DOE/EIS-0026-SA-10

SUPPLEMENT ANALYSIS FOR THE WASTE ISOLATION PILOT PLANT SITE-WIDE OPERATIONS

U.S. Department of Energy
Carlsbad Field Office
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ACRONYMS AND ABBREVIATIONS

AIB	Accident Investigation Board
AGSC	Above Ground Storage Capability
ALARA	as low as reasonably achievable
BLM	U.S. Bureau of Land Management
CAM	continuous air monitor
cfm	cubic feet per minute
CFR	*Code of Federal Regulations*
CH	contact-handled
CX	categorical exclusion
DOE	U.S. Department of Energy
DSA	documented safety analysis
EIS	environmental impact statement
EMP	Emergency Management Program
EPA	U.S. Environmental Protection Agency
FPP	Fire Protection Program
ft^3	cubic feet
GTCC	Greater-Than-Class C (low-level waste)
HEPA	High Efficiency Particulate Air
IVS	interim ventilation system
LANL	Los Alamos National Laboratory
LMP	Land Management Plan
LWA	*Waste Isolation Pilot Plant Land Withdrawal Act of 1992*
m^3	cubic meter
MEI	maximally exposed individual
NEPA	*National Environmental Policy Act of 1969*
PCB	polychlorinated biphenyls
PVS	permanent ventilation system
RCP	Radiological Control Program
RCRA	*Resource Conservation and Recovery Act*
RH	remote-handled
ROD	Record of Decision
ROI	region of influence
SA	supplement analysis
SEIS-II	*Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*
SNL	Sandia National Laboratory
SVS	supplemental ventilation system
TRU	transuranic (waste)
TSCA	*Toxic Substances Control Act*
UG	underground
UVS	underground ventilation system
WAC	waste acceptance criteria
WHB	Waste Handling Building
WIPP	Waste Isolation Pilot Plant

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1 INTRODUCTION

1.1 Background

The U.S. Department of Energy (DOE) was authorized by the *U.S. Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980* (Public Law 96-164) to provide a research and development facility for demonstrating the safe, permanent disposal of transuranic (TRU) wastes from national defense activities and programs of the United States exempted from U.S. Nuclear Regulatory Commission regulations. This legislation resulted in the design of a centralized repository for the disposal of TRU waste (after *National Environmental Policy Act* (NEPA) reviews— see Section 1.5 below) known as the Waste Isolation Pilot Plant (WIPP).

On October 30, 1992, the *Waste Isolation Pilot Plant Land Withdrawal Act of 1992* (LWA) (Public Law 102-579) transferred 10,240 acres of land from the U.S. Department of the Interior to the DOE to demonstrate the safe disposal of radioactive waste materials generated by atomic energy defense activities. The LWA reserved the area surrounding the WIPP site for construction, experimentation, operation, repair and maintenance, disposal, shutdown, monitoring, decommissioning, and other activities associated with WIPP. The site selected for the repository is located approximately 26 miles east of Carlsbad, New Mexico (Figure 1).

TRANSURANIC WASTE

According to the *WIPP Land Withdrawal Act*, Public Law 102-579, TRU waste is 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 concurrence of the U.S. Environmental Protection Agency, does not need the degree of isolation required by the disposal regulations; or (c) waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61. TRU elements, each having several isotopes, are radioactive and typically manmade.

The half-lives of many TRU wastes are considerably longer than 20 years. For instance, the half-life of one isotope of plutonium is 24,000 years.

TRU waste is further classified as contact-handled (CH) and remote-handled (RH). CH-TRU waste has radioactivity levels that are low enough to permit workers to directly handle the containers in which the waste is kept. This level of radioactivity is specified as a dose rate of no more than 200 millirems per hour (mrem/hr) at the outside surface of the container. RH-TRU waste has a surface dose rate greater than 200 mrem/hr, so workers use remote manipulators to handle containers of RH-TRU waste. TRU mixed waste is CH-TRU or RH-TRU waste that also contains hazardous components, such as lead or organic solvents regulated in accordance with the *Resource Conservation and Recovery Act*. TRU waste also may be commingled with polychlorinated biphenyls (PCBs), which are regulated by the *Toxic Substances Control Act*.

The WIPP facility is a deep geologic repository mined within a 2,000-foot-thick bedded-salt formation. The underground (UG) portion of the disposal facility—where waste is emplaced for disposal—is 2,150 feet beneath the ground surface. As of February 2014, DOE had safely removed approximately 90,800 cubic meters (m^3) of TRU waste from 22 generator sites

throughout the country, disposing of the waste at WIPP, and reducing the environmental risk resulting from continued long-term storage to site workers and the public in the vicinity of generator sites (DOE 2014a).

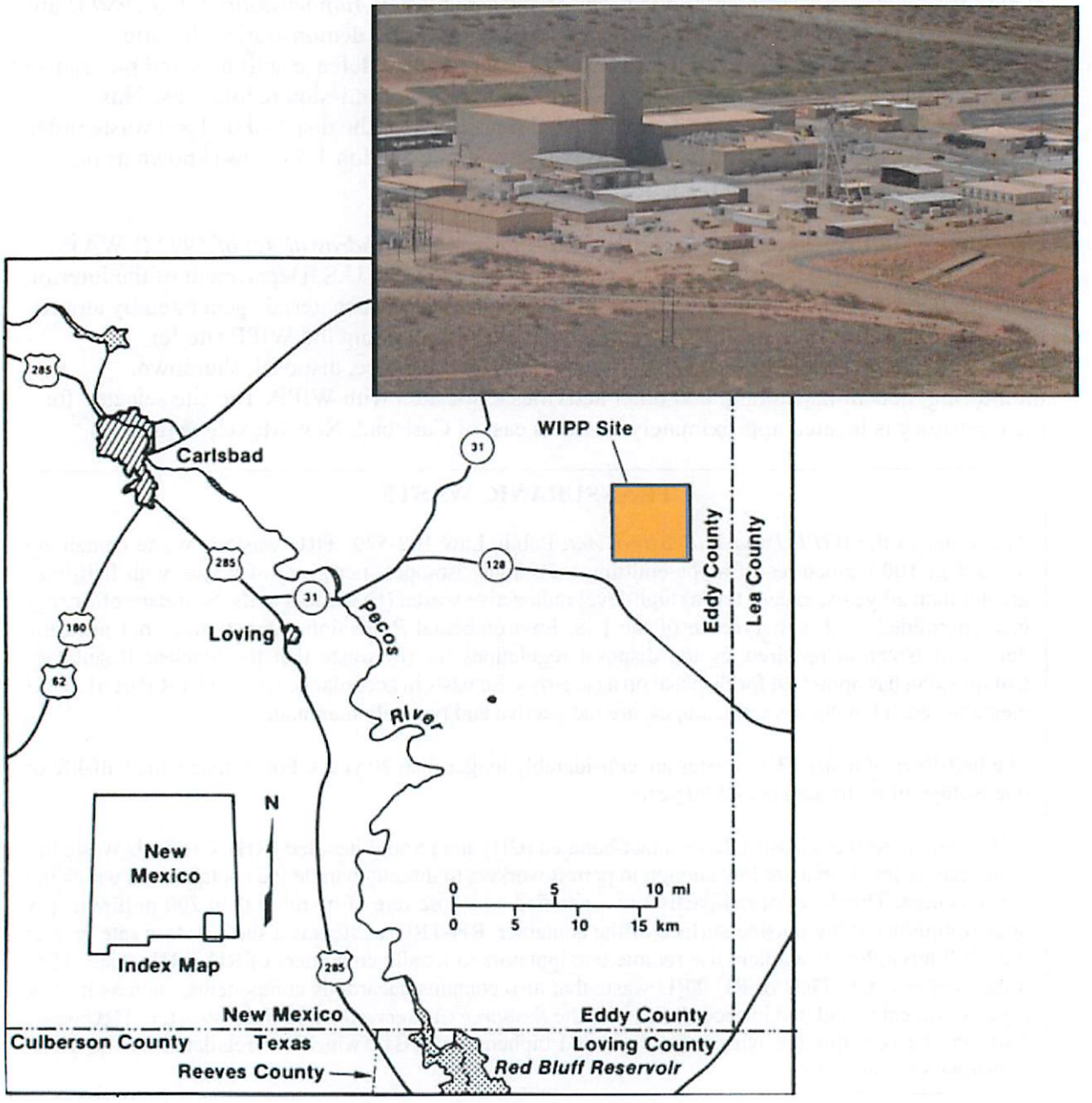


Figure 1. Waste Isolation Pilot Plant near Carlsbad, New Mexico

On February 5, 2014, a fire occurred in the UG involving a salt haul truck. DOE and Nuclear Waste Partnership LLC (NWP), the current WIPP Management and Operating contractor, investigated this event. DOE issued an accident investigation report, *U.S. Department of Energy Accident Investigation Report, Underground Salt Haul Truck Fire at the Waste Isolation Pilot Plant*, on March 13, 2014, which reported 22 "Conclusions of Need" and 35 "Judgments of Need" (DOE 2014b).[1]

On February 14, 2014, a radioactive release event occurred in the UG due to an exothermic chemical reaction in a waste drum. The event involved a small release of radioactive material to the environment. Unknown at the time of the event, the exothermic reaction was the result of the introduction of an organic desiccant material into the drum that was incompatible with the waste, making the drum noncompliant with the WIPP waste acceptance criteria (WAC). Because access to the UG was restricted following the radiological release and examination of the area and containers was not possible, DOE conducted its investigation in two phases.

DOE issued the Phase 1 accident investigation report, *U.S. Department of Energy Accident Investigation Report, Phase 1, Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014*, on April 22, 2014, which reported 31 Conclusions of Need and 47 Judgments of Need (DOE 2014c).

Once limited access to the underground was re-established, DOE initiated Phase 2 of the investigation, which focused on the mechanism(s) of release from the waste containers in the UG and included entries into the contaminated areas, sampling, and additional forensics. Following the completion of a survey of the affected panel and room, DOE issued the Phase 2 accident investigation report, *U.S. Department of Energy Accident Investigation Report, Phase 2, Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014*, on April 15, 2015, which reported 24 Conclusions of Need and 40 Judgments of Need (DOE 2015a). Section 2.1 below provides details about these two incidents. Since February 2014, DOE has suspended TRU waste emplacement at WIPP.

DOE and NWP have finalized corrective action plans for both the UG fire and the radiological release, and have completed corrective actions required for the resumption of waste emplacement operations. These corrective actions resulted in important changes associated with WIPP operations, which include enhancements to fire protection, emergency management, and other facility programs (Section 2.2 herein provides details of these changes). Since the February 14, 2014, incident, the ventilation system has been operated continuously in filtration mode, which reduces the overall ventilation flow rate in the UG from unfiltered capacity (Section 2.3 herein provides details relating to ventilation). Decontamination activities, such as encapsulation

[1] As defined in the accident investigation reports, "Conclusions of Need" are significant deductions derived from the investigation's analytical results. They are derived from and must be supported by the facts as well as the results of testing and the various analyses conducted. "Judgments of Need" are the managerial controls and safety measures the Accident Investigation Board determined were necessary to prevent or minimize the probability or severity of a recurrence. Such judgments are linked directly to the causal factors derived from the facts and analysis and form the basis for corrective action plans, which must be developed by line management.

of radiological material into the salt matrix by applying a water spray, have also taken place to support future UG operations (NWP 2016).

