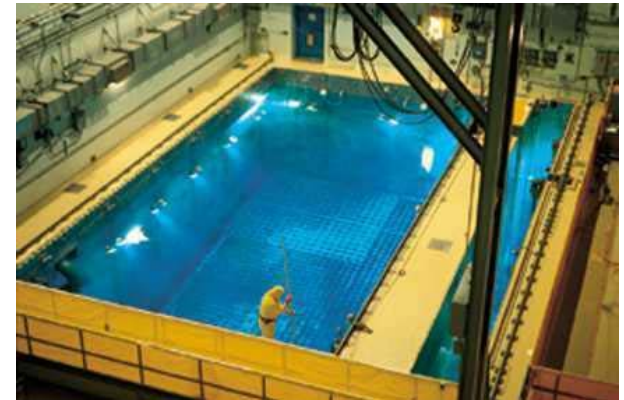
Transuranic (TRU) Waste at WIPP

- 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste
- Half-lives greater than 20 years
- Except for:
 - high-level radioactive waste, spent nuclear fuel
 - waste that the Secretary has determined, with the concurrence of the Administrator, does not need the degree of isolation required by the disposal regulations

Initial amount
100%



After 1st half-life,
50% remains



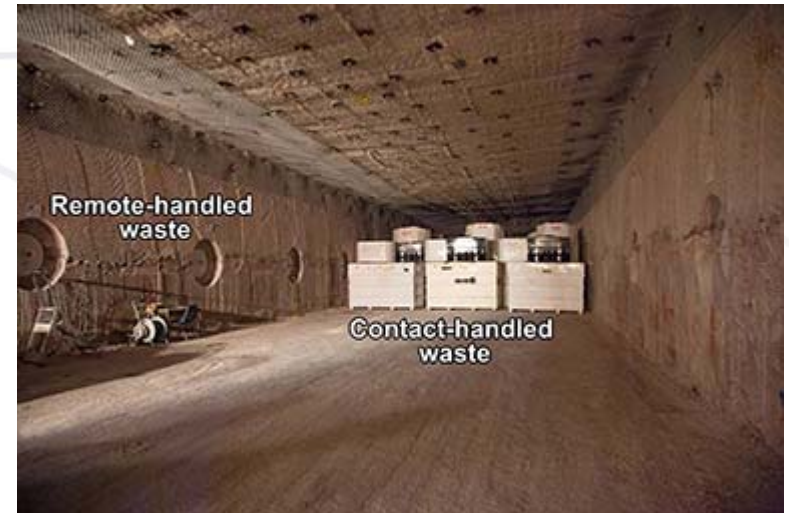
South Texas Project Nuclear
Power Plant

Transuranic (TRU) Waste

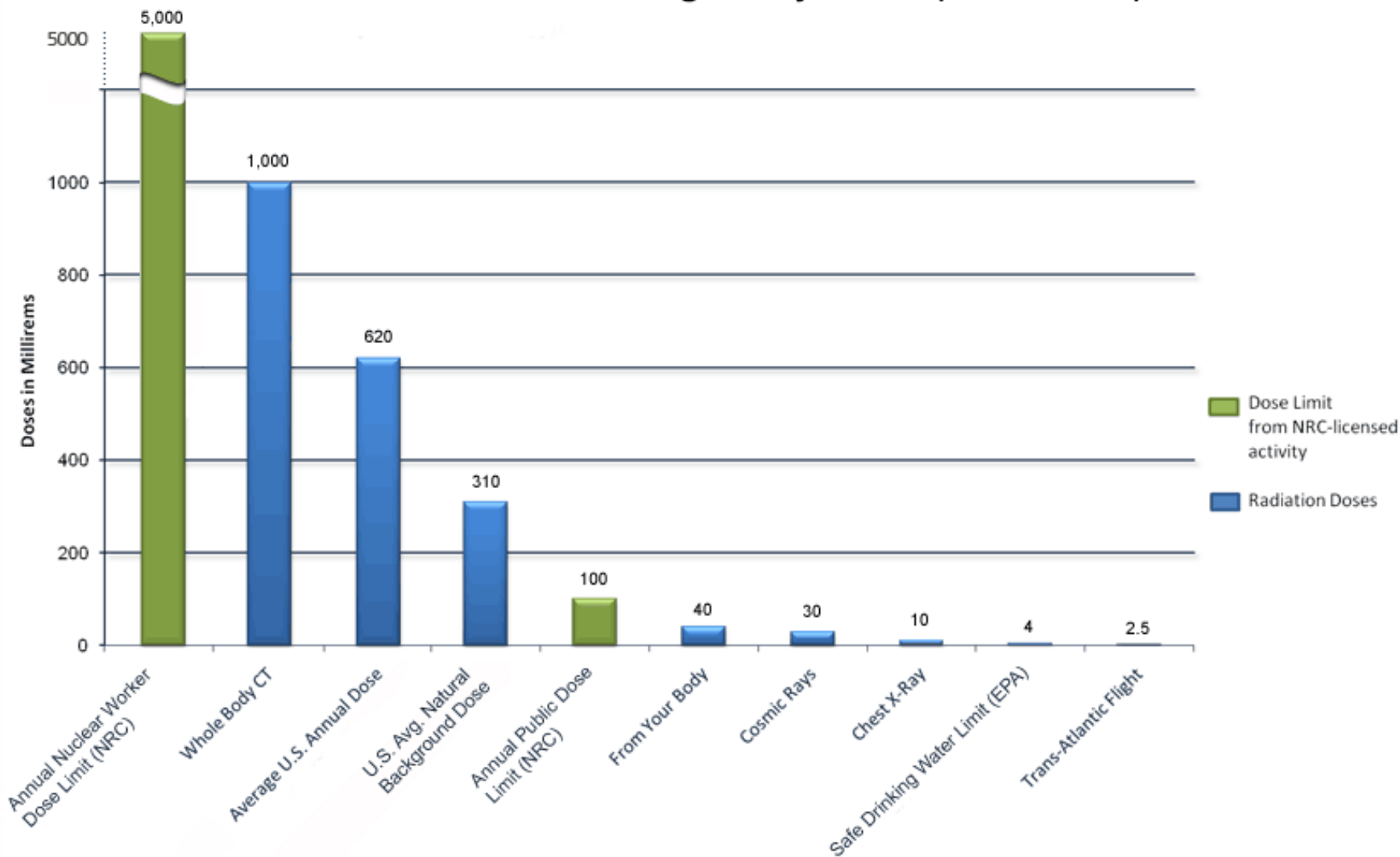


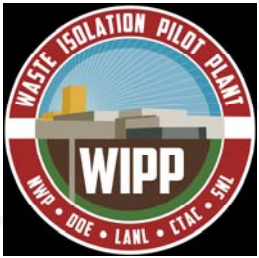
Types of TRU Waste

- Contact Handled (CH) Waste
 - Directly Handled
 - <200 millirem/hr
- Remote Handled (RH) Waste
 - Remote Manipulators to Handle
 - >200 millirem/hr
 - $<1,000$ rem/hr



Radiation Doses and Regulatory Limits (in Millirems)





