

## Radiological Release Accident Investigations at the Waste Isolation Pilot Plant (WIPP) on February 14, 2014



Gary T. Staffo, PE, CSP, CPE  
Manager - US DOE Accident Prevention and  
Investigation Program  
Office of ES&H Reporting and Analysis

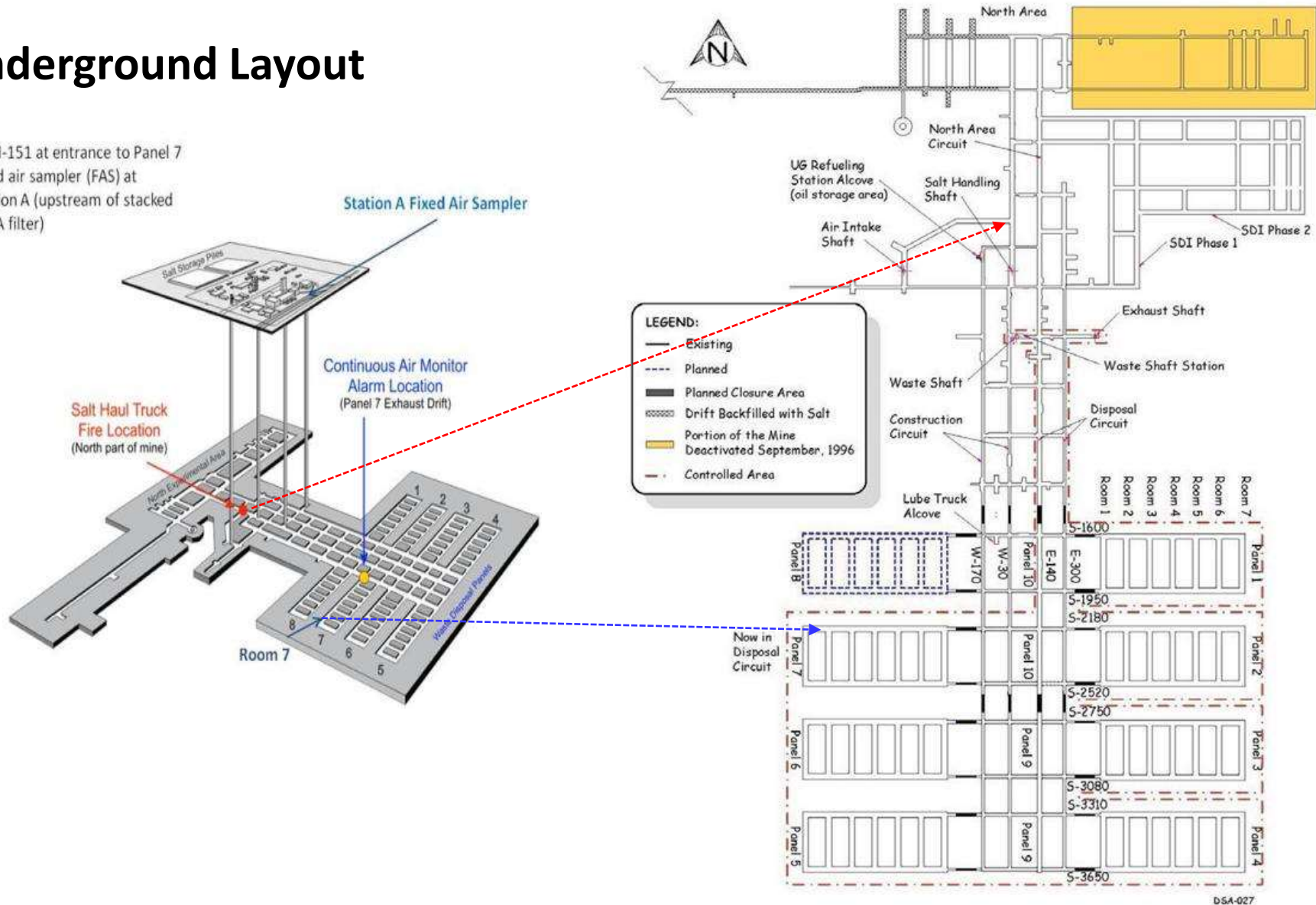
## Introduction

- The Waste Isolation Pilot Plant (WIPP), located in southeastern New Mexico near Carlsbad, was constructed to determine the efficacy of an underground repository for disposal of transuranic (TRU) waste.
- Disposal operations began in **1999**.
- WIPP is designed to permanently dispose of TRU radioactive waste left over from the research and production of nuclear weapons.
- The project facilities include disposal rooms excavated in an ancient, stable salt formation **2,150 feet underground**.
- Following a fire in the underground involving a salt haul truck on **February 5, 2014**, *all underground waste handling activities were suspended pending completion of a DOE Accident Investigation.*