1.2 Proposed Action

DOE is proposing to resume and continue the transportation of waste to WIPP by truck and the operation of the WIPP for the disposal of TRU waste generated by atomic energy defense activities. DOE has addressed safety concerns in response to the February 2014 salt haul truck fire and radiological release events to create an environment of robust safety awareness at WIPP that complies with applicable requirements and protects workers, the public, and the environment. The WIPP UG has been systematically upgraded to ensure protection of workers with the resumption of critical mine safety and maintenance operations.

Shortly after the February 2014 incidents, DOE and NWP began resumption of activities in the UG, which included investigations, cleanup, maintenance, and implementation of corrective actions. These activities involved (as will resumption of waste emplacement operations involve) working in both contaminated and uncontaminated sections of the mine. As part of the resumption of waste emplacement effort, DOE has surveyed the mine and made it habitable for workers, and the workforce has been retrained for contaminated operations (DOE 2014a).

Safety, health, and protection of the public, the workers, and the environment are DOE's highest priorities. Every stage of the effort to resume waste emplacement operations has been supported by rigorous regulatory compliance and robust attention to upgraded safety management programs, including nuclear safety, fire protection, radiological controls, and emergency management, and associated documentation, procedures, and training. These have been validated in accordance with DOE directives through the conduct of operational readiness reviews by both NWP and DOE. In addition, the resumption of waste emplacement operations has been approved by the New Mexico Environment Department (NMED 2016).

When emplacement operations resume, the first wastes likely to be emplaced would be some or all of the containers currently stored in the Waste Handling Building (WHB) at WIPP followed by wastes currently stored at Waste Control Specialist, LLC (WCS) in Andrews, Texas that can be shown to comply with the WIPP WAC. In addition, WIPP would begin receiving wastes from the generator sites. The number of shipments is expected to be limited initially and increase as workers become more proficient in waste emplacement operations in a contaminated environment. After resumption of waste emplacement, operation of a new ventilation system is anticipated to restore the WIPP emplacement rate to pre-2014 operational levels and support simultaneous full-scale salt mining (DOE 2014a).

1.3 Purpose and Need for the Proposed Agency Action

The purpose and need for WIPP has not changed since documented in the *Waste Isolation Pilot Plan Disposal Phase Final Supplemental Environmental Impact Statement* (SEIS-II) (DOE/EIS-0026-S-2) or authorized by the WIPP *Land Withdrawal Act*, Public Law 102-579, as amended by Public Law 104-201. DOE needs to safely dispose of the TRU waste that has resulted from atomic energy defense activities in a manner that protects the workers, the public health, and the environment.

1.4 Scope of this Supplement Analysis

NEPA requires federal agencies to consider the potential environmental consequences of their proposed actions and reasonable alternatives before making decisions. The DOE NEPA regulations at 10 CFR 1021.330(d) state that DOE shall evaluate site-wide EISs at least every five years by means of a Supplement Analysis (SA). In accordance with 10 CFR 1021.314, DOE may also prepare an SA where specific circumstances make it unclear whether or not to prepare a supplemental EIS. An SA is a comparative document that analyzes changes commensurate with their contribution to potential impacts, and evaluates changes absolutely and in comparison to the existing NEPA analyses (DOE 2005a). Since issuance of the SEIS-II in 1997, DOE has prepared eight WIPP-related SAs. The most recent site-wide evaluation occurred in 2009, DOE/EIS-0026-S7, *Supplement Analysis for the Waste Isolation Pilot Plant Site-Wide Operations* (DOE 2009).

DOE has prepared this SA in accordance with the CEQ NEPA regulations at 40 CFR 1502.9(c)(1) and DOE NEPA implementing regulations at 10 CFR 1021.314. This SA assesses reasonably foreseeable programs, operations, and activities at WIPP, including resumption of waste emplacement. This SA evaluates whether there are any substantial changes to the Proposed Action in the SEIS-II that are relevant to environmental concerns, and any significant new circumstances or information relevant to environmental concerns and bearing on the Proposed Action or its impacts since the preparation of the SEIS-II and 2009 SA. Based on this evaluation, DOE will then determine whether to (1) supplement the SEIS-II, (2) prepare a new EIS, or (3) conduct no further NEPA documentation because the WIPP SEIS-II remains adequate.

Section 1.2 of this SA provides a high-level description of the Proposed Action analyzed in this SA. More details concerning the Proposed Action and other changes (such as environmental baseline changes) are presented in Chapter 2. This SA analyzes these changes against the existing NEPA analyses for WIPP (see Section 1.5) in order to support a determination on whether there are any substantial changes to the Proposed Action compared with the proposed action analyzed in the existing NEPA documents (namely, SEIS-II, as informed further by the 2005 SA [EIS-0026-SA-05; DOE 2005b] and 2009 SA [EIS-0026-SA-07]) or significant new circumstances or information relevant to environmental concerns and bearing on the Proposed Action or its impacts.

Chapter 2 of this SA describes these changes and proposals. Chapter 3 compares any environmental impacts that would occur from resumption of emplacement activities with those identified and analyzed in SEIS-II. In addition, the cumulative impact analysis (Chapter 4 of this SA) identifies and considers the potential impacts of reasonably foreseeable future actions.

1.5 Relevant National Environmental Policy Act Documents

The following NEPA documents are relevant to the Proposed Action described in Section 1.2. This information provides a context for understanding the current status of NEPA analyses associated with activities at WIPP and forms the foundation for preparing the comparative analysis in this SA.

- ***Waste Isolation Pilot Plant Final Environmental Impact Statement* (1980 WIPP EIS) (DOE/EIS-0026; DOE 1980).** In October 1980, DOE issued the 1980 WIPP EIS, which

analyzed the potential environmental impacts of initial construction and operation of WIPP. The ROD (46 FR 9162, January 28, 1981) documented DOE's decision to proceed with the phased construction and operation of WIPP near Carlsbad, New Mexico. Because DOE prepared two subsequent SEISs (SEIS-I and SEIS-II), the 1980 WIPP EIS is included here only for completeness; this SA does not analyze changes against that document.

- ***Final Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant* (SEIS-I) (DOE/EIS–0026–FS; DOE 1990).** In January 1990, DOE issued the SEIS-I to evaluate the environmental impacts associated with new information and changes since issuance of the 1981 ROD. SEIS-I included an analysis of changes in the TRU waste inventory, consideration of the hazardous chemical constituents in the TRU waste, modification and refinement of the system for the transportation of TRU waste to WIPP, modification of the Test Phase, and changes in the understanding of the hydrogeological characteristics of the WIPP site. The ROD for SEIS-I, which was issued in June 1990, continued the phased development of WIPP by instituting an experimental program to further examine WIPP's suitability as a TRU waste repository (55 FR 25689, June 22, 1990).

- ***Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact, Statement Eddy County, near Carlsbad, New Mexico* (SEIS-II) (DOE/EIS–0026–S2; DOE 1997).** In 1997, DOE issued the SEIS-II, which analyzed the potential environmental impacts associated with disposing TRU waste at WIPP and polychlorinated biphenyl (PCB)-commingled TRU waste in the DOE inventory at the time. DOE's Proposed Action was to open WIPP and dispose of up to 175,600 m^3 of TRU waste generated from atomic energy defense activities.

  In the SEIS-II, DOE analyzed the potential environmental impacts associated with shipping contact-handled (CH) TRU wastes and remote-handled (RH) TRU wastes to WIPP and disposing of them there. Under the Proposed Action in the SEIS-II, most CH-TRU waste was assumed to move directly to WIPP from the site where it was stored or generated. RH-TRU waste from some smaller sites was assumed to be moved to the Hanford Site in Washington or the Oak Ridge National Laboratory in Tennessee prior to shipment to WIPP. The total volumes of waste analyzed for WIPP disposal in the SEIS-II were 168,500 m^3 of CH-TRU waste and 7,080 m^3 of RH-TRU waste.

  On January 23, 1998, DOE announced its decision to implement the Proposed Action in the ROD (63 FR 3624). The SEIS-II, as the most recent SEIS related to TRU waste disposal at WIPP, is the foundational NEPA document against which the changes described in this SA are compared.

- ***Supplement Analysis for Disposal of Polychlorinated Biphenyl-Commingled Transuranic Waste at the Waste Isolation Pilot Plant* (DOE/EIS-0026-SA-02; DOE 2004a).** DOE's decision to implement the Proposed Action in the ROD for SEIS-II did not include the disposal of PCB-commingled TRU waste because no facilities were then available to provide thermal treatment of that waste prior to disposal. However, in June 2004, DOE issued SA-02, which evaluated the potential impacts of disposing up to

2,500 m^3 of PCB-commingled TRU waste at WIPP. DOE determined that the SEIS-II was adequate, and therefore, did not have to supplement the EIS or prepare a new EIS. Subsequent to the determination based on that SA, on June 30, 2004, DOE issued a revision to the WIPP SEIS-II ROD, announcing its decision to dispose of up to 2,500 m^3 of TRU waste containing PCBs at WIPP (69 FR 39456).

- ***Supplement Analysis for the Waste Isolation Pilot Plant Site-Wide Operations* (DOE/EIS-0026-SA-05; DOE 2005b) *and the Supplement Analysis for the Waste Isolation Pilot Plant Site-Wide Operations* (DOE/EIS-0026-SA-07; DOE 2009).** DOE prepared two SAs in 2005 and 2009 related to TRU waste disposal at WIPP. These SAs were prepared in accordance with 10 CFR 1021.330(d), and analyzed changes that had occurred since issuance of the SEIS-II. In these SAs, DOE determined that there were no significant new circumstances or information relevant to environmental concerns and bearing on the Proposed Action or its impacts since the preparation of the SEIS-II. DOE determined in both instances that the SEIS-II was adequate, and therefore, it did not have to supplement the EIS or prepare a new EIS.

- ***Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement* (DOE/EIS-0283-S2; DOE 2015b).** This SEIS evaluated the potential disposal of 13.1 metric tons of surplus plutonium for which a disposal path had not been assigned. In the ROD (81 FR 19588, April 4, 2016), the DOE National Nuclear Security Administration announced its decision to implement the Preferred Alternative for the disposition of 6 metric tons of surplus non-pit plutonium. Shipments of this surplus non-pit plutonium to WIPP, once operational, will be placed in the queue of waste to be shipped to WIPP. This plutonium will be prepared and packaged to meet the WIPP WAC for CH-TRU waste and other applicable regulatory requirements.

- ***Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste* (DOE/EIS-0375; DOE 2016a).** This Final EIS evaluated five alternatives, including the Preferred Alternative to dispose of GTCC and GTCC-like waste in a geologic repository at WIPP and/or land disposal at generic commercial facilities.

- ***Final Long-Term Management and Storage of Elemental Mercury Supplemental Environmental Impact Statement (DOE/EIS-0423-S1; DOE 2013a).*** This Final SEIS evaluates three additional locations for a long-term elemental mercury storage facility(ies), all three of which are in the vicinity of WIPP.