WIPP's Philosophy

- Start Clean - Stay Clean



- March 25-26, 1999 LANL 1st Shipment to WIPP

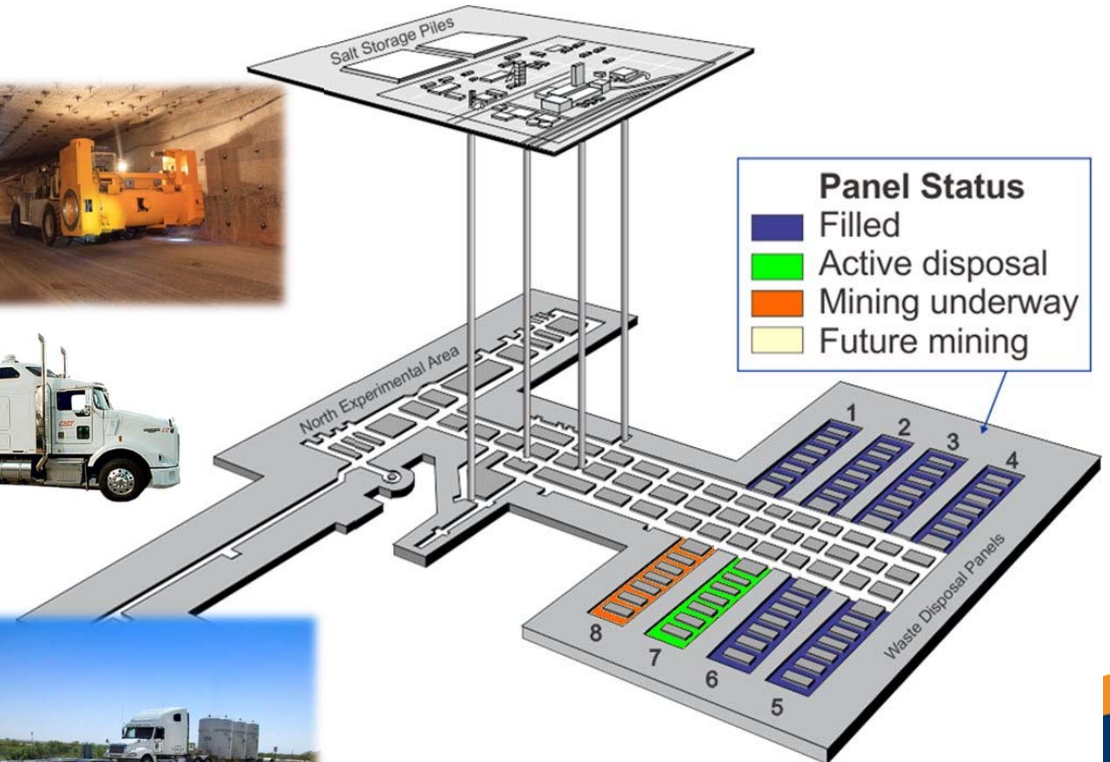


WIPP's 15-year History of Success 1999- 2014



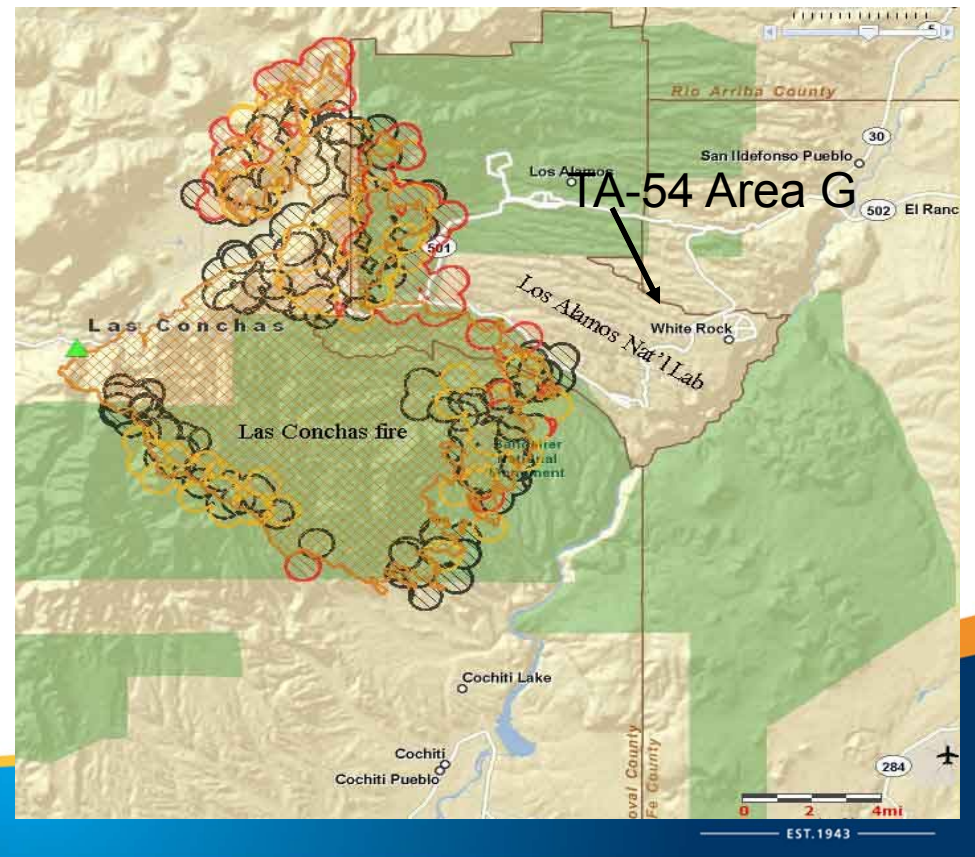
11,894
91,000
14,200,000
24

shipments received
cubic meters of TRU waste disposed
loaded miles
storage sites cleaned



The Catalyst: Las Conchas Fire 2011

- Burned 63 Structures and 156,000 acres
- Evacuation of residents
- Burned for 5 weeks
- Came within 3.5 miles of TA 54 Area G Storage and Processing areas
 - 1957 Radioactive Waste Landfill
 - Post-1970's TRU waste stored in pits, domes, trenches and shafts



Response: Framework Agreement

Agreement between NM Environment Department (NMED) and DOE/NNSA



TA-54 Area G



- Accelerates removal of above-ground TRU waste at LANL including:
 - 3,706 cubic meters non-cemented above-grade by June 30, 2014
 - Removal of all new-gen TRU waste received at TA-54 Area G during FY12 and FY13 by December 31, 2014
 - Development of a schedule that includes pacing milestones for disposition of below-grade TRU requiring retrieval at Area G by December 31, 2012 (submitted December 10, 2012)
 - Complete removal of above-grade cemented legacy TRU waste in an efficient and effective manner.

LANL 3706 TRU Waste Campaign



Organize -> Process -> Characterize -> Certify -> Ship to WIPP

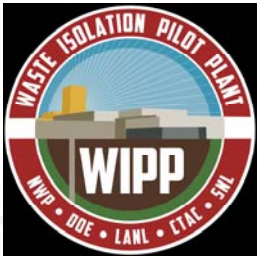
Challenges: Radiological, Environmental, Staffing, Emerging Process Issues, Expanded Shifts, Budget, Oversight etc....

93% of the 3706 Campaign TRU waste containers were removed from LANL

- 70% Oversized Containers

- 20% Drums

- 10% Standard Waste Boxes



2014 Fire at WIPP

Salt Haul Truck Fire

February 5, 2014 10:45 am

Keith Lacy (NPI-7 GL) drove this truck!