# Waste Isolation Pilot Plant Investigations

## Underground Layout

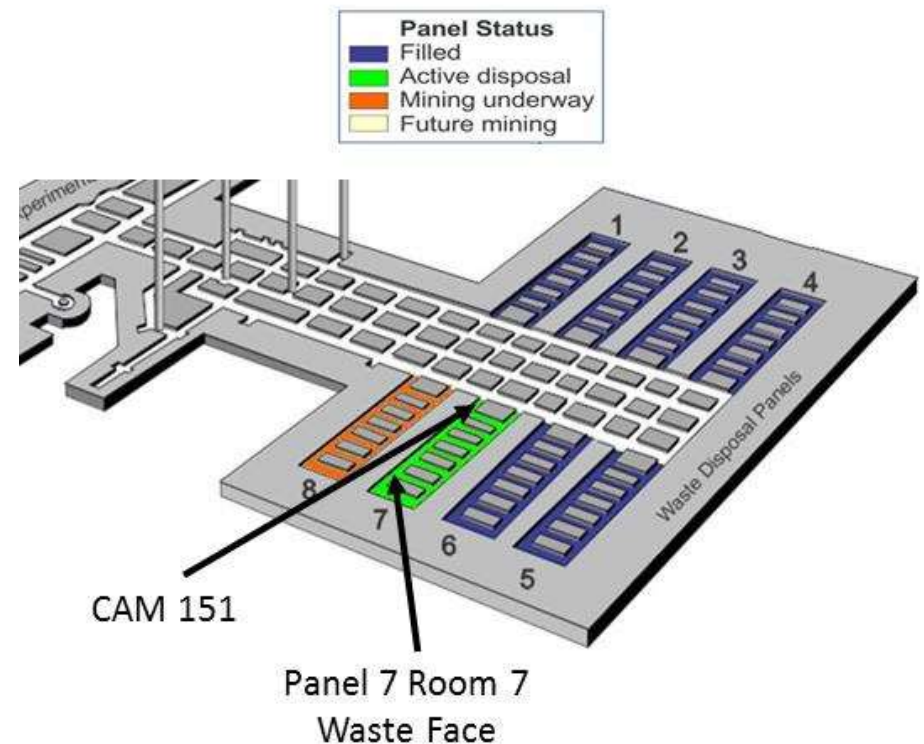
- CAM-151 at entrance to Panel 7
- Fixed air sampler (FAS) at Station A (upstream of stacked HEPA filter)



# The WIPP Radiological Release

## On February 14, 2014:

- Shortly after **11:10PM**, a release was detected by an underground continuous air monitor (CAM) which was monitoring airborne radioactivity levels in air exhausting from **Panel 7**, an active waste panel where TRU waste was being emplaced for disposal.
- An alarm was received on the Central Monitoring System (CMS) in the Central Monitoring Room (CMR) at the WIPP surface which initiated a shift to filtration of the underground ventilation.
- At approximately **11:13 PM**, a “HI RAD” alarm from CAM-151 was received on the CMS. *The “HI RAD” setpoint for this CAM is 30 Derived Air Concentration (DAC) for alpha and beta contamination.*
- Approximately one minute later, a “HI-HI RAD” alarm from CAM-151 was received on the CMS. *The “HI-HI RAD” setpoint is 50 DAC.* The CMS indicated that the CAM reading was **332 DAC**.



**Location of Panel 7 and CAM-151**

# The WIPP Radiological Release

## Immediately following the initial alarm:

- At **11:42 PM**, the CMR Operator logged, “Disabled U/G CAM 151,” which was the only in-service CAM in the underground, due to a malfunction indication, suspected due to filter plugging. Ventilation continued to run in filtration mode through the HEPA filters.
- Radiological Control Technicians collected filters from upstream and downstream effluent sample stations for radiological counting. *There were no other CAMs in the underground or on the surface monitoring the exhaust.*
- The release was directed through HEPA filter banks located in the surface exhaust building. However, *a measurable portion bypassed the HEPA filters via design leakage through two ventilation system dampers and was discharged directly to the environment from an exhaust duct.*
- *The incident resulted in the release of americium and plutonium from one or two transuranic (TRU) waste containers. Trace amounts of americium and plutonium were detected off-site.*
- *No personnel were determined to have received external contamination.*
- *However 21 people were identified by bioassay to initially test positive for low level internal contamination as of March 28, 2014*