In addition, DOE prepared three categorical exclusion (CX) determinations and one SA related to recovery actions as a result of the February 2014 incidents.

- ***Categorical Exclusion: Installation of an Interim Ventilation System to Support Recovery Actions at the Waste Isolation Pilot Plant* (DOE 2014d).** This CX determination addressed an upgrade to the existing WIPP ventilation exhaust system to increase ventilation to the UG. This interim ventilation system added two fans to the existing high-efficiency particulate air (HEPA) filtration system.

- ***Categorical Exclusions: Remove and Replace HEPA Filters* (DOE 2014e and DOE 2015c).** These two CX determinations involved actions in 2014 and 2015 to remove and replace HEPA filters and associated materials. The used filters and associated materials are considered to be mixed low-level waste.

- ***Supplement Analysis for a Proposal to Temporarily Store Defense Transuranic Waste Prior to Disposal at the Waste Isolation Pilot Plant* (DOE/EIS-0026-SA-09; DOE 2014f).** SA-09 examined a proposal to temporarily store a limited amount of TRU waste at the WCS facility in Andrews, Texas. DOE determined that temporary storage of TRU waste at WCS did not significantly change the Proposed Action analyzed in the WIPP SEIS-II, that is, the packaging and transportation of TRU waste for disposal in the WIPP repository. Thus, DOE had not made substantial changes in the Proposed Action(s) that are relevant to environmental concerns, nor would the temporary storage of TRU waste at WCS contribute significantly to the potential impacts identified in the WIPP SEIS-II. DOE determined that the SEIS-II was adequate, and therefore, did not have to supplement the EIS or prepare a new EIS.

2 CHANGES CONSIDERED IN THIS SUPPLEMENT ANALYSIS

The Proposed Action (*i.e.*, transportation of waste to WIPP by truck and the operation of the WIPP for the disposal of TRU waste generated by DOE atomic energy defense activities) has not changed since the preparation of the SEIS-II. There are, however, certain differences in the implementation of the Proposed Action from those analyzed in the SEIS-II. This chapter describes the changes that have occurred since 2009, or are reasonably foreseeable, related to the transportation of TRU waste to WIPP and the operation of WIPP for TRU waste disposal. In general, three types of differences (or changes) are pertinent to proposed operations and are discussed in this chapter: (1) differences at the WIPP facility and differences to proposed operations (Sections 2.2 and 2.3), (2) changes/updates in the affected environment at the WIPP site and the regions of influence (ROI) associated with the environmental analyses (Section 2.6), and (3) changes in the guidance related to NEPA analyses (Section 2.7). Two other types of changes (*i.e.*, PCB-commingled TRU waste inventory and wastes generated as a result of the February 2014 incidents) are discussed in Sections 2.4 and 2.5, respectively. As discussed in Section 1.4, the scope of this SA focuses on evaluating these changes against the analysis in SEIS-II in order to support a determination as to whether the changes are substantial and relevant to environmental concerns, or represent significant new circumstances or information relevant to environmental concerns and bearing on the Proposed Action or its impacts.

2.1 February 2014 Incidents

Because the February 2014 incidents and subsequent actions led to the suspension of TRU waste emplacement operations at WIPP, a more detailed description of those incidents is presented in order to provide for a context to understand the changes at the WIPP facility and the proposed operations. Figure 2 depicts the locations within WIPP where the incidents occurred.

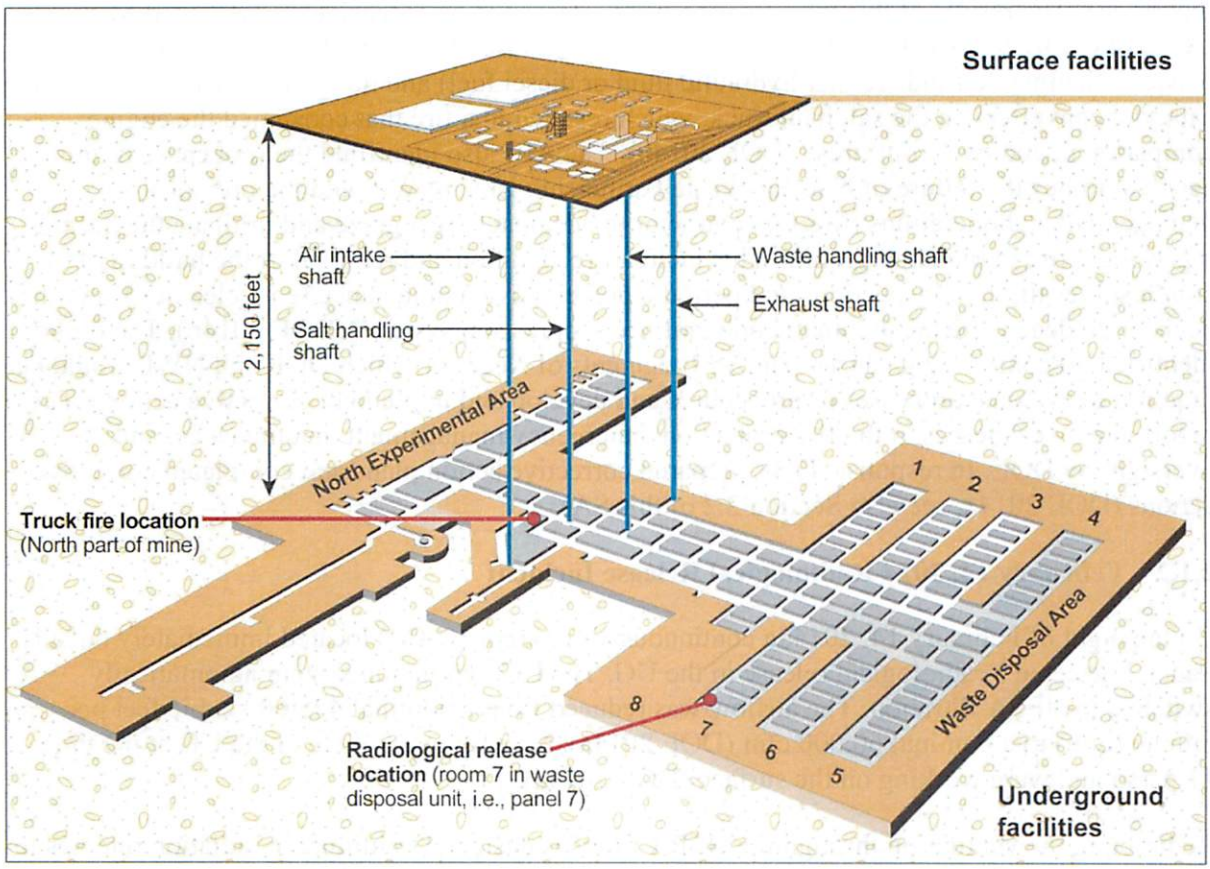


Figure 2. Locations of February 2014 Incidents (Source: GAO 2016)

2.1.1 February 5, 2014 Fire Incident

On the morning of February 5, 2014, a fire in the UG occurred involving a diesel-powered vehicle (salt haul truck) used to move mined salt from the excavation of salt to the salt hoist within the UG. All 86 people in the UG at the onset of the fire exited the mine safely. Six personnel were evaluated for smoke inhalation and released from a local hospital the day of the UG fire. One employee required longer treatment for smoke inhalation as a result of the fire (DOE 2014a).

The fire burned the engine compartment of the salt haul vehicle and consumed the front tires, the main contributor to the amount of smoke and soot in the area of the fire. The fire resulted in heavy smoke damage to WIPP's mechanical and electrical equipment and systems. Soot was deposited on the mine's walls, shafts, and UG equipment, including the waste hoist tower, which is used to transport TRU waste containers to the UG for emplacement. Additionally, soot collected in the HEPA filtration system, resulting in replacement of those filters. In summary, the soot and smoke from the fire adversely affected key equipment and facilities of the WIPP repository, requiring a widespread cleanup effort.

On February 7, 2014, DOE appointed an Accident Investigation Board (AIB) to determine the cause of the accident and to develop recommendations for corrective actions to prevent

recurrence. The results of this investigation were released in an extensive report issued March 13, 2014 (DOE 2014b). The AIB identified the direct cause of this accident to be "contact between flammable fluids (either hydraulic fluid or diesel fuel) and hot surfaces (most likely the catalytic converter) on the salt haul truck, which resulted in a fire that consumed the engine compartment and two front tires" (DOE 2014b). The AIB also identified the root cause of this accident to be "the failure of Nuclear Waste Partnership LLC (NWP) and the previous management and operations (M&O) contractor to adequately recognize and mitigate the hazard regarding a fire in the underground. This includes recognition and removal of the buildup of combustibles through inspections and periodic preventative maintenance (e.g., cleaning), and the decision to deactivate the automatic onboard fire suppression system" (DOE 2014b). The report identified 10 contributing causes[2] and 35 Judgments of Need for which DOE and NWP would be required to evaluate processes or procedures and develop and implement corrective actions. The report cited weaknesses in the fire protection, emergency management, maintenance, and oversight by DOE. In response, DOE prepared corrective action plans and completed corrective actions (DOE 2014a; see also Section 2.2 of this SA).

2.1.2 February 14, 2014 Radiological Release Incident

On the night of February 14, 2014, a continuous air monitor (CAM) located immediately outside Panel 7 detected a radiological release in the UG. The UG ventilation system automatically switched to HEPA filtration. The airflow was reduced from a nominal 425,000 cubic feet per minute (cfm) to a nominal 60,000 cfm (DOE 2014a). No employees were in the UG at the time; 11 personnel were working on the surface (DOE 2014a).

Redirecting the ventilation through the HEPA filters is designed to minimize radiation releases to the environment and, thus, protect aboveground workers at the site and the public in the surrounding areas. The automatic switch to HEPA ventilation operated as designed, thereby minimizing the external radiological release. Monitors detected slightly elevated levels of airborne radioactive concentrations outside the WIPP facility after the release occurred due to leakage through closed ventilation filter bypass dampers (DOE 2014a).

Actions were taken immediately following the incident to stabilize the facility and to determine the extent of impact to WIPP personnel, the public, and the environment. Activities included radiological surveys across the WIPP site and adjacent areas, as well as collection and analysis of environmental and personnel bioassay samples. Bioassay tests showed that 22 workers received internal contamination as a result of the release, each with a total lifetime exposure of less than 10 millirem (mrem) over 50 years, which is equivalent to the exposure resulting from a chest x-ray. All follow-up bioassay tests were below minimum detectable concentrations. No long-term adverse health effects are expected for these employees (DOE 2014a). The maximum estimated public dose was determined to be less than 1 mrem, with expected doses closer to 0.1 mrem or less (DOE 2014g).

[2] Contributing causes, as defined in the Accident Investigation Reports, are "events or conditions that collectively with other causes increased the likelihood or severity of an accident but that individually did not cause the accident. For the purposes of this investigation, contributing causes include those related to the cause of the fire, as well as those related to the subsequent response."

Other actions followed as part of the initial incident response. On March 6, two ventilation system dampers that were known to have allowed a small amount of the radioactive material to bypass the HEPA filters were sealed with a high-density foaming material. Periodic air sampling downstream of the HEPA filters was also conducted, and soil, surface water, sediment, animal, and vegetation sampling were performed. Maintenance was performed on the ventilation system fans to ensure reliable operation, and in 2015, the HEPA filters were removed and replaced (DOE 2014a, 2015c).