Location operator saw orange glow.

http://www.wipp.energy.gov/wipprecovery/accident_desc.html



86 people in the mine
6 treated for smoke inhalation
7 more treated on-site

WIPP Fire Accident Investigation

- Unreasonable expectations/uncertain capabilities of the Facility Shift Manager (FSM) to manage all aspects of an emergency or abnormal event.
 - 10:58 am: Switch the ventilation system from normal to filtration mode believing this would reduce fire and smoke in underground. This resulted in the flow of smoke into areas of the underground which workers expected to have good air
- Inadequate Fire Hazard Analysis, Training and Drills
 - Hadn't run fire drills and poor visibility (smoke)
 - Ineffective fire suppression system on truck
 - 300 lb fire extinguisher – ineffective
 - Workers said they couldn't hear the evacuation announcement



http://www.wipp.energy.gov/Special/AIB_Report.pdf

WIPP Fire Accident Investigation

- Inadequate combustible loading program in the underground.
 - Obscured evacuation route reflectors
- Emergency Operating Center (EOC) Ineffective as an Incident Command System (ICS)
 - Forgot to activate evacuation strobe lights
 - 11:03 am EOC did not classify event as emergency and did not contact DOE Headquarters
- Inadequate Operability and recognition of impaired critical safety equipment
 - Workers had difficulty opening and donning self rescuers

<http://www.wipp.energy.gov/Special/AIB/Report.pdf>



Inset Shows Obstructed Reflectors



Salt Haul Fire Findings

- Maintenance program = ineffective
- Fire protection program = less than adequate
- Evaluation and protective actions = less than adequate
- Maintenance of waste vs. mining vehicles



Air Lock Doors Wired Open



Hydraulic Leak under Sister Vehicle



Combustible Loading in the Mine

CAM Alarm Event at WIPP

February 14th 2014 at 11:14 pm
(9 days after Salt Haul Fire)

- A high radiation alarm was received in the Central Monitoring Room
- Response: Underground Ventilation System initiated the switch to a HEPA Filtration mode.
- Exhaust Duct Dampers did not fully seal
- February 15th 2014 (7:15 am): 4.4 million dpm alpha contamination on filters upstream of HEPAs



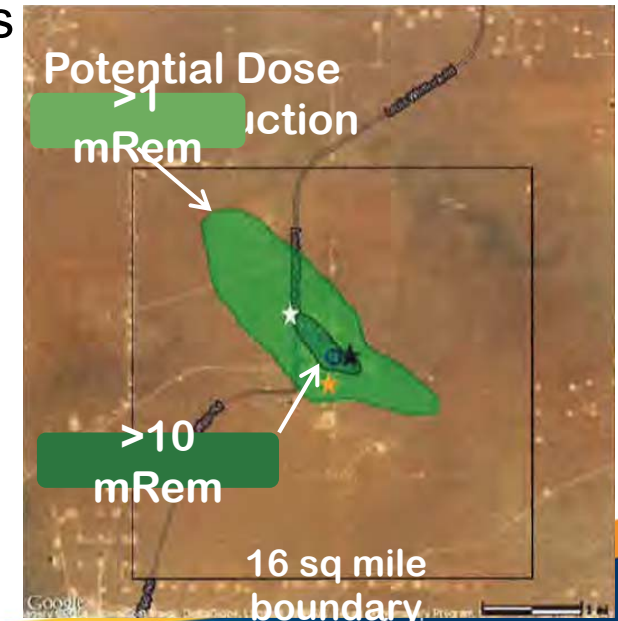
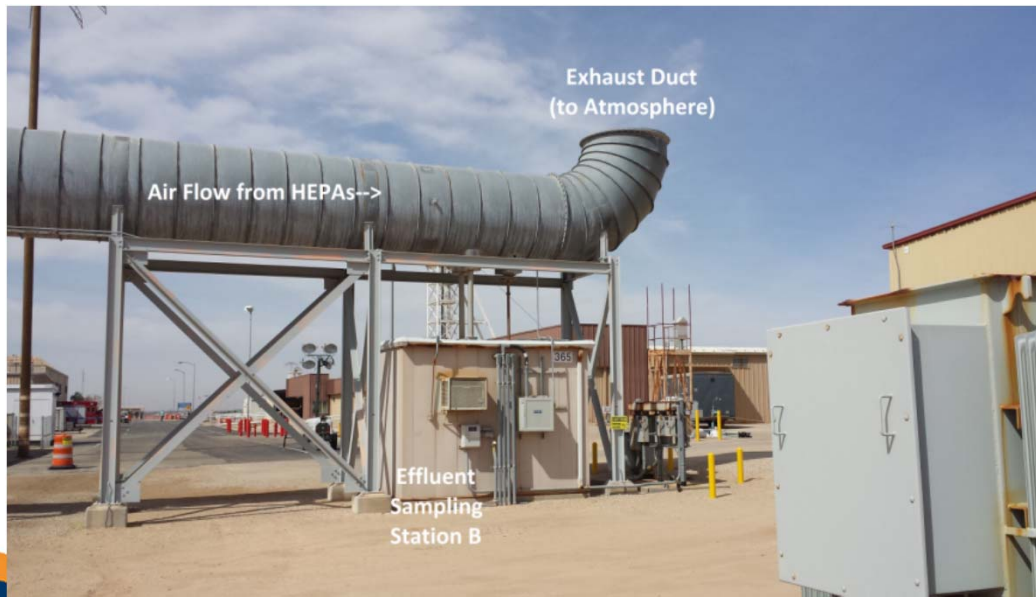
SRNL Preliminary Summary Report for WIPP Samples

Tested Fixed Air Samples and CAM Filters (some filters were black, one CAM had no filter): Am-241, followed by Pu-239, Am-243/Np-239, and Np-237/Pa-233.

www.wipp.energy.gov/Special/SRNL_Preliminary_Summary_Report.pdf

CAM Alarm Event at WIPP

- 114 employees are on their way to WIPP but also 3rd Shift on their way home
- At 9:15 am: 28 thousand dpm (alpha) and 5.9 dpm (beta) contamination reported downstream of HEPAs. Trace Amounts: Americium and Plutonium
- Shelter in place lasted from 9:34 am to 4:34 pm, then frisk and release; the site was restricted to essential personnel
- Exposure to Employees: 21 measurable exposure (<10 millirem during 50 years of dose) 13 had above normal backgrounds



WASTE DISPOSAL PANELS

Salt Truck Fire 2/5/14

24 rows of CH waste in Room 7 of Panel 7

CAM Alarm Location (Panel 7 Exhaust Drift)