# The WIPP Radiological Release

## Air sampling and monitoring:

- Radiological data from site surveys, effluent monitoring, portable air samplers and low volume off-site sampling continued to be collected with no indication of a detectable release to the environment.
- *The radiological event on February 14, 2014, with the leakage past the isolation dampers, was less than the National Emission Standards for Hazardous Air Pollutants (NESHAP) guidelines for the public and below the limits established by DOE and WIPP for site workers.*
- On Saturday, **February 15, 2014**, the filters were counted at **7:15 AM**; the *RCM reported 4.4 million disintegrations per minute (dpm) alpha contamination on the filters from the effluent sample station upstream from the HEPA filters (Station A). Preliminary data indicated the presence of TRU materials.*
- Results from analysis of filters from the effluent sample station downstream of the HEPA filters (**Station B**) and at the discharge point to the atmosphere were reported at **9:15 AM** and *indicated 28,000 dpm alpha and 5,900 dpm beta contamination. This was the first indication that there was a release of contamination downstream of the HEPA filters to the environment.*

# The WIPP Radiological Release

- **Station A** is *located over the underground ventilation exhaust elbow at the surface and samples using probes that extend 21 feet below the elbow in the Exhaust Shaft*. Station A contains three sampling skids, each splitting the sample and directing the air into three air samplers per skid.
- **Station B** samples from a point *downstream from the UVS fans and HEPA filters*. Station B contains two sampling skids, each splitting the sample and directing the air into three air samplers per skid.
- The effluent samplers collect *periodic* confirmatory particulate samples from the total volume of air being discharged. The samplers consist of a sample delivery system, a filter holder, and a vacuum supply.

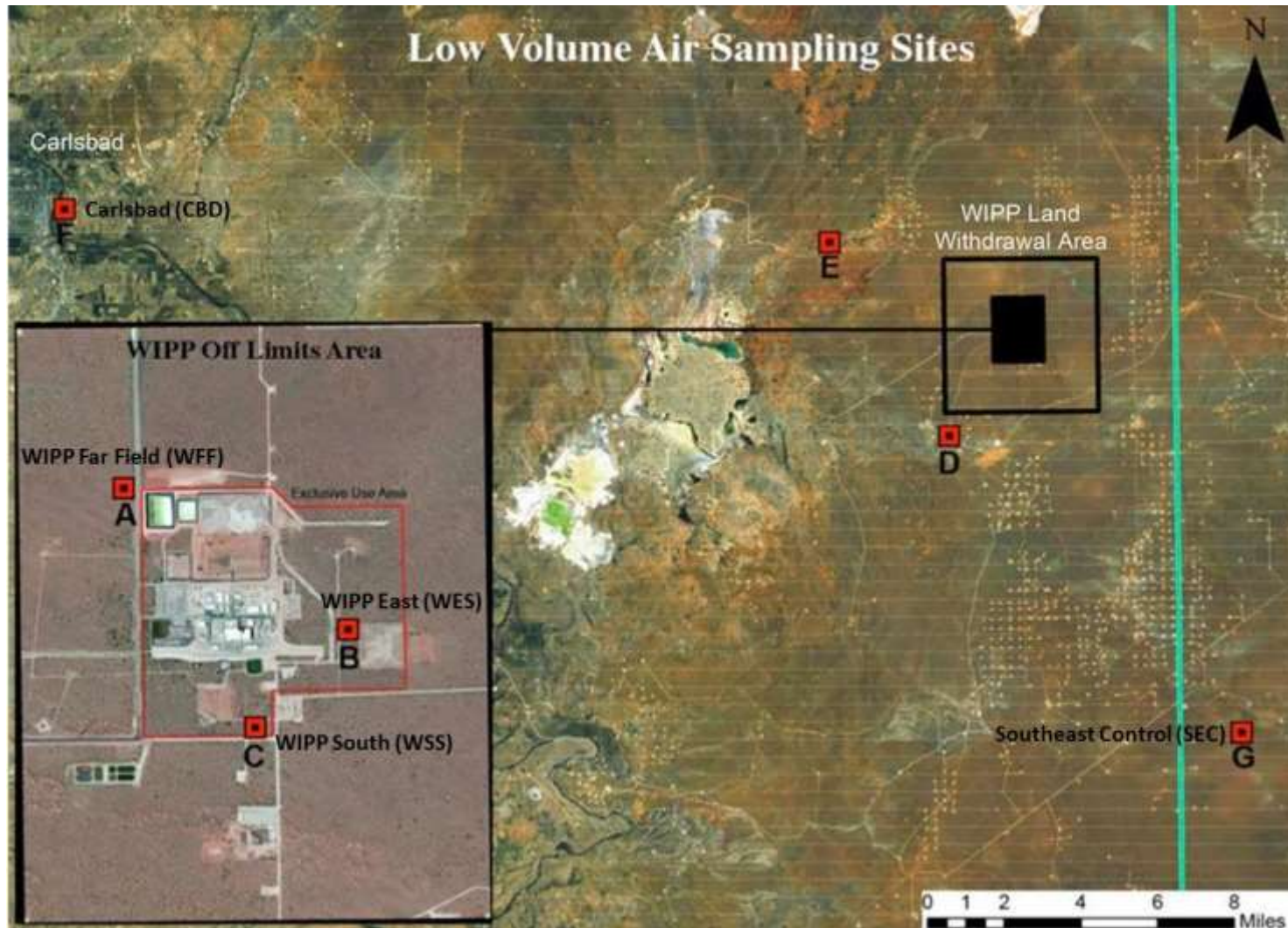


**Effluent Sampling Station A**



**Effluent Sampling Station B**

# The WIPP Radiological Release





As the underground was inaccessible, the Board was unable to determine the physical mechanism of the release, e.g., container failure, back (roof) or rib (wall) fall, puncture of a container by a failed roof bolt, over pressurization, etc.