In response to stakeholder requests, DOE initiated a comprehensive public outreach and communications strategy that included holding periodic town hall meetings, adding the WIPP recovery website, starting WIPP Update email notifications, and conducting regular, formal discussions with WIPP's regulators, the U.S. Environmental Protection Agency, and the New Mexico Environment Department (DOE 2014a).

On February 27, 2014, DOE appointed a second AIB to determine the cause of the radiological release and to develop recommendations for corrective actions. This second AIB used a two-phased approach to conduct its investigation. The first phase focused on the response to the radioactive material release, including related exposure to aboveground workers and the response actions, while the second phase evaluated the cause of the radiological release event.

The comprehensive Phase 1 AIB report was issued April 24, 2014 (DOE 2014c). According to the Phase 1 report, the cumulative effect of inadequacies in ventilation system design and operability compounded by the degradation of key safety management programs and safety culture resulted in the release of a minimal amount of radioactive material from the UG to the environment. The AIB identified the direct cause of this accident to be "the breach of at least one TRU waste container in the UG which resulted in airborne radioactivity escaping to the environment downstream of the HEPA filters" (DOE 2014c). The AIB identified the root cause of the release of radioactive material from UG to the environment to be "NWP's and CBFO's [DOE Carlsbad Field Office's] management failure to fully understand, characterize, and control the radiological hazard" (DOE 2014a). The Phase 1 report identified 47 Judgments of Need for which DOE and NWP would be required to evaluate processes or procedures and develop and implement corrective actions. The report cited deficiencies in the response to the event and in the areas of nuclear safety, maintenance, radiological protection and controls, emergency management, safety culture, and oversight. In response, DOE prepared corrective action plans and completed corrective actions (DOE 2014a; see also Section 2.2 of this SA).

Phase 2 of the AIB investigation focused on the mechanism(s) of release of the radioactive material and included entries into contaminated areas in the UG, sampling, and additional forensics. The comprehensive Phase 2 report was issued April 15, 2015 (DOE 2015a). In that report, the AIB identified the direct cause of the incident to be "an exothermic reaction of incompatible materials in Los Alamos National Laboratory (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 UG" (DOE 2015a). The AIB identified the local root cause of the radioactive material release in the WIPP UG to be "the failure of LANS [Los Alamos National Security, LLC, the Management and Operating contractor of LANL] to understand and effectively implement the LANL Hazardous Waste Facility Permit and Carlsbad Field Office

directed controls" (DOE 2015a). The AIB identified the systemic root cause as "the Los Alamos Field Office (NA-LA) and National Transuranic Program/Carlsbad Field Office (CBFO) failure to ensure that LANL had adequately developed and implemented repackaging and treatment procedures that incorporated suitable hazard controls and included a rigorous review and approval process" (DOE 2015a). The Phase 2 report identified 40 Judgments of Need for which DOE and NWP would be required to evaluate processes or procedures and develop and implement corrective actions. In response, DOE prepared and has implemented corrective action plans.

In response to the incidents that occurred in February 2014, DOE made improvements and enhancements to the WIPP facility and to some of the conduct of operations. This SA evaluates these changes, which are described in Sections 2.2 and 2.3 of this SA.

2.2 Changes to the Underground and the Conduct of Operations

In response to the February 2014 incidents, DOE has improved many of the systems and operations associated with TRU waste emplacement. The differences include both physical and operational changes and are described in the following bullets.

- UG operations will initially resume with TRU waste emplacement in a contaminated part of the UG. The same general waste emplacement process and equipment will be used as were used prior to February 2014. Additionally, the TRU waste will be emplaced in the same manner (i.e., stacked in columns and rows in a honeycomb fashion) and the same documentation processes will be used. The difference would be essentially twofold: There will be a transition zone where the TRU waste packages will be transferred from one forklift in the uncontaminated area of the mine to another forklift in the contaminated section, and workers will use additional personal protective equipment. These modifications to the process will require increased vigilance and attention to detail to ensure worker safety (DOE 2014a).

- The UG is segregated into four control areas for radiological protection as follows (DOE 2016b unless otherwise noted):

  (1) Areas with no restrictions

  (2) Radiological Buffer Area
    - Radiological buffer areas are areas between contaminated areas and uncontaminated areas to prevent and control the spread of radioactive contamination and to protect personnel from exposure;
    - Radiation Worker I training (basic) for workers is required prior to entry; and
    - Hand and foot monitoring (using a radiation detection instrument) required prior to exit.

(3) Contamination Area[3]
- Radiation Worker II training (more advanced) for workers is required prior to entry;
- Radiological work permit required for entry;
- Respiratory protection in airborne radioactivity areas is required;
- Dosimeters and protective clothing to be worn by all workers; and
- Whole body scans (using a radiation detection instrument) prior to exit after removing protective clothing.

(4) High Contamination Area
- Radiation Worker II training for workers is required prior to entry;
- Radiological work permit required for entry;
- Respiratory protection in airborne radioactivity areas is required;
- Dosimeters and protective clothing to be worn by all workers; and
- Whole body scans (using a radiation detection instrument) prior to exit after removing protective clothing.

- The initial closure of Panel 6 and Panel 7 in Room 7 was a priority for DOE and the New Mexico Environment Department in order to isolate the drums associated with the LANL waste that was the source of the radiological release. In accordance with the Nitrate Salt-Bearing Waste Isolation Plan, DOE has constructed closures at the entrance and exit of Panel 6 consisting of the same type of initial closures constructed for other panels (i.e., Panel 3 and 4). The closures constructed for Panel 7, Room 7 are the same type of disposal room closures (i.e., chain-link, brattice cloth, and steel bulkheads) installed between disposal rooms in Panels 5 and 6. The closures isolate these areas from the active ventilation system in order to contain any potential releases and minimize impacts outside the closed areas (NWP 2016).

- Wastes generated during resumption of operations could be disposed of in Panel 7. These wastes that are derived from activities performed in some UG areas could include, but are not limited to, vehicles, equipment, and other materials used during UG or surface decontamination activities as well as contaminated HEPA filter units (NWP 2016). The process of evaluating waste generated or derived from activities is a controlled process.

- The amount of ventilation has always dictated the types and number of activities that could be performed simultaneously in the UG at any given time. As discussed in more detail in Section 2.3 below, operating the UG ventilation system in filtration mode would not support simultaneous TRU waste emplacement operations and large-scale panel mining. TRU waste emplacement is projected to restart slowly and then ramp up commensurate with worker comfort and proficiency to continue to emphasize that production and schedule are not a priority over safe and compliant TRU waste emplacement operations. TRU waste emplacement operations at pre-February 2014 rates

[3] Contamination areas are designated by the amount of removable radioactive contamination in the area. A "high contamination area" has 100 times more removable radioactive contamination than a "contamination area."

and simultaneous same shift salt mining would not likely occur until a new permanent ventilation system becomes operational (see Chapter 4 of this SA). However, mine maintenance activities can be performed with the existing UG ventilation system and the interim ventilation system (IVS) (see Section 2.3) in filtration mode.[4]

- Following resumption of TRU waste emplacement, wastes would initially be emplaced into the UG area in Panel 7. Once Panel 7 is filled, TRU waste emplacement operations would then likely move to Panel 8 (see Figure 2). Over time, as areas are decontaminated and other contaminated areas are closed off, the majority of operations would take place in uncontaminated parts of the UG (DOE 2014a).

- Because some waste drums resulting from the same treatment campaign as drum 68660 (e.g., drums that were noncompliant with the WIPP WAC) were disposed of in Panel 6 and Panel 7, Room 7, NWP performed a comprehensive revision of the hazards evaluation, documented in the *Waste Isolation Pilot Plant Documented Safety Analysis* (DSA) (NWP 2016). Chapter 3 of this SA summarizes the DSA analysis of an exothermic chemical reaction in noncompliant drums.

- The *Waste Isolation Pilot Plant Recovery Plan* (DOE 2014a) identified three safety management programs—emergency management, fire protection, and radiological readiness and safety—as key to existing recovery activities as well as resumption of waste emplacement activities (DOE 2016b unless otherwise noted):

  (1) Emergency Management—The Emergency Management Program (EMP) has been enhanced to improve response to site incidents and emergencies.
    - The EMP has been restructured to align with current and changing needs in accordance with the U.S. Department of Homeland Security's National Incident Management System and the Incident Command System (DHS 2008);
    - The EMP restructuring includes updates to the emergency management policies, plans, and procedures, as well as changes to equipment and facilities;
    - WIPP personnel are conducting updated training, drills, and validation exercises; and
    - The EMP was verified to align with the revised DSA (NWP 2016).

  (2) Fire Protection—The Fire Protection Program (FPP) has been enhanced to include:
    - Upgraded UG fire protection equipment including onboard automatic fire suppression systems on applicable diesel-fueled vehicles;
    - Better controls on materials that have the potential to cause a fire in the UG;
    - Improved scheduling of maintenance to manage fire protection controls;
    - New fire protection equipment, including new emergency response vehicles both on the surface and in the UG; and
    - Analysis based on a greater probability of fires (the latest version of the DSA reflects an increased probability of fires).

[4] The pre-2014 annual/weekly number of TRU waste shipments to WIPP varied according to numerous factors, including facility maintenance requirements and weather.

(3) Radiological Readiness and Safety—A comprehensive program has been completed to examine aspects of the Radiological Control Program (RCP) and to address the need to operate in both an uncontaminated and a contaminated environment.
   - o The program complies with 10 CFR Part 835, "Occupational Radiation Protection," and DOE-STD-1128-2008, "Good Practices for Occupational Radiation Protection in Plutonium Facilities";
   - o Procedures have been updated and training and drills are conducted on the new procedures and processes;
   - o Radiological signage has been installed in the UG to clearly distinguish contaminated areas and clean areas;
   - o The waste disposal area UG ventilation system is operating in HEPA filtration mode;
   - o WIPP personnel have deployed upgraded CAMs in the UG; and
   - o There is increased training for individuals who require access to contaminated areas.

- RH-TRU waste emplacement would not occur until the completion of a revised DSA (NWP 2016) (for example, CH-TRU waste emplacement operations were performed for seven years before RH-TRU waste emplacement operations started up).

2.3 Ventilation Systems

Before the February 2014 incidents, the nominal ventilation airflow rate in the UG was 425,000 cfm. As a result of the radiological incident, the UG ventilation system was initially switched from a nominal 425,000 cfm of unfiltered air to a nominal 60,000 cfm of air in the HEPA filtration mode. Filtration mode mitigates the consequences of a UG waste-handling accident by reducing the air flow rate and directing the UG exhaust through two HEPA filter units located on the surface in the exhaust filter building (DOE 2014a). Running in filtered mode restricts the number of people and the activities that can be conducted simultaneously in the UG.

To increase the airflow to resume waste emplacement operations and perform panel mining, DOE planned two upgrades to the existing ventilation system: an IVS that would increase airflow to about 110,000 cfm, and a supplemental ventilation system (SVS) that would increase airflow to about 180,000 cfm.