U/G Status February 5, 2014

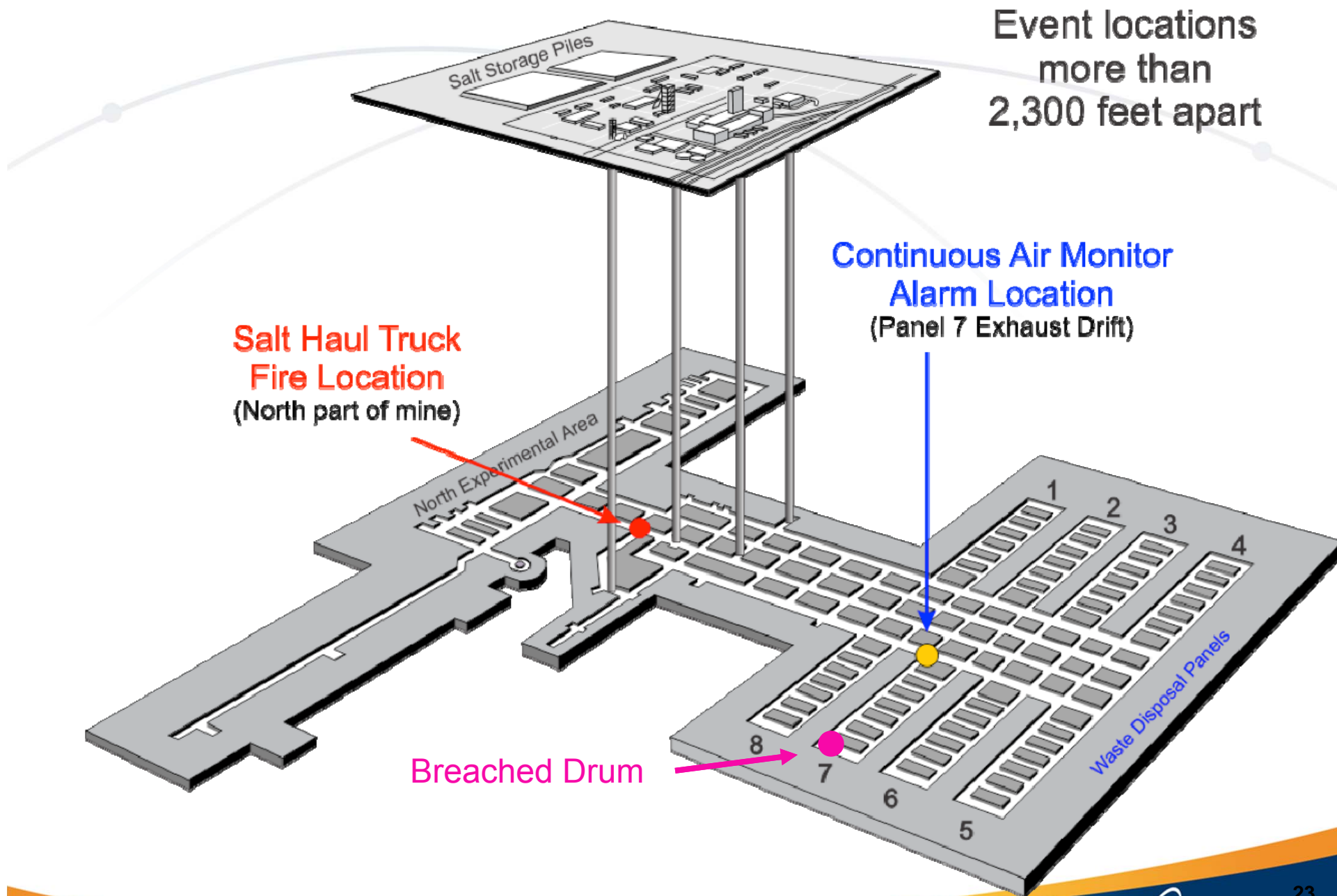
- Panels 1-5 filled and sealed
- Panel 6 filled and sealing in process
- CH waste emplacement in Room 7
- RH waste emplacement in Room 6
- Active mining Panel 8

NNSA
National Nuclear Security Administration

Los Alamos
NATIONAL LABORATORY
EST. 1943

U/G Status February 5, 2014

- Panels 1-5 filled and sealed
- Panel 6 filled and sealing in process
- CH waste emplacement in Room 7
- RH waste emplacement in Room 6
- Active mining Panel 8



Root Cause of Contamination to Environment

The Investigation Board identified the root cause to be NWP and CBFO management failure to fully understand, characterize and control the radiological hazard.

Inadequacies:

- Ventilation system design and operability were blocked due to fire
- Delay and ineffective recognition and response of the release
- Degradation of key safety management programs and safety culture

http://www.wipp.energy.gov/Special/AIB_Final_WIPP_Rad_Release_Phase_1_04_22_2014.pdf

DOE/CBFO Response

February 19-20, 2014

- LANL-CO developed list based on a comparison of isotopic ratios for each emplaced container in Room 7 of Panel 7 and of WIPP Station A air filter samples. List included containers from an Idaho - Rocky Flats waste stream and several drums containing nitrate salts from LANL.

May 1, 2014

- CBFO declared a Potential Inadequacy in the Safety Analysis (PISA) regarding the potential for untreated nitrate salt waste being emplaced, which later prompted LANL to declare a PISA as well.

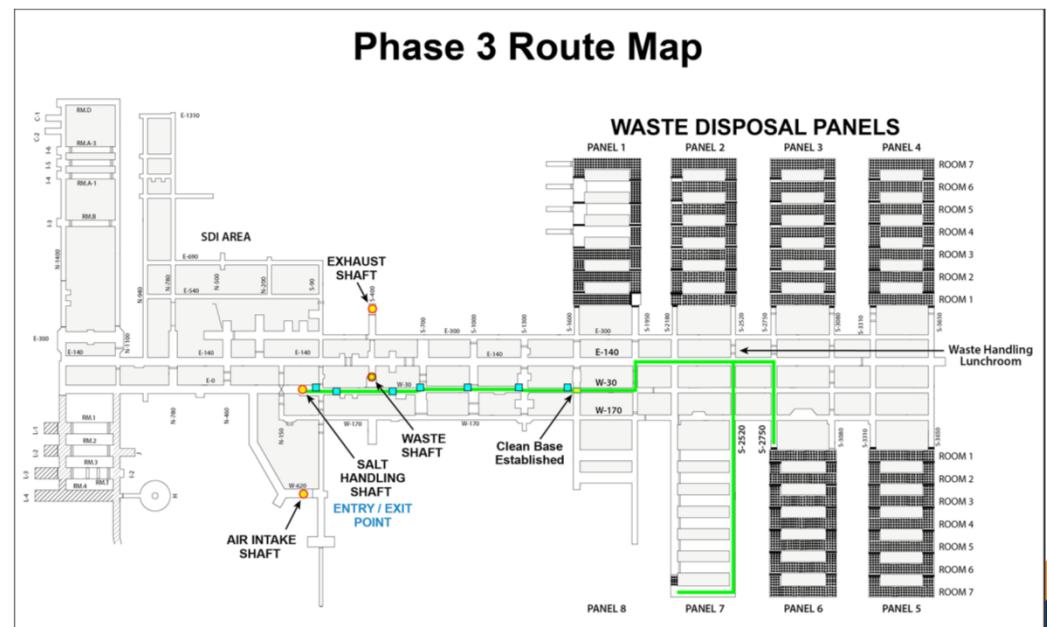
May 15, 2014

- Photographic evidence confirmed that a LANL container (drum 68660) was breached.