**Phase 1** focused on the release of radioactive material from underground to the environment, and the follow-on site response.

The cumulative effect of:

- inadequacies in ventilation system design and operability
- compounded by degradation of key safety management programs and safety culture

Resulted in the release of radioactive material and delayed/ineffective recognition and response.

**The Phase 1 report was issued April 22, 2014.**

Once limited access to the underground was re-established, **Phase 2** of the investigation was initiated. This phase of the investigation focused on the mechanism(s) of release from the waste containers.

**The Phase 2 report was issued April 16, 2015.**

# The WIPP Radiological Release

## Continued air sampling and monitoring:

- On **February 15, 2014** RCTs set up portable air samplers: one between Buildings 451 and 452, one north side 452, on north side of Building 486.
- Radiological controls personnel continued to perform surveys and field sampling. At **2:27PM**, Radcon personnel completed surveys of the parking lot and site and reported all results as clean.
- In addition, filters pulled from **Station D** on **February 14, 2014**, were recounted on **February 15** to verify no release prior to collection.
- At **2:46 PM**, the Radcon *off-site survey team* completed **five** surveys enroute to the **Far Field air sampler**. *No unusual activity was detected.*
- **Five** initial radiological surveys (direct and removable contamination) *were performed at WIPP, Panel 7, in Rooms 7, 6, and 1 during the period April 23 through May 19, 2014.*
- Surveys consisted of smears, quantitatively measuring removable contamination per 100 cm<sup>2</sup>, as well as Masslinn cloth wipes, providing qualitative gross contamination.
- *These surveys reported alpha activity contamination levels, with no beta or dose rate information collected.*
- Radiological survey results of **Panel 7** indicated that the general surface alpha contamination levels in **Room 7** of 8,000 – 40,000 dpm, **Room 6** of 10,000 – 20,000 dpm, and **Room 1** of 6,000 – 28,000 dpm.

## PHASE 1

**Direct Cause:** The Board identified the direct cause of this accident to be the breach of at least one TRU waste container in the underground which resulted in airborne radioactivity escaping to the environment downstream of the HEPA filters. Due to restrictions on access to the U/G following the event, the exact mechanism of container failure, e.g., back or rib fall, puncture by a failed roof bolt, offgassing, etc., was unknown at this time and was determined once access to the underground was restored.

**Root Cause:** The Board identified the root cause of Phase 1 of this accident to be NWP's and CBFO's *management failure to fully understand, characterize, and control the radiological hazard*. The cumulative effect of inadequacies in ventilation system design and operability compounded by degradation of key safety management programs and safety culture resulted in the release of radioactive material from the underground to the atmosphere; and the delayed/ineffective recognition and response to the release.

## PHASE 2

**Direct Cause:** The Board identified the direct cause of Phase 2 of this accident to be an *exothermic reaction* of incompatible materials in LANL waste drum 68660 that led to thermal runaway, which resulted in over-pressurization of the drum, breach of the drum, and release of a portion of the drum's contents (combustible gases, waste, and wheat-based absorbent) into the WIPP underground.

**Local Root Cause:** Failure of LANS to understand and effectively implement the LANL Hazardous Waste Facility Permit and Carlsbad Field Office directed controls.

**Systemic Root Cause:** Los Alamos Field Office and National Transuranic Program failure to ensure that LANL had adequately developed and implemented repackaging and treatment procedures.

# The WIPP Radiological Release



This photo of the **Panel 7 Room 7** waste face was taken only a few hours *prior* to the release event during an underground survey by the AI Board .

# The WIPP Radiological Release

## Conclusions

- Deterioration in safety culture.
- Ineffective nuclear safety program in accordance with 10 CFR 830 Subpart B.
- Maintenance program not effective in ensuring the operability and reliability of key components and equipment.
- ***Radiation protection program not effective in ensuring timely and effective response.***
- Emergency management program not effective in ensuring prompt categorization and classification, timely implementation of protective actions, and required notifications and reporting.
- Key elements of the NWP Conduct of Operations program were ineffective in driving safe and compliant operation of a Hazard Category 2 facility.
- Inadequate Contractor and Federal oversight.