The IVS consists of two skid-mounted centrifugal exhaust fans (referred to as 960 fans), two skid-mounted filter housings, isolation dampers, and associated ductwork. The 960 fans can each provide a filtered flow of about 25,000 cfm (or about 50,000 cfm combined). The 960 fans are located on the surface near the Exhaust Shaft (NWP 2016). The environmental impacts of the IVS were addressed in a CX determination (see Section 1.5 of this SA) (DOE 2014d). The IVS, which exhausts through the existing HEPA filtration system is operational and the current airflow in the UG is about 110,000 cfm.

Since the February 2014 radiological incident, exhaust air from the UG passes through a HEPA filtration unit before discharging to the environment. The HEPA filter efficiency removes more than 99 percent of particles with diameters of approximately 0.7 micron or greater to ensure that

onsite consequences of a radiological release are reduced to levels as low as reasonably achievable (ALARA) (NWP 2016). Prior to the radiological incident, the exhaust air did not flow exclusively through the HEPA filtration system. The DSA (NWP 2016), which now credits the UG ventilation system as a Safety Significant control, contains a detailed hazard analysis based on the February 2014 radiologic incident.

In 2017, DOE will complete the installation of the SVS. The SVS will augment the existing ventilation system with a supplementary fan to provide a nominal 70,000 cfm in the UG using the same processes, equipment, and appurtenances such as bulkheads, overcasts, airlocks, and bulkhead ventilation regulators that have been used in the WIPP UG for years. Ventilation for clean areas of the mine (involving uncontaminated air) would be exhausted using one of the existing shafts other than the exhaust shaft (DOE 2014a).

To resume simultaneous pre-February 2014 waste emplacement rate and mining operations, DOE contemplates building a new permanent ventilation system (PVS) to replace the existing system and to provide airflow of about 540,000 cfm (DOE 2014a). The PVS would not be expected to be operational until approximately 2021. The PVS is not yet ripe for analysis in this SA; however, it is discussed in Chapter 4 below.

2.4 PCB-Commingled TRU Waste Inventory

The SEIS-II (DOE 1997) analyzed the potential environmental impacts associated with shipping TRU wastes to, and disposal at, WIPP. This evaluation included PCB-commingled TRU wastes. DOE's decision to implement the Proposed Action in 1998 did not include the disposal of PCB-commingled TRU waste. After DOE issued its ROD, the U.S. Environmental Protection Agency (EPA) promulgated regulations governing the disposal of PCBs (63 FR 35384, June 1998). EPA's rule defined several types of PCB wastes, including PCB bulk product wastes and PCB remediation wastes, and disposal pathways for the various types of these wastes. Under the rule, the PCB bulk product wastes and remediation wastes that constitute the major portion of DOE's PCB-commingled TRU waste could be disposed of in an authorized chemical waste landfill without prior treatment. DOE consulted with EPA to identify a disposal path for DOE's PCB-commingled TRU wastes. As a result of this consultation, DOE received a letter from EPA clarifying that most of DOE's solidified TRU wastes "fall within the definition of remediation waste" (EPA 2003). The letter further stated this waste, "may be disposed of in accordance with the requirements of 40 CFR 761.50 and 761.61," which allow disposal in a chemical waste landfill without treatment.

In June 2004, DOE issued the *Supplement Analysis for Disposal of Polychlorinated Biphenyl-Commingled Transuranic Waste at the Waste Isolation Pilot Plant* (DOE/EIS-0026-SA-02), which evaluated the potential environmental impacts associated with the disposal of up to 2,500 m^3 (88,000 ft^3) of PCB-commingled TRU wastes at WIPP. Subsequent to the release of that SA, DOE issued an amended WIPP ROD announcing its decision to dispose of up to 2,500 m^3 (88,000 ft^3) of TRU waste containing PCBs at the WIPP (69 FR 39456, June 30, 2004).

In the most recent complex-wide assessment of the inventory of PCB-commingled TRU waste, DOE has estimated that an overall total of approximately 11,000 m^3 (388,500 ft^3) of such waste currently exists. Additional TRU and TRU-mixed waste commingled with PCB waste will likely

be generated during decontamination and decommissioning activities at DOE facilities in the future, and sites in the DOE complex may also identify some TRU waste that contains PCBs during the process of characterizing their TRU waste for disposal at WIPP. All TRU and TRU-mixed waste eligible for disposal at WIPP is characterized to meet the WIPP WAC, the WIPP Waste Analysis Plan, the transportation requirements, and the EPA certification criteria.

In the 2004 SA, DOE examined the potential impacts of disposal of PCB-commingled TRU waste at WIPP, relying in part upon a study prepared by the Sandia National Laboratory (SNL) that evaluated the risks to repository performance associated with PCBs in the TRU waste inventory over both a long-term and short-term time period. An updated PCB risk assessment analysis was prepared by SNL to examine whether any additional impacts would result from disposal of additional PCB inventory at WIPP (SNL 2013). In the updated analysis, SNL considered three PCB-Commingled TRU waste inventory estimates to evaluate risks: a "conservative" volume of 10,000 m^3, a "very conservative" volume of 18,750 m^3, and a "bounding case" volume of 125,000 m^3. The analysis found that the overall risks of PCBs relative to radionuclide risks are insignificant at all three of the estimated inventory values, with risks due to radionuclides greater than 3 orders of magnitude above those for PCBs. Similarly, overall risks due to PCBs in any additional inventory when compared to the total hazardous chemical exposure risks identified in the SEIS-II are also insignificant.

2.5 Waste Management Inventory

As a result of the February 2014 incidents and the associated recovery and resumption activities, there have been changes in the quantities of wastes to be managed at WIPP. Specifically, the recovery actions resulted in the generation of the following waste streams and approximate volumes (DOE 2016b):

- TRU waste: approximately 20 m^3 (used personal protection equipment and HEPA filter equipment);
- Low-level radioactive waste: approximately 735 m^3; and
- Hazardous solid waste: approximately 8 m^3 (soot cleanup wastes).

TRU waste would be disposed of at WIPP and represents a *de minimis* contribution to the planned TRU waste inventory. The low-level radioactive waste and hazardous solid waste are disposed of at licensed, offsite facilities.

2.6 Changes to the Affected Environment

This section discusses changes to the affected environment, including human health and environment resources, since last evaluated in the 2009 SA (DOE 2009). These changes are determined by comparing the present to SEIS-II (DOE 1997). Section 4.1 of the SEIS-II presented information on the following resource areas:

- Land Use and Management
- Air Quality, Climate, and Noise
- Geology and Hydrology
- Biological Resources

- Cultural Resources
- Socioeconomic Environment (Background Characteristics, Role of WIPP in the Economic Base, and Environmental Justice)
- Transportation
- Background Radiation

These same resource areas are evaluated below for any differences, which are used in Chapters 3 and 4 to determine if this information, combined with differences in the Proposed Action, would have a bearing on the potential environmental impacts presented in SEIS-II. Additionally, population information is used in the Chapters 3 and 4 evaluations, and although not listed above, is discussed first below.

2.6.1 Population

Potential consequences to human health from normal operations and accidents are evaluated within a specific ROI. The ROI is different for each of the groups evaluated. The groups evaluated in SEIS-II included the workers at the WIPP site, the 50-mile population surrounding the WIPP site (for which the population of Eddy and Lea counties are substituted), and the population along the transportation corridors from the generator sites. The following population information for each ROI was presented in SEIS-II and used to estimate potential impacts.

2.6.1.1 WIPP Project Workforce

The workforce evaluated in SEIS-II was 1,095 persons (DOE 1997). The workforce prior to February 2014 was 979 workers, with 32 workers classified as radiological workers. The current (2016) workforce is 1,082 workers, with 34 workers classified as radiological workers (DOE 2016b). While no significant changes in this workforce are anticipated, minor, temporary changes in the workforce associated with construction may occur.

2.6.1.2 WIPP Site

The WIPP site is located 26 miles east of Carlsbad in Eddy County, near Lea County. SEIS-II utilized Eddy and Lea counties as the ROI to estimate the 50-mile population surrounding WIPP, with a combined population of 104,370 people. The 2010 Census ROI population grew to a combined population of 118,556 people (USCB 2010). In 2015, the population of the ROI was 128,758 people, which represents a 23 percent increase over the ROI population in SEIS-II (USCB 2016a).

2.6.1.3 Transportation Corridor

The population demographics of the transportation corridor were not evaluated in detail for this SA. Given that the population corridors span much of the continental United States, this SA assumes that changes in the corridor population are likely to be similar to the overall changes in the U.S. population. In 1990, the U.S. population was 248,709,873. The 2015 population is 321,418,820 people (USCB 2016b). This represents an approximate 29 percent increase.

2.6.2 Land Use and Management

SEIS-II defines the ROI for land use impacts as WIPP plus "the site and the area immediately adjacent to the site" (DOE 1997). Thus, for WIPP, the area of consideration for potential land use impacts includes privately owned ranches, U.S. Bureau of Land Management (BLM) lands, and New Mexico state trust lands, including some leased as mineral and grazing lands immediately adjacent to the WIPP site.

Section 4 of the WIPP LWA (Public Law 102-579, as amended), made the Secretary of Energy responsible for managing the lands that encompass the WIPP facility consistent with the *Federal Land Policy and Management Act of 1976* (43 U.S.C. § 1701 *et seq*). The LWA also required the Secretary of Energy to consult with the Secretary of the Interior and the State of New Mexico in discharging this responsibility. In order to execute this responsibility, the DOE developed a Land Management Plan (LMP), as required by the WIPP LWA, to identify resource values, promote multiple-use management, and identify long-term goals for the management of WIPP lands. The LMP was developed in consultation with the BLM and the State of New Mexico.

The LMP sets forth cooperative arrangements and protocols for addressing WIPP-related land management actions. This LMP is reviewed biennially to assess the adequacy and effectiveness of the document, or as may be necessary to address emerging issues affecting lands within the WIPP land withdrawal. Affected agencies, groups, and/or individuals may be involved in the review process. There are no known (BLM) grazing lease or other land use and management changes or proposed changes within the WIPP site boundary or in the immediate area around the WIPP site (DOE 2016b).[5]

The Delaware Basin Drilling Surveillance Program is designed to monitor drilling activities in the vicinity of the WIPP Site (DOE 2012). This program is based on EPA criteria at 40 CFR 194.33. DOE will provide surveillance of the mining and drilling activity in the Delaware Basin in accordance with the criteria until DOE and the EPA mutually agree that no further benefit can be gained from continued surveillance. The results of the ongoing surveillance is used to determine if a change has occurred that would affect the performance of the WIPP disposal system.

2.6.3 Air Quality, Climate, and Noise

2.6.3.1 Air Quality

SEIS-II documented that the EPA has classified Eddy County, New Mexico, where WIPP is located, as an attainment area for all six of the criteria pollutants under the National Ambient Air Quality Standards. WIPP is also in a Class II Prevention of Significant Deterioration area, and any new sources of emissions would have to adhere to the standards for such an area. The Class I Prevention of Significant Deterioration areas nearest to WIPP are Carlsbad Caverns National Park, which is approximately 61 kilometers (38 miles) southwest of WIPP, and Guadalupe

[5] When BLM issues a well drilling permit on land adjacent to the WIPP LWA, BLM notifies DOE of the well permit for DOE to evaluate whether it would potentially impact WIPP. Since SEIS-II, wells have been drilled adjacent to WIPP and none of them has been determined to impact WIPP (DOE 2004b, Appendix C).