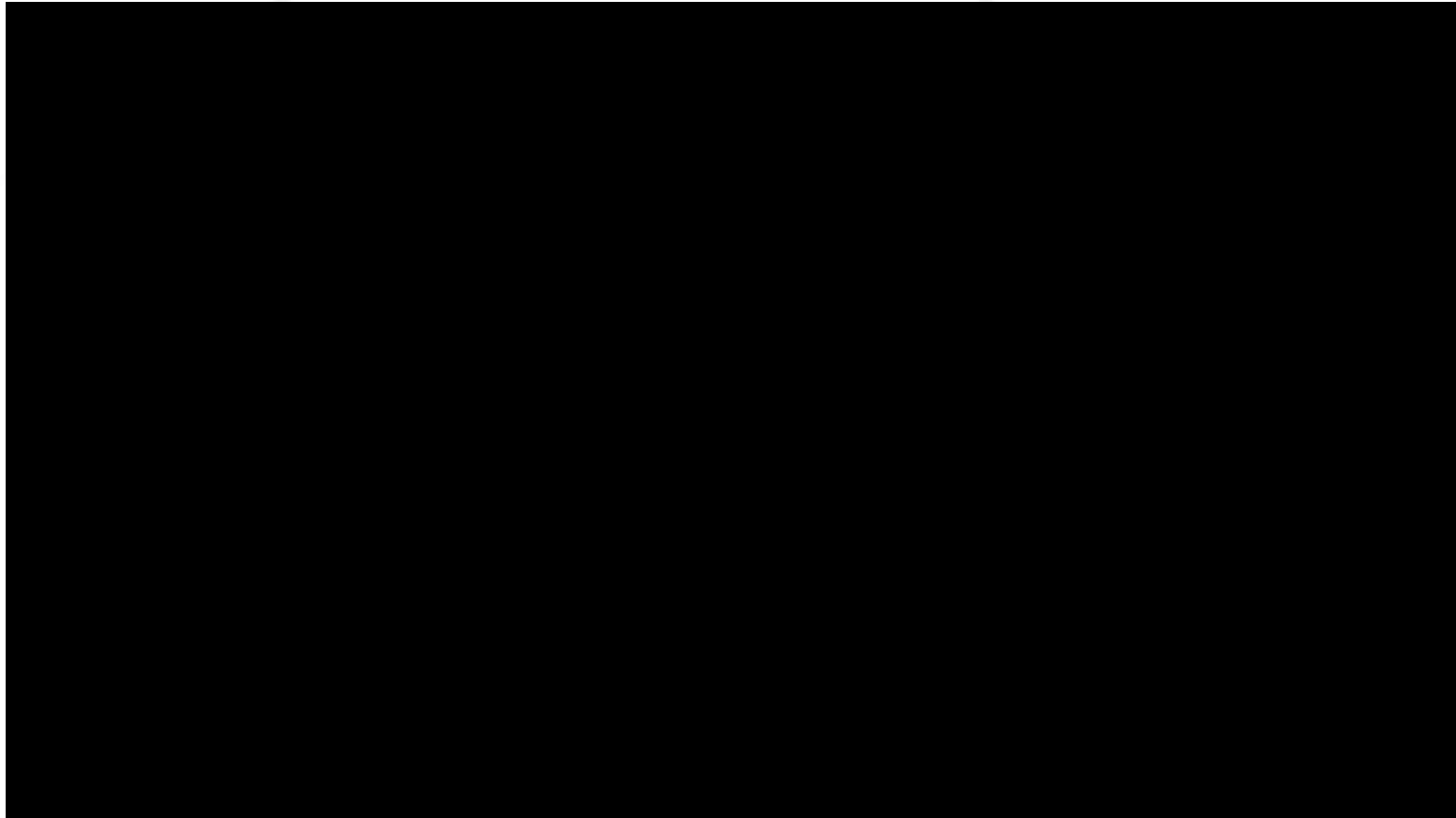
LANL continued shipping to Waste Control Specialists (WCS) via agreement in Texas due to 3706 Campaign from March 2014 until May 2014

2014 Re-entry Timeline into WIPP

- April 2, 2014: First underground re-entry (still not at the disposal site)
- April 16, 2014 - 4th entry (2 teams still not at disposal site)
- April 21, 2014 - SRS to train WIPP employees to replace HEPA Filters
- April 23, 2014 - Re-entry teams access Room 7
- May 10-15, 2014 - Rope on camera to take initial video of breached drum
- June 10, 2014 - Filter Replacements Begin
- October 23, 2014 - Ventilation Fan Restarted

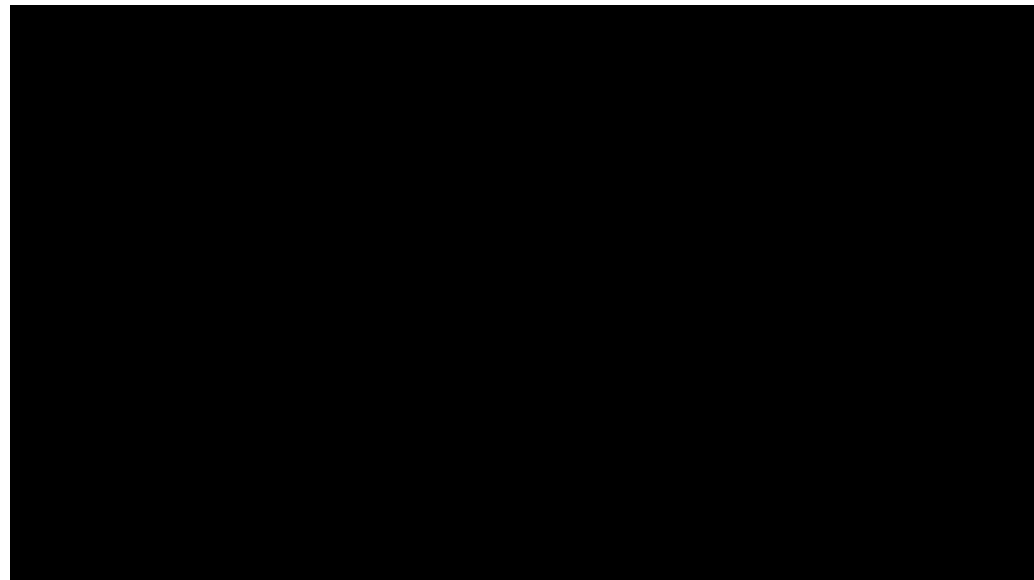
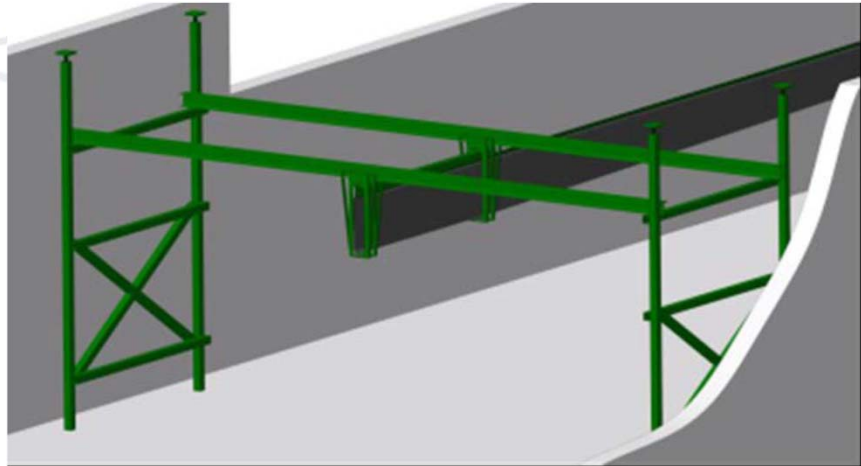


Video of Evidence of Breached Drum



Project Reach

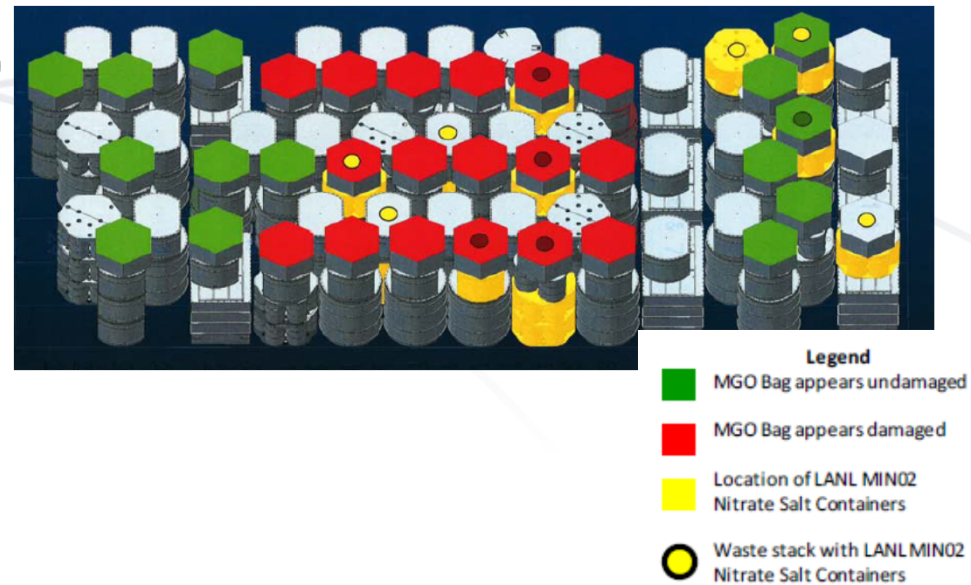
- 90-foot composite boom equipped with high resolution video equipment to take video, photographs and obtain samples
- January 26, 2015
- Cost/benefits?



