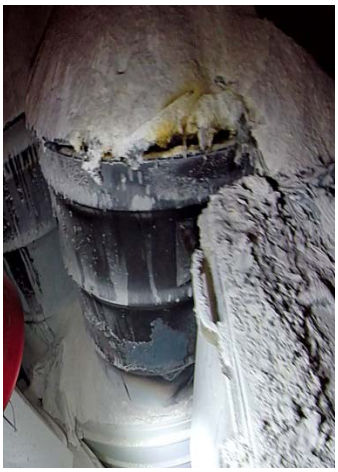
Investigation of Incident at Waste Isolation Pilot Plant by Technical Assessment Team

March 2015

Overall Findings

On February 14, 2014, an incident in Panel 7 Room 7 (P7R7) of the Waste Isolation Pilot Plant (WIPP) underground repository resulted in the release of radioactive material into the environment and contaminated 21 people with low-level radioactivity.

The Technical Assessment Team concluded that one drum, Drum 68660, was the source of radioactive contamination released during the February 14, 2014, radiological event at the Waste Isolation Pilot Project (WIPP). The contents of Drum 68660 were chemically incompatible, and the drum breached as a result of internal chemical reactions.



Technical Assessment Team Investigates the Cause of Drum Breach

To complement the Accident Investigation Board (AIB) investigations, the Department of Energy created an independent Technical Assessment Team (TAT) to determine the mechanisms and chemical reactions that may have contributed to the failure of the waste drum. The TAT was led by Savannah River National Laboratory and included scientists from several other Energy Department National Laboratories, including: Lawrence Livermore National Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory, Sandia National Laboratory and Idaho National Laboratory. The multi-laboratory endeavor included scientific experts across disciplines – including sampling and analysis, forensic science, modeling, and reaction chemistry – and enabled the generation and peer-review of scientifically-based conclusions. This team approach ensured that the appropriate expertise was available to assess the event.

Investigative Strategy Pursued Objectives in Several Technical Assessment Areas

The TAT tested various hypotheses about what caused the radiological release. Participating scientists collected and analyzed samples using various techniques that provided information about the chemical reactions. Collecting information about the waste drum provided insight into possible chemical reactions and inputs to various modeling calculations. Integrating data allowed for a collaborative exploration of various scenarios the researchers though might have caused the drum breach.

Several Constraints Limited Ability to Determine an Exact Cause

The TAT could not determine the cause of the drum breach with absolute certainty because the investigation was hindered by several constraints:

- Access to the breached drum was limited as a safety precaution; video evidence and samples could only be collected using a remote sampling device.
- The contents of the drum were generally known and documented, but it was not possible to perform another inventory of the drum to get data on the exact reaction mixture.
- Details about the exact remediation process for the waste in Drum 68660 were not fully documented.

Conclusions and Key Judgments

The TAT concluded that chemically incompatible contents in Drum 68660, in addition to the configuration of materials in the drum, supported exothermic chemical reactions that led to a thermal runaway. In other words, a series of ever-increasing heat releasing reactions occurred, which led to the creation of gases within the drum. The resulting build-up of gases within the drum displaced the drum lid, venting radioactive material and hot matter that further reacted with the air or other materials outside the drum to cause the observed damage in P7R7 of WIPP.

Key Judgment 1. The contents of Drum 68660 were incompatible. The nitrate salt residues, organic sorbent (Swheat Scoop®), and neutralization agent (triethanolamine) known to be present represent a potentially reactive chemical mixture of fuels and oxidizers.

Key Judgment 2. Drum 68660 breached as a result of internal chemical reactions. Experiments showed that various combinations of nitrate salt, Swheat Scoop®, nitric acid, and oxalate self-heat at temperatures below 100°C. Computer modeling of thermal runaway was consistent with the observed 70-day birth-to-breach of Drum 68660.

Key Judgment 3. Drum 68660 was the source of radioactive contamination in WIPP. Images of drums in P7R7 do not show additional breaches. Uranium, plutonium and americium isotopic measurements on post-event samples are consistent with the recorded contents of Drum 68660 and suggest that this drum was the source of the radioactive contamination.

Key Judgment 4. The thermal runaway was initiated by internal, and not external, events. The TAT considered that perhaps a thermal pulse, combustion products, exothermic reactions of water with magnesium oxide (MgO) located in bags on top of the waste containers of P7R7, or reduced ventilation in WIPP following a truck fire nine days prior may have contributed to the release event. Various computer models simulating these scenarios, chemical analyses and experiments designed to characterize changes in drum color due to heating, did not support any considered externally-initiated mechanisms.

Key Judgment 5. Thermal and pressure effects resulted in the movement of material during the release event and caused the damage in P7R7. Post-event video images showed disintegration of 17 MgO sacks on top of the waste containers. A computational fluid dynamic model of a release from the position of Drum 68660 produced a damage footprint consistent with the damage observed in WIPP.