Mountains National Park, which is approximately 100 kilometers (62 miles) southwest of WIPP. There is no change in this information.

2.6.3.2 Climate

As discussed in SEIS-II, the regional climate is semiarid, with low precipitation and humidity and a high rate of evaporation. Precipitation is unevenly distributed throughout the year, with most occurring during summer thunderstorms. Winds are mostly from the southeast and moderate. In late winter and spring, there are strong west winds and dust storms. Thunderstorms are frequent from June through September, and are often accompanied by hail. Rains are brief but occasionally intense and can result in flash flooding in arroyos and along floodplains. Tornadoes are common throughout the region. There is no change in this information.

Based on the U.S. Climate Resilience Toolkit (https://toolkit.climate.gov/climate-explorer2/), expected climate changes include increased heat, drought, and insect outbreaks, all linked to climate change and increased wildfires. Declining water supplies, reduced agricultural yields, health impacts in cities due to heat, and flooding and erosion in coastal areas are additional concerns. Such changes are not anticipated to impact the potential environmental impacts of WIPP as described in SEIS-II.

2.6.3.3 Noise

DOE requires its facilities to comply with Occupation Safety and Health Administration standards with regard to noise. WIPP noise sources with the potential to exceed those standards are mitigated and are maintained in compliance with those standards. Additionally, all new projects are required to undergo a noise impacts analysis as part of the design and construction process. Since publication of the 2009 SA, no known new noise receptors have been identified in the WIPP ROI (DOE 2016b).

2.6.4 Geology and Hydrology

Although the geology and seismology in the area surrounding WIPP has not changed since publication of SEIS-II, more recent seismic activity data are available. Seismic activity within 186 miles of the WIPP site is currently monitored by seismographs installed and operated by the New Mexico Institute of Mining and Technology. Based on the four quarterly reports for 2013, the largest seismic event recorded was a 2.5 magnitude event located about 173 miles northwest of the WIPP site. The closest seismic event recorded had a 1.1 magnitude and was located about 20 miles northwest of the site. The events did not produce a ground motion at the WIPP site larger than 0.01 g and had no observable effect on WIPP structures (NWP 2016). In June of 2009, a re-assessment of natural phenomena hazard was performed on the WHB in accordance with the applicable revision of DOE Order 420.1. The assessment verified no changes to natural phenomena hazard intensities and no significant changes in the WHB structures, systems, and components (NWP 2016).

With regard to hydrology, there are no major surface water bodies located within 10 miles of the WIPP site. The Pecos River is about 12 miles west of the WIPP site at its closest point. In the vicinity of the WIPP site, there are limited occurrences of potable water, and several water-bearing zones produce poor-quality water. In the immediate vicinity of the WIPP site,

groundwater above the Salado Formation is commonly of such poor quality that it is not usable for most purposes. There is shallow groundwater at the WIPP site. Hydrological characteristics of the WIPP site do not pose any operational safety hazards (NWP 2016).

A Groundwater Detection Monitoring Program is required by the WIPP Permit. In 2014, groundwater samples were collected from six different detection monitoring wells on the WIPP site. Isotopes of naturally occurring uranium were detected in the groundwater well samples in 2014. The concentrations of the uranium isotopes measured in 2014 did not vary significantly from the concentrations measured in the same wells in 2013 (DOE 2015d).

2.6.5 Biological Resources

According to the most recent Annual Site Environmental Report (DOE 2015d), there have been no substantive changes in the site's biological resources since SEIS-II. During 2014, no species of plants or animals that are protected by the *Endangered Species Act* were identified within the WIPP land withdrawal area (DOE 2015d).

2.6.6 Cultural Resources

DOE has not conducted any activities since 2009 that would have required archaeological investigations or other cultural resource surveys (DOE 2016b). There is no change in this information.

2.6.7 Environmental Justice

Under Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," federal agencies are responsible for identifying and addressing the possibility of disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions. Minority populations refer to persons of any race self-designated as Asian, Black, Native American, or Hispanic. Low-income populations refer to households with incomes below the federal poverty thresholds.

A large number of minority and low-income individuals are located in Eddy and Lea counties. In this area, 53.0 percent of the population is classified as minority, while 15.5 percent is classified as low-income. Although the number of minority individuals does not exceed the state average by 20 percentage points or more, the number of minority individuals exceeds 50 percent of the total population in the area; that is, there is a minority population in this area based on 2010 Census data. The number of low-income individuals does not exceed the state average by 20 percentage points or more, and does not exceed 50 percent of the total population in the area; that is, there are no low-income populations in this area (DOE 2016a). No significant changes from the impacts analyzed in the SEIS-II are anticipated. Therefore, no disproportionate impacts to low-income and minority populations are anticipated.

2.6.8 Transportation

The 2009 SA included an updated assessment of transportation impacts. The transportation analysis included updates to the parameters that contribute to the analysis (e.g., population, dose

conversion factors, computer codes, projected numbers of shipments, and package types). There have been no substantive changes to the transportation parameters since 2009 that would affect the transportation analysis from the SEIS-II, with the exception of changes in the annual number of TRU waste shipments, population, and dose conversion factor that would occur following resumption of operations. Section 3.3 of this SA evaluates the changes in the annual number of TRU waste shipments.

2.6.9 Background Radiation

No substantive changes have occurred in the estimates or understanding of the background radiation[6] at WIPP since SEIS-II (DOE 2016b).

2.7 New NEPA Guidance

2.7.1 Intentional Destructive Acts

When DOE prepared the SEIS-II, DOE NEPA documents did not normally include an analysis of the potential impacts of intentional destructive acts. Following the terrorist attacks of September 11, 2001, DOE has implemented measures to minimize the risk and consequences of potential terrorist attacks on its facilities. DOE subsequently issued guidance on the analysis of accidents and intentional destructive acts in its NEPA documents (DOE 2002; Borgstrom 2006). In this SA, DOE has considered security scenarios involving intentional destructive acts to assess potential environmental impacts (see Chapter 3). The analysis addresses both the transportation of TRU wastes to WIPP and the disposal of those wastes at WIPP.

2.7.2 Dose Conversion Factor

When converting radiological doses to potential latent cancer fatalities (LCFs), the SEIS-II used a factor of 5×10^{-4} fatality per rem for the public and a factor of 4×10^{-4} fatality per rem for workers. The value for workers was lower due to the absence of children and the elderly, who are considered to be more radiosensitive (DOE 2000). Since publication of the SEIS-II, DOE guidance (DOE 2003) recommends the use of a conversion factor of 6×10^{-4} fatality per rem for both workers and members of the public. The DOE guidance recommends use of factors developed by the Interagency Steering Committee on Radiation Standards (ISCORS 2002). Using the higher conversion factor increases the potential radiological impacts presented in the SEIS-II by 50 percent for workers and 20 percent for the public. This change in conversion factors has been applied in previous SAs since 2003. Chapter 3 of this SA presents the results of this change.

[6] Background radiation includes radiation resulting from (1) naturally occurring radioactive materials as they exist in nature prior to removal, transport, or enhancement or processing by man; (2) cosmic and natural terrestrial radiation; (3) global fallout as it exists in the environment; (4) consumer products containing nominal amounts of radioactive material or emitting nominal levels of radiation; (5) medical procedures/sources; and (6) radon and its progeny in concentrations or levels existing in buildings or the environment that have not been elevated as a result of current or past human activities (DOE 1997).

Latent Cancer Fatality

A latent cancer fatality (LCF) is a death from a cancer that results from, and occurs an appreciable time after, exposure to ionizing radiation. Death from radiation-induced cancers can occur any time after the exposure. However, latent cancers generally occur from 1 year to many years after exposure. Using a conversion factor of 0.0006 LCF per rem of radiation exposure (ISCORS 2002), the result is the increased lifetime probability of developing a latent fatal cancer. For example, if a person received a dose of 0.033 rem, that person's risk of LCF from that dose over a lifetime would be 0.00002. This risk corresponds to 1 chance in 50,000 of an LCF during that person's lifetime. Because estimates of LCFs are statistical, the results often indicate less than 1 LCF for cases that involve low doses or small populations. For instance, if a population collectively received a dose of 500 person-rem, the number of potential LCFs would be 0.3.

2.7.3 Greenhouse Gas Analysis

In August 2016, the CEQ issued final guidance to assist federal agencies in improving their consideration of the effects of greenhouse gas (GHG) emissions and climate change in evaluating proposals for federal actions under NEPA (CEQ 2016). Where appropriate, DOE NEPA documents consider the potential impacts associated with GHG emissions. Pursuant to the CEQ guidance, agencies should quantify a proposed action's projected emissions unless "tools, methodologies, or data inputs are not reasonably available." Chapter 3 of this SA presents the results of the GHG analysis.

3 ENVIRONMENTAL IMPACTS

3.1 Introduction

Through the discussion presented in Chapter 2, which describes differences in implementation of the Proposed Action and new circumstances in the affected environment that changed since last evaluated in the 2009 SA, DOE determined that land use and management, noise, water resources and infrastructure, biological resources, cultural resources, , and socioeconomics (including environmental justice), do not require further analysis. Human health, accidents and industrial safety, TRU waste transportation, air quality (greenhouse gas emissions), and intentional destructive acts do require further analysis in this SA with respect to potential impacts.

This chapter presents an analysis of the potential environmental impacts resulting from the changes and new circumstances that are relevant to environmental concerns since DOE issued the 2009 SA, and compares the impacts to those analyzed in the 1997 SEIS-II to determine if any of the changes are substantial or new circumstances are significant and relevant to environmental concerns and bearing on the proposed action or its impacts.

3.2 Human Health

This section evaluates the differences or changes that have occurred, or are expected to occur, at WIPP (as identified and discussed in Sections 2.3 and 2.4) that are related to human health impacts. These changes include:

- Differences in the WIPP facility and the conduct of operations, including:
  - Radiation exposures associated with recovery and preparation for resumption of operations activities since February 2014;
  - UG operations in a facility with contaminated and uncontaminated areas;
  - Near-term reduced rate of TRU waste emplacement;
  - Operations that, in the near term, do not include RH-TRU waste emplacement;
- A change in the dose conversion factor; and
- Population changes.

3.2.1 Changes to the WIPP Facility and the Conduct of Operations

Table 1 depicts worker dose information for normal operations for the years 2013 and 2015. The 2013 information represents worker doses for operations before the February 2014 incidents; the 2015 information represents worker doses associated with post-February 2014 activities. Data are presented for the average worker, the maximally exposed worker, and all workers (collective annual). As the data show, average worker doses and maximally exposed worker doses at WIPP are very small (less than 1 mrem/year). Collective annual worker doses are also small, at less than 1 person-rem/year. Table 1 also presents the potential for an LCF using the dose conversion factor of 6×10^{-4} fatality per rem.