Breached Drum 68660



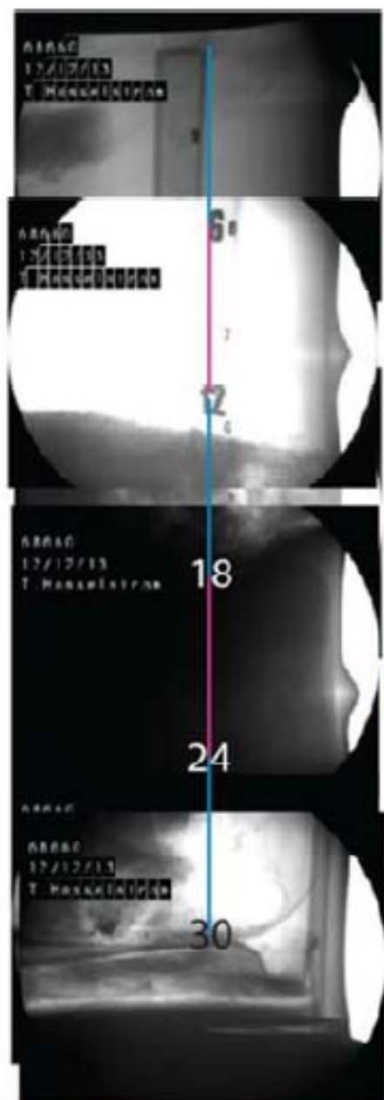
Breached Drum



Model and X-Rays of Drum #68660



Drum #68660 (X-rays)



2011 LANL Remediation of Nitrate Drums

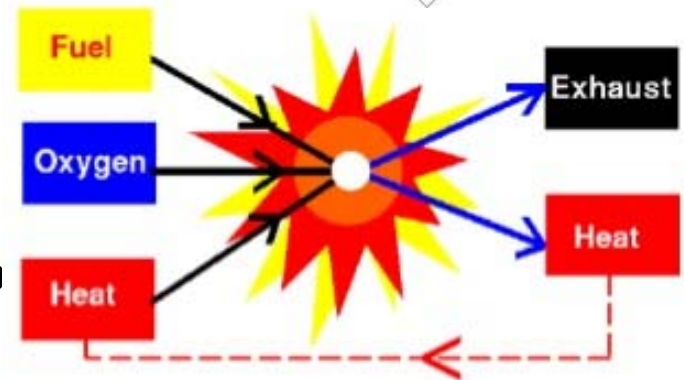


What was packaged and why?

Remediation of Nitrate Salt Drums at WCRRF (3706 Campaign)

2012 LANL Memo:

- Waste Repackaging put ON HOLD
 - Characterized Incorrectly (D001, D002)
 - No pH adjustment of “Free Liquid” prior to shipment
- October 2012 Procedure Change at WCRRF
 - pH adjustment: KOLORSAFE Liquid Acid Neutralizer = **Incompatible with Oxidizers**
 - WCRRF: **Not RCRA Permitted** for treatment
 - “Use of organic absorbent”
 - Added additional debris waste: Leaded Gloves



Other Contributing Causes

- National Transuranic Program (NTP)
 - Failure to ensure RCRA and WIPP WAC requirements
- Central Characterization Program (CCP)
 - Failure to develop Acceptable Knowledge (AK) that captured all available information regarding waste gen and repack activities
 - Did not adequately evaluate potential impact of changes to LANS Glovebox Operations Procedures
 - Failed to ID the potential impact of the addition of secondary waste
- LANS
 - Hazard ID and Controls – inadequate processes
 - Procedure and Safety Program – inadequate procedure development, review and change control
- LANS Contractors, LA Field Office, DOE
 - Failure of oversight

http://www.wipp.energy.gov/Special/AIB_WIPP%20Rad_Event%20Report_Phase%20II.pdf

LANL-Carlsbad Office: Scoping Studies

- Identified “absorbents” and oxidizers (77) in all waste streams being shipped to WIPP
- Scoping Studies 2015: EPA 846 Method 1040 Test Method for Oxidizing Solids
- Bounding Conditions: fastest burning oxidizer and absorbent
- Potassium Nitrite (KNO_2) and Quik Solid (polyacrylate polymer)



LANL-Carlsbad Office: Oxidizer Testing

Absorption Results:

- Absorb with a listed inorganic sorbent zeolite type of clay
- NoChar, WasteLock and Quik Solid <30 weight percent oxidizer - no remediation required
 - Anything greater needs to be remediated with 50 weight percent zeolite
- Slikwik, sWheat Scoop (cellulose-based sorbents) absorbed with any amount oxidizer will require remediation of 70 weight percent zeolite



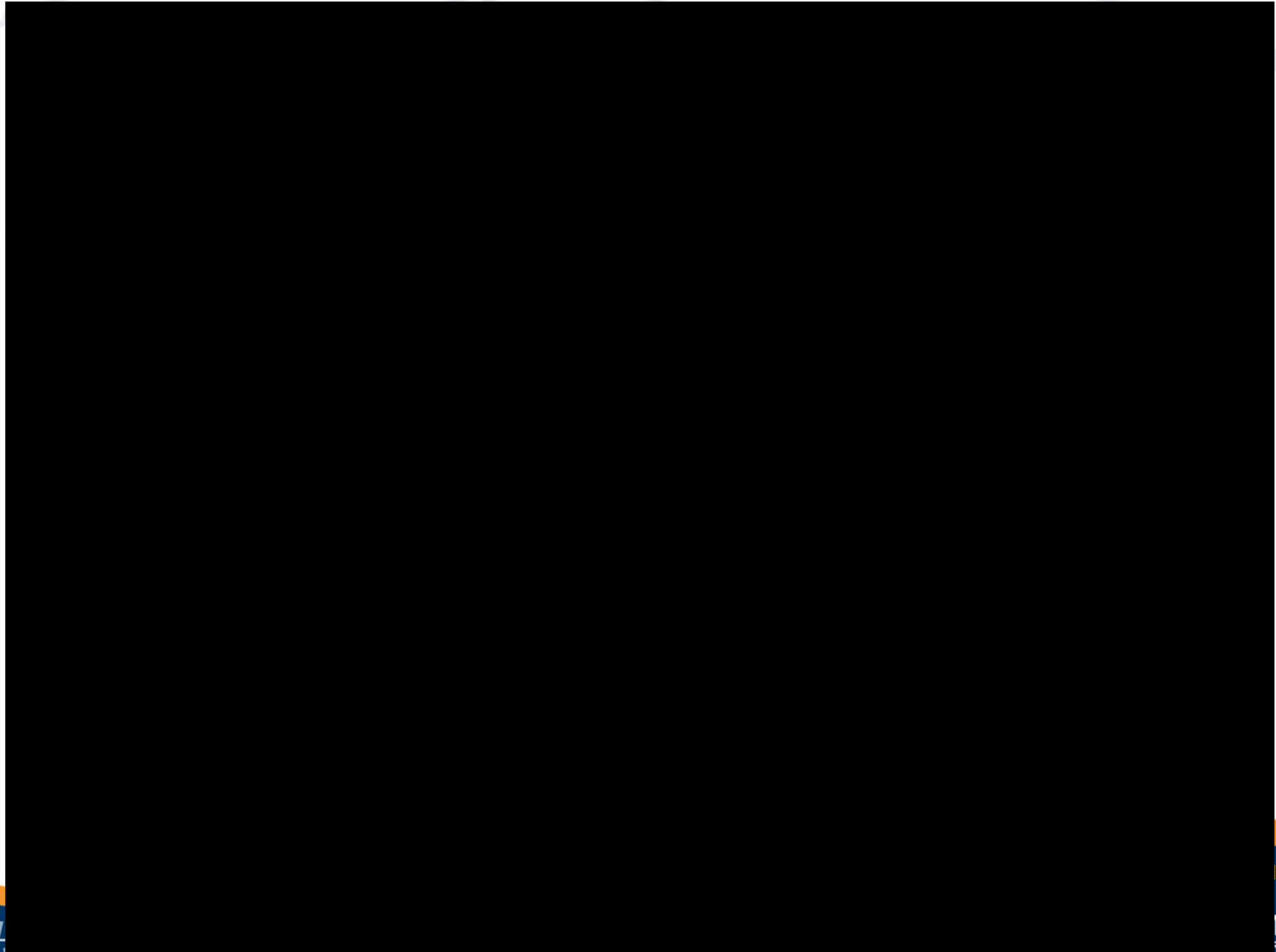
Developed: DOE Basis of Knowledge (BoK)