As with the pre-February 2014 disposal activities at WIPP, potential worker exposures would achieve ALARA by four main factors: (1) using appropriate personal protective equipment; (2) minimizing times of exposure; (3) maintaining operations that would initially process and dispose of only CH-TRU waste and not RH-TRU waste (until the revalidation of the RH safety analysis [NWP 2016] has occurred); and (4) configuration of the UG ventilation so that ventilation flow is always from the involved workers toward areas of potential contamination and then to the HEPA filtration system. Over time, the TRU waste disposal throughput would gradually increase to levels similar to those in 2013, and as a result of the same ALARA principles identified above, it is expected that worker doses following resumption of activities would be less than or similar to 2013 levels (DOE 2016b).

Table 1. Worker Doses and Impacts

	2013		2014		2015	
	Dose	**LCF**	**Dose**	**LCF**	**Dose**	**LCF**
Average worker	< 1 mrem/yr	6×10^{-7}	< 1 mrem/yr	6×10^{-7}	<1 mrem/yr	6×10^{-7}
Maximally exposed worker	< 1 mrem/yr	6×10^{-7}	<34 mrem/yr	2×10^{-5}	<1 mrem/yr	6×10^{-7}
All workers (annual)	0.564 person-rem/yr	3.4×10^{-4}	0.034 person-rem/yr	2×10^{-5}	0.161 person-rem/yr	9.7×10^{-5}

Source: DOE 2016b with dose data documented in the Radiation Exposure Monitoring System database, https://energy.gov/ehss/policy-guidance-reports/databases/occupational-radiation-exposure.

SEIS-II estimated the radiological impacts to workers at WIPP from emplacement operations to be less than or equal to 1 LCF over the 35-year lifetime[7] of operations (DOE 1997, Table 5-13

[7] In March 2013, the DOE Carlsbad Field Office (CBFO) Manager requested a change in the WIPP lifecycle baseline for management planning purposes to Fiscal Year 2050. The DOE Office of Environmental Management responded and authorized

"Lifetime Human Health Impacts to Involved Workers from Waste Treatment and WIPP Disposal Operations for the Proposed Action"). This equates to a maximum annual risk of 0.03 LCF to all workers. For the Proposed Action addressed by this SA, DOE has estimated that the annual worker exposures projected after the resumption of TRU waste emplacement would be less than or similar to the doses measured in 2013 (DOE 2016b). Based on the data in Table 1, the annual impacts to all workers for the Proposed Action would be less than or equal to 3.4×10^{-4} LCF, which is within the bounds of the analysis presented in SEIS-II.

With regard to potential impacts to the public from normal operations, Table 2 presents dose information for the hypothetical public maximally exposed individual (public MEI) residing at the WIPP Exclusive Use Area (defined as the 290-acre area containing the WIPP facility that is surrounded by a barbed wire fence, posted no trespassing, and restricted to DOE use only) fence line as measured by the WIPP facility monitoring program.

Table 2. Public MEI Dose from WIPP Operations

Year	Public MEI Dose (mrem/yr)
2009	1.71×10^{-3}
2010	1.31×10^{-3}
2011	1.29×10^{-3}
2012	7.55×10^{-4}
2013	5.25×10^{-4}
2014	**2.38×10^{-1}**
2015	4.12×10^{-4}

Source: DOE 2016b, with dose data documented in the WIPP Annual Site Environmental Reports, http://www.wipp.energy.gov/Documents_All_Title.htm#A.

As shown in Table 2, the public MEI dose in 2014 increased as a result of the February 2014 radiological release event (see Section 3.3 for a more detailed analysis of that impact). In 2015, the public MEI dose returned to less than previous levels. Future doses to the public MEI are expected to be similar to the doses received from 2009 to 2013 and in 2015 (DOE 2016b). DOE expects that the average public MEI dose after resumption of TRU waste emplacement would be approximately 1×10^{-3} mrem/year (DOE 2016b). This equates to a maximum annual risk of 6×10^{-10} LCF.

SEIS-II evaluated the potential dose to the public MEI and presented that result in Table 5-11, "Lifetime Human Health Impacts to the Public from Waste Treatment and WIPP Disposal Operations for the Proposed Action." SEIS-II estimated that the risk of an LCF to the public MEI would be 3×10^{-7} over the lifetime of operations (35 years). This equates to a maximum annual risk of 8×10^{-9} LCF to the public MEI. The potential risk of an LCF to the public MEI from resumption of TRU waste disposal operations at WIPP (6×10^{-10} LCF) is not significantly different than the value (8×10^{-9} LCF) estimated in SEIS-II.

CBFO to use Fiscal Year 2050 as the "planning basis for the project management planning for the capital asset projects and other strategic planning initiatives." The baseline change proposal to formally update the lifecycle baseline for the capital asset projects and other strategic planning initiatives has not been prepared.

3.2.2 Change in the Dose Conversion Factor

Since publication of SEIS-II, DOE guidance (DOE 2003) recommends the use of a dose conversion factor of 6×10^{-4} fatality per rem for both workers and members of the public. Using this higher conversion factor compared to the factors used in SEIS-II (see Section 2.7.2 of this SA) would increase the potential radiological impacts presented in SEIS-II by 50 percent for workers and 20 percent for the public. For the worker and public MEI doses discussed above, the potential impacts due to a change in the dose conversion factor would remain small, notwithstanding the change from the potential impacts presented in the SEIS-II.

3.2.3 Population Changes

Since publication of SEIS-II, the population in the ROI has increased by approximately 23 percent (see Section 2.6.1). This change would have a proportional effect on the public population dose presented in the SEIS-II. SEIS-II evaluated the potential doses to the population surrounding WIPP and presented those results in Table 5-11, "Lifetime Human Health Impacts to the Public from Waste Treatment and WIPP Disposal Operations for the Proposed Action." SEIS-II estimated 3×10^{-4} LCF occurring in the exposed population from TRU waste disposal over the lifetime of operations. A 23 percent increase as a result of population increases would increase that estimate to 4×10^{-4} LCF. Applying the updated dose conversion factor described above would increase the lifetime potential human health impacts to the public population to 4.8×10^{-4} LCF, which still represents a *de minimis* impact (0.04 percent chance of an LCF over 35 years of operation).

3.3 Accidents and Industrial Safety

This section evaluates the changes that have occurred since 2009, or are reasonably foreseeable (as identified and discussed in Sections 2.2 and 2.3) that are related to accident and industrial safety impacts at WIPP. This section begins with a comparative analysis of the February 2014 incidents against the impacts presented in SEIS-II, then provides an assessment of how impacts presented in the SEIS-II would be affected by changes identified in Chapter 2.

February 5, 2014, Fire Incident. As a result of this incident, six personnel were evaluated for smoke inhalation and released from a local hospital the day of the UG fire. One employee required longer treatment. The SEIS-II analyzed the potential nonradiological impacts for this type of incident in Table 5-21, "Industrial Safety Impacts from Operations and Decommissioning of WIPP for the Proposed Action." As shown in that table, over the 35-year operational period, 1,225 reportable, nonradiological injuries/illnesses were projected to occur from operations at WIPP. Injuries to the seven personnel as a result of the truck fire would not constitute a significant change to the estimates in the SEIS-II analysis.

February 14, 2014, Radiological Release Incident. As a result of this incident, 22 workers received internal contamination, each with a total lifetime exposure of less than 10 mrem over 50 years, which is equivalent to the exposure resulting from a chest x-ray. All follow-up bioassay tests revealed that contamination was below minimum detectable levels. No long-term adverse health effects are expected for these employees (DOE 2014a). The maximum estimated public

dose was determined to be less than 1 mrem, with expected doses being closer to 0.1 mrem or less (DOE 2014g).

The SEIS-II considered and presented impacts for this type of accident in Table 5-18, "WIPP Disposal Accident Scenarios for the Proposed Action." As shown in that table, a container fire was depicted as accident scenario "W5." For a release of less than 8 plutonium-239 equivalent curies (PE-Ci), the annual occurrence frequency was estimated at 1×10^{-4} (which equates to a probability that the accident would occur once every 10,000 years). (Note: the February 14 incident was estimated to have released 0.0005 PE-Ci [DOE 2014c]).

For an exposed worker, the potential impacts were estimated and presented in Table 5-19 of SEIS-II. As shown in that table, for an exposed worker, the probability of an LCF was estimated to be 3×10^{-3}. For the February 2014 radiological release incident, the exposed worker dose of 10 mrem equates to a probability of an LCF of 6×10^{-6}. Thus, the potential dose to a worker as a result of the February 2014 radiological release incident is within the bounds of the SEIS-II analysis.

The potential consequences of a container fire were estimated and shown in SEIS-II Table 5-19, Radiological Consequences of WIPP Disposal Accident Scenarios for the Proposed Action." As shown in that table, for the public MEI, the probability of an LCF was estimated to be 4×10^{-3}. For the February 2014 radiological release incident, the public MEI maximum dose of 1 mrem equates to a probability of an LCF of 6×10^{-7}. Thus, the potential dose to the public MEI as a result of the February 2014 radiological release incident is within the bounds of the SEIS-II analysis.

3.3.1 Proposed Action Impacts

SEIS-II evaluated eight potential accidents that could occur at WIPP during emplacement operations (Table 5-18, "WIPP Disposal Accident Scenarios for the Proposed Action"). These accidents include drum drops, a container fire, a hoist failure, a roof fall, and a canister breach.

For the accidents evaluated, the maximum potential consequences presented in SEIS-II were as follows (DOE 1997):

- Public population surrounding WIPP: 0.3 LCF;
- Public MEI: less than 0.08 LCF; and
- Maximally exposed worker: less than 0.06 LCF.

As discussed in Chapter 2 in this SA, DOE identified the following changes that have occurred or are expected to occur at WIPP related to accident and industrial safety impacts.

- Disposal of drums that do not meet the WIPP WAC (e.g., noncompliant drums);
- A change in the dose conversion factor; and
- Population changes.

3.3.2 Disposal of Drums Not Meeting the WIPP WAC

NWP performed and documented a comprehensive revision of the hazards evaluation (NWP 2016). The analysis addresses potential exothermic chemical reactions in noncompliant drums present at WIPP and propagating fires involving multiple waste drums. The unmitigated dose to the public MEI from this event in the UG was estimated to be 3.1 rem. Mitigation actions (credit for the UG ventilation system and interim ventilation system) were estimated to reduce this dose to 31 mrem (NWP 2016). Statistically, a dose of 3.1 rem equates to 0.0019 LCF, while a dose of 31 mrem equates to 1.9×10^{-5} LCF (both results reflect the updated dose conversion factor described in Section 2.7.2). In comparison, SEIS-II estimated a dose to the public MEI from a canister fire to be 0.3 LCF. Consequently, the potential impacts of an exothermic chemical reaction in a noncompliant drum (the bounding accident presented in the 2016 DSA) is bounded by the analysis in SEIS-II. Table 3 depicts this information in a tabular format.

Table 3. SA Proposed Action versus SEIS-II for Maximum Dose from Canister Fire

	Proposed Action in this SA	SEIS-II
Maximum Dose (unmitigated)	3.1 rem (0.0019 LCF)	600 rem[a] (0.3 LCF)

a. SEIS-II presented LCF information only. The 600 rem was determined by utilizing the dose conversion factor that would have been used in SEIS-II (e.g., 5×10^{-4} fatality per rem for the public) to present dose information.
Source: NWP 2016; DOE 2016b.

3.3.3 Change in the Dose Conversion Factor

For accidents evaluated in SEIS-II, the maximum consequences from the change in the dose conversion factor would be as follows (DOE 1997):

- Public population surrounding WIPP: 0.4 LCF;
- Public MEI: less than 0.1 LCF; and
- Maximally exposed worker: less than 0.09 LCF.

Compared to the analysis in the SEIS-II, these changes are not significant, as the potential consequences, for example would remain low. Table 4 depicts this information in a tabular manner.

Table 4. SA Proposed Action versus SEIS-II for Change in Dose Conversion Factor

	Proposed Action in this SA (LCF)	SEIS-II (LCF)
Public population surrounding WIPP	0.4	0.3
Public MEI	0.1	0.08
Maximally exposed worker	0.09	0.06

Source: Derived from DOE 1997.

3.3.4 Population Changes

Since publication of SEIS-II, the population in the ROI has increased by approximately 23 percent (see Section 2.6.1). This change would have a proportional effect on the public population dose presented in the SEIS-II. In this instance, an increase in the ROI population of

23 percent would result in an increase of the potential impacts to the population identified in the SEIS II from 0.3 LCF to 0.4 LCF.

3.3.5 Intentional Destructive Acts

The potential impacts of intentional destructive acts (i.e., acts of sabotage or terrorism) would be no greater than the impacts of an accident as analyzed in SEIS-II and the 2009 SA because the initiating forces and resulting quantities of radioactive or hazardous materials potentially released by an intentional destructive act would be similar to those for the severe accident scenarios as discussed in SEIS-II and the 2009 SA; intentional destructive and accident scenarios both involve the same containers with the same radionuclide loadings.

3.4 Transportation

In Fiscal Year 2013, 769 TRU waste shipments were sent to WIPP (DOE 2013b). Shipping rates for the next five years have not been formally established. However, the shipping rates will be lower than the 2013 shipping rate. SEIS-II analyzed the number of truck shipments to WIPP and presented that information in Table 5-4, "Number of Truck Shipments to WIPP for the Proposed Action." As shown in that table, over the 35-year WIPP lifetime, DOE estimated a total of 37,723 TRU waste shipments to WIPP (29,766 shipments of CH-TRU waste and 7,957 shipments of RH-TRU waste). This equates to an average of 1,078 annual shipments of TRU waste to WIPP.

The 2009 SA updated the WIPP transportation analyses to account for an updated RADTRAN code, population changes, dose conversion changes, and changes in the number of waste shipments. As explained below, the results of the 2009 SA, which are incorporated by reference into this SA, document the fact that there were no significant new circumstances or information relevant to environmental concerns and bearing on the proposals analyzed in SEIS-II or the impacts of those proposals (DOE 2009).

While, the annual number of TRU waste shipments over the next five years is expected to be less than the SEIS-II projections, the overall quantity of TRU waste to be disposed of at WIPP would not change compared to prior WIPP analyses. As such, over the WIPP lifetime, the amount of transportation and the associated impacts presented in SEIS-II and the 2009 SA would not be significantly different as a result of the Proposed Action addressed in this SA.

3.4.1 Change in the Dose Conversion Factor

The SEIS-II Table 5-7, "Aggregate Accident-Free Population Radiological Impacts from Truck Transportation for the Proposed Action," presented the potential impacts to workers and the public from transportation of TRU waste to WIPP. The impacts were as follows (DOE 1997):

- Transportation workers: 0.3 LCF;
- Population along transportation routes: 3 LCFs.

Using this higher conversion factor compared to the factors used in SEIS-II (see Section 2.7.2 of this SA) would increase the potential radiological impacts that were presented in SEIS-II by 50 percent for workers and 20 percent for the public. Impacts would be as follows:

- Transportation workers: 0.5 LCF;
- Population along transportation routes: 3.6 LCFs.

These potential impacts are not significantly different than the impacts presented in SEIS-II.

3.4.2 Population Changes

As discussed in Section 2.6.1, the population in the United States is 29 percent larger than the 1990 population data used in SEIS-II. Based on an assumed 29-percent increase along the TRU waste transportation routes, annual doses to the public would be expected to increase by 29 percent. For the same amount of transportation as analyzed in SEIS-II, the impacts to the population along the transportation routes would increase from 3 LCFs to 3.9 LCFs. These potential impacts are not significantly different than the impacts presented in SEIS-II.

In addition, there have been no notable changes in the transportation packages that would have a bearing on health and safety impacts (e.g., source terms, external dose rates). The reissuance of the Certificates of Compliance for Type B packages by the U.S. Nuclear Regulatory Commission confirms that the packaging continues to meet the applicable requirements of 10 CFR 71.51 (DOE 2016b).

The additional offsite shipments of low-level radioactive waste and hazardous solid waste (as identified in Section 2.5) to licensed facilities would constitute an extremely small contribution to the overall transportation program and would not significantly contribute to transportation impacts.

3.5 Air Quality

CEQ's *Final Guidance on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews* (CEQ 2016) recommends that agencies quantify a proposed action's projected direct and indirect GHG emissions, and use these emissions as a proxy for assessing potential climate change effects. The WIPP comprehensive GHG inventory reported emitting 17,832 metric tons of CO_2 equivalent in FY 2013 (DOE 2014h) and approximately 14,500 metric tons of CO_2 equivalent for FY 2014 (DOE 2015d).

In accordance with Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management," and Executive Order 13514, "Federal Leadership in Environmental, Energy, and Economic Performance," DOE has made reduction of GHG emissions a priority. DOE's *2015 Strategic Sustainability Performance Plan* commits the agency to reduce by Fiscal Year 2025 Scope 1 and 2 emissions by 50 percent and Scope 3 emissions by 25 percent from a Fiscal Year 2008 baseline (DOE 2015e).

The WIPP comprehensive GHG inventory (Figure 3) reveals that the largest contributors to the WIPP GHG footprint are electricity use (Scope 2) and business travel and employee commute to the WIPP site (Scope 3) (DOE 2015d).

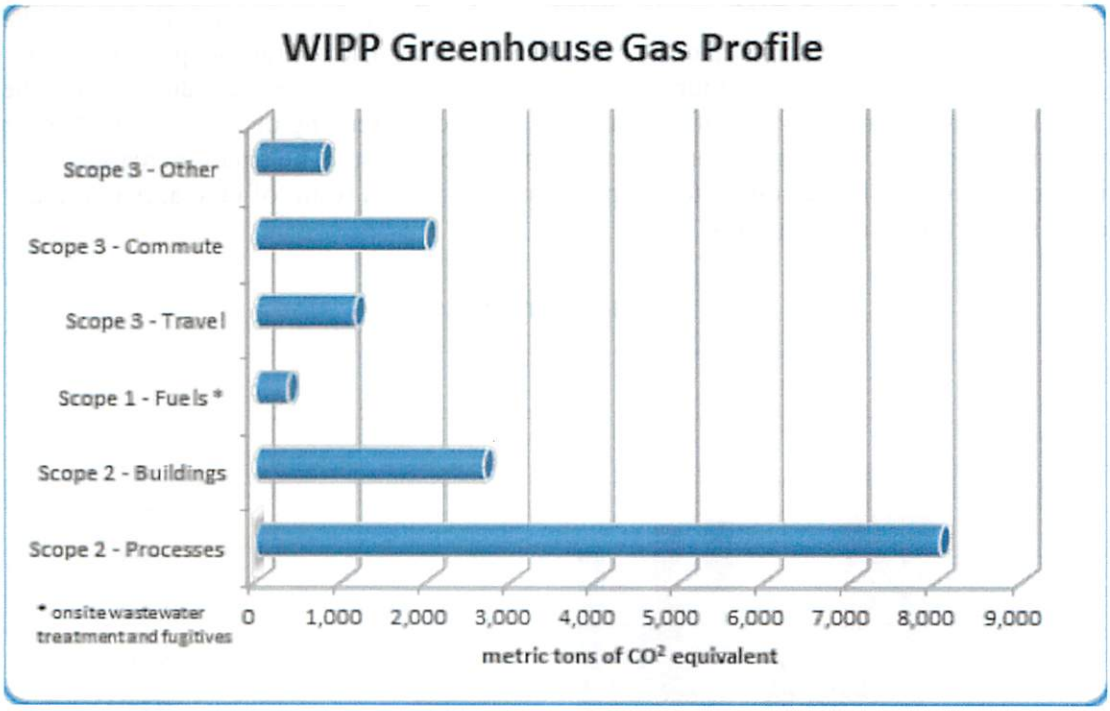


Figure 3. WIPP Project Greenhouse Profile (Source: DOE 2015d)

Given the profile, the priority for GHG reduction at the WIPP is electricity use, with secondary emphasis on business travel and petroleum fuel use. Figure 4 illustrates the progress in reducing Scope 1 and Scope 2 GHG emissions.

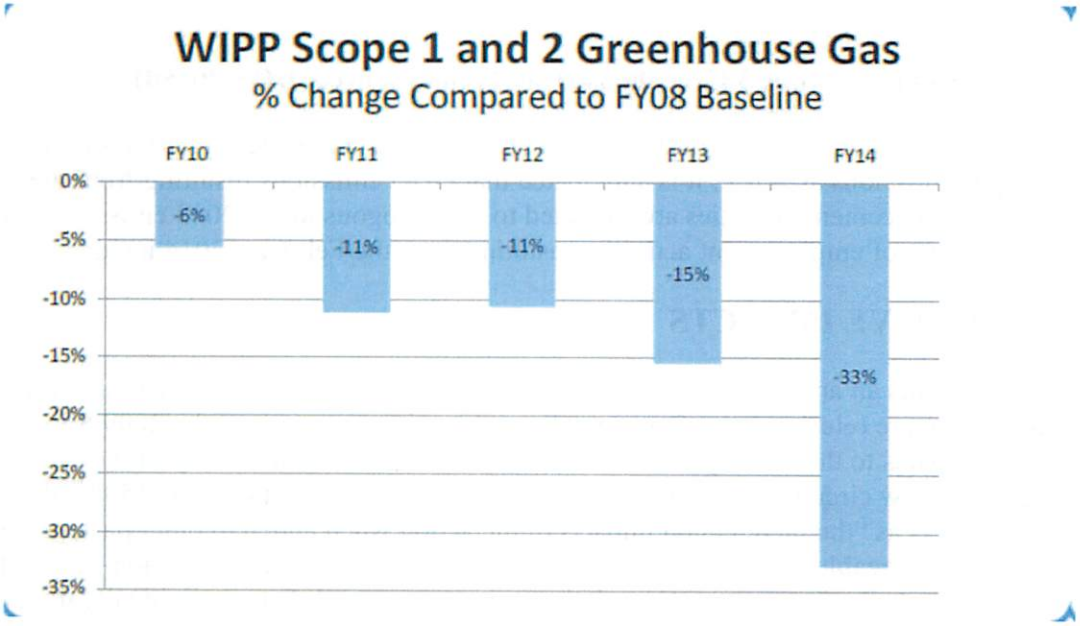