DOE/WIPP-17-3589

What is the Basis of Knowledge (BoK)?

- Part of the ENHANCED AK which focuses on evaluating oxidizing chemicals in the TRU waste.
- Using testing results that ensure the waste will not undergo unacceptable reactions when placed in WIPP.
 - Know oxidizing chemical concentrations or at least bounding concentrations in the waste components being evaluated
 - Evaluate oxidizing chemical concentrations before mixing with sorbents
 - Search for procedures and other process information on special processes such as cementation and waste loading
 - Use headspace gas sampling, analysis and evaluation on containers with rags and other polyols

What was LANL doing?



LANL TA-55

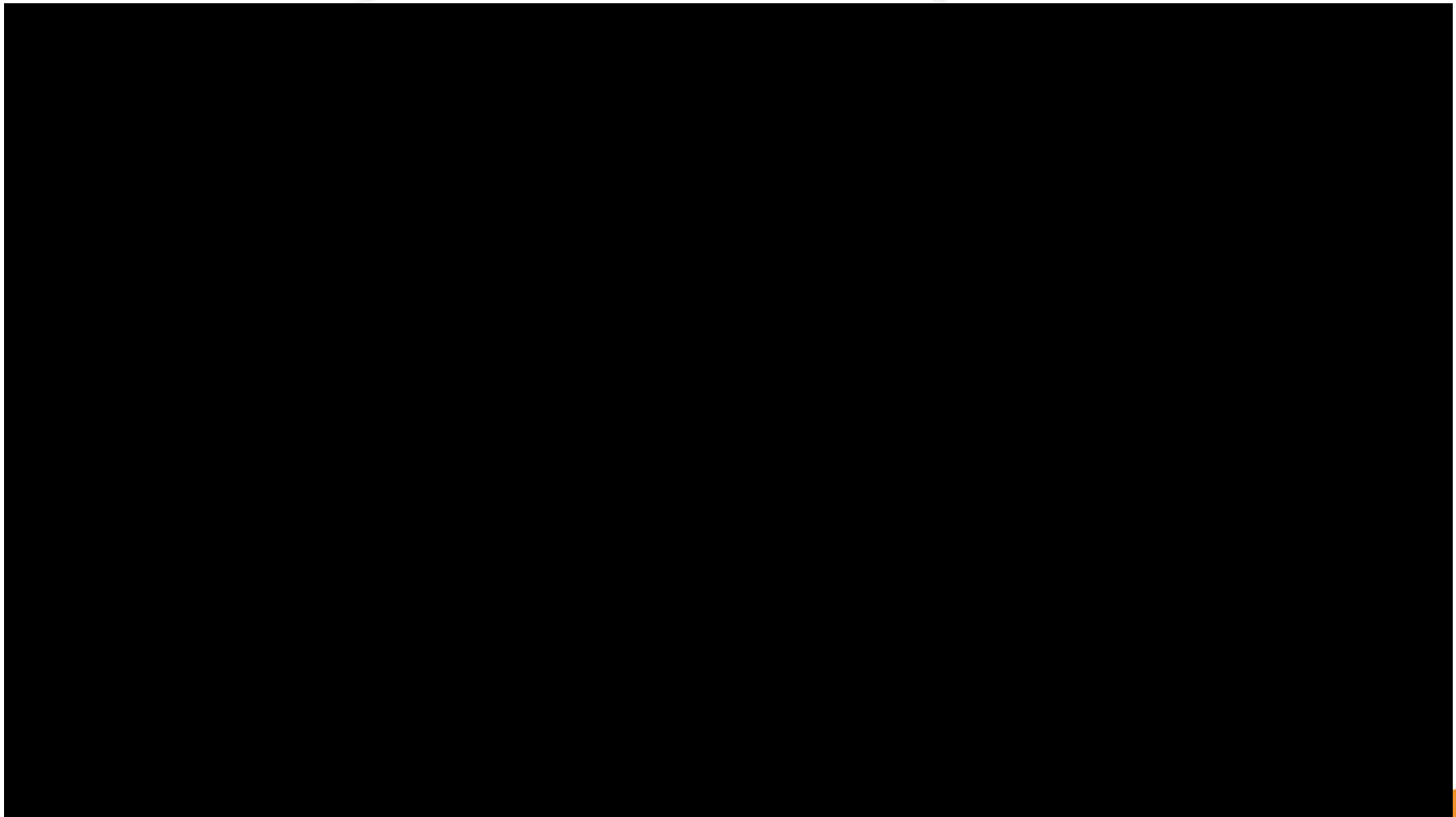


- LANL used cheesecloth in many processes to wipe down gloveboxes or clean up spills
- Spills in TA-55 range from 5 milliliters to 20 milliliters and can be acids/oxidizers (i.e., 1 Molar to 15.8 Molar), bases or cleaning solutions such as Fantastic
- Using cheesecloth and an oxidizer could result in an incompatibility issue
- Cheesecloth was not identified in the scoping study done by LANL-CO
- After the OE-3, LANL NPI-7 decided to search for alternatives to cheesecloth and have LANL-CO test these alternatives per the modified SW-846 Method 1040 test. NPI-7 chose to use LANL-CO because they did all of the original Basis of Knowledge testing for the DOE complex.

Search for an Alternative to Cheesecloth

- Several programmatic groups provided NPI-7 with different fabrics to evaluate
- NPI-7 chose 9 fabrics to test
- LANL-CO used Sigma-Aldrich Zeolite to perform all of the scoping study tests
- LANL TA-55 uses KMI Zeolite
- LANL NPI-7 wanted to ensure that both zeolites were comparable
- KMI Zeolite is much cheaper than the Sigma-Aldrich Zeolite

LANL NPI-7 Testing



Effect of Rinsing Potassium Nitrite Absorbed on Cheesecloth with Water

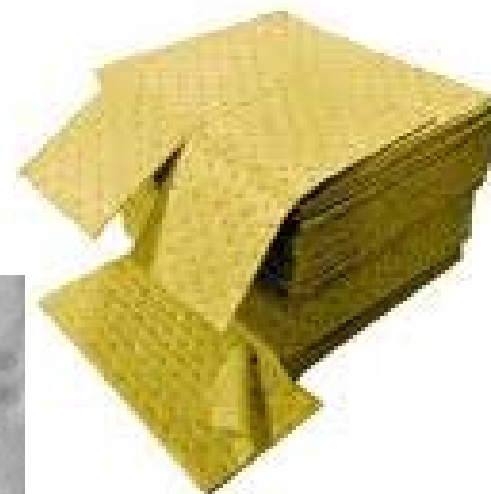
- LANL-CO performed three tests on saturated cheesecloth (with saturated solution of potassium nitrite (75 wt. %))
- The cheesecloth was wrung out until no dripping was observed
 - **1st test:** the saturated cheesecloth was soaked in 1 liter of deionized water for 1.33 minutes
 - **2nd test:** the saturated cheesecloth was soaked in 1 liter of deionized water for 30 minutes
 - **3rd test:** the saturated cheesecloth was soaked in 3 liters of deionized water for 2 minutes
- In all three scenarios, the direct burn tests resulted in an oxidizer



Results for an Alternative to Cheesecloth

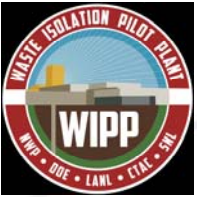
- Hazmat Sorbent Wipes and Kimtech Pure W4 Wipers

- 100% Polypropylene
- Passed with non-oxidizer results saturated with 75 wt. % potassium nitrite solution



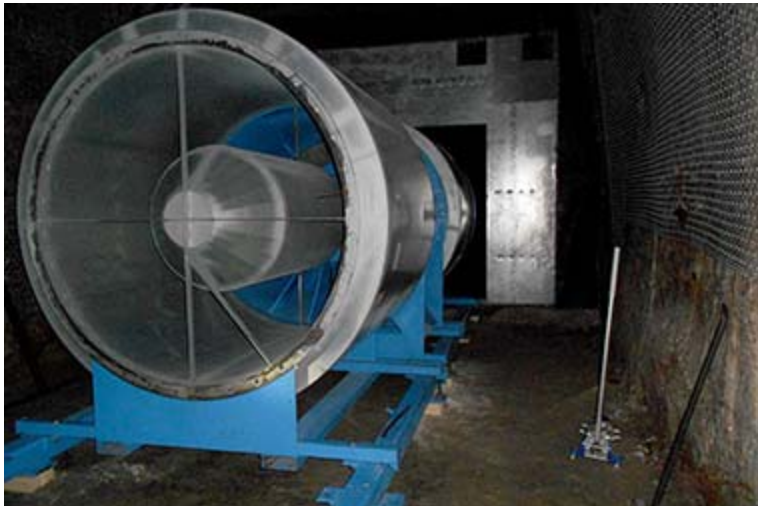
- KMI Zeolite
 - Passed with non-oxidizer results saturated with 65 wt. % potassium nitrite solution

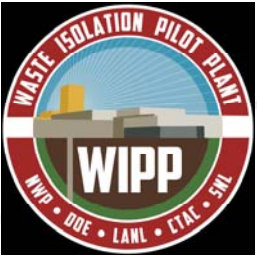




What has WIPP done since then?

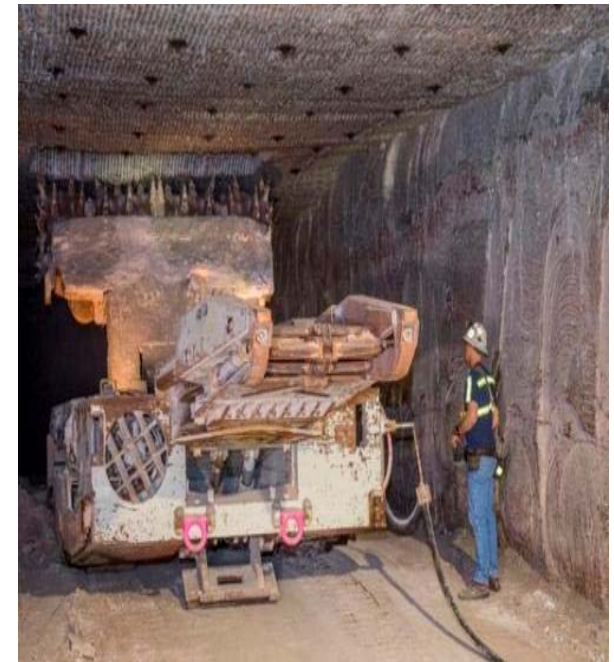
- Supplemental Ventilation System (SVS)
 - Startup January 2018: Support mining and waste emplacement activities
- Safety Significant Confinement Ventilation System (SSCVS) \$273 million
- New Shaft (existing Exhaust Shaft) \$100 million
- New Filter Building
- Revised Training Plan

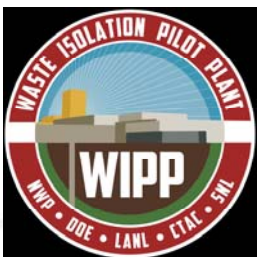




What has WIPP done since then?

- New Equipment
- Resumed mining on dayshift and emplace waste on backshift





WIPP Waste Acceptance Criteria (WAC)

DOE/WIPP-02-3122

TRANSURANIC WASTE ACCEPTANCE CRITERIA FOR THE WASTE ISOLATION PILOT PLANT

Revision 8.0

Effective Date: July 5, 2016



This document supersedes DOE/WIPP 02-3122, Rev. 7.4

U.S. Department of Energy
Carlsbad Field Office

- Basis of Knowledge (BoK)
- Chemical Compatibility Evaluation Memorandum (CCEM)
- Acceptable Knowledge Assessment (AKA)
- Generator Site Technical Review (GSTR)

What has LANL done since then?

Implemented Enhanced Acceptable Knowledge (AK)

- Waste Characterization and Tracking System (WCATS) Questionnaire
- Acceptable Knowledge Specialist (AKS)
 - Walk down procedures
 - VI/VE all bagouts
 - Evaluate waste for chemical compatibility
 - Review IWD's
 - Chemical Compatibility Training
 - Educated programmatic groups why the need to use polypropylene wipes (Hazmat Spilfyter and Kimtech W4 Wipers)



The image shows a 'WCATS Questionnaire' form, identified as 'PA-EM-00016_R2' and 'Page 1 of 4'. The form is titled 'WCATS Questionnaire' and includes fields for 'Name / Z# of NPI-7 Waste Generator', 'Date', 'Program Personnel Name / Z #', 'Program Personnel Signature', and 'Off Normal Events in Glovebox? (Y / N) Explanation:'. It also has a section for 'Description of Waste:' followed by four numbered 'Matrix' entries (1. Matrix, 2. Matrix, 3. Matrix, 4. Matrix), each with a percentage field. Below these are fields for 'Chemical(s):' and 'Matrix #'. The form also includes a section for 'Wipes present Y / N' with fields for 'Type(s) of wipes', 'Approximate Date(s) of wipe used', and 'Purpose:'. At the bottom, there is a 'Liquid Characterization: Y / N' field and a 'Volume:' field.

What has LANL done since?

Hurdles LANL Overcame for Shipments to Resume to WIPP

- EPA Audit: Completed February 2017
- NMED Audit: Completed February 2017
- Generator Site Technical Review (GSTR): Completed April 17-21, 2017
- Mobile Loading at TA-55: Approved mid-2017
- 1st Shipment to WIPP since release: Completed December 2017





Questions?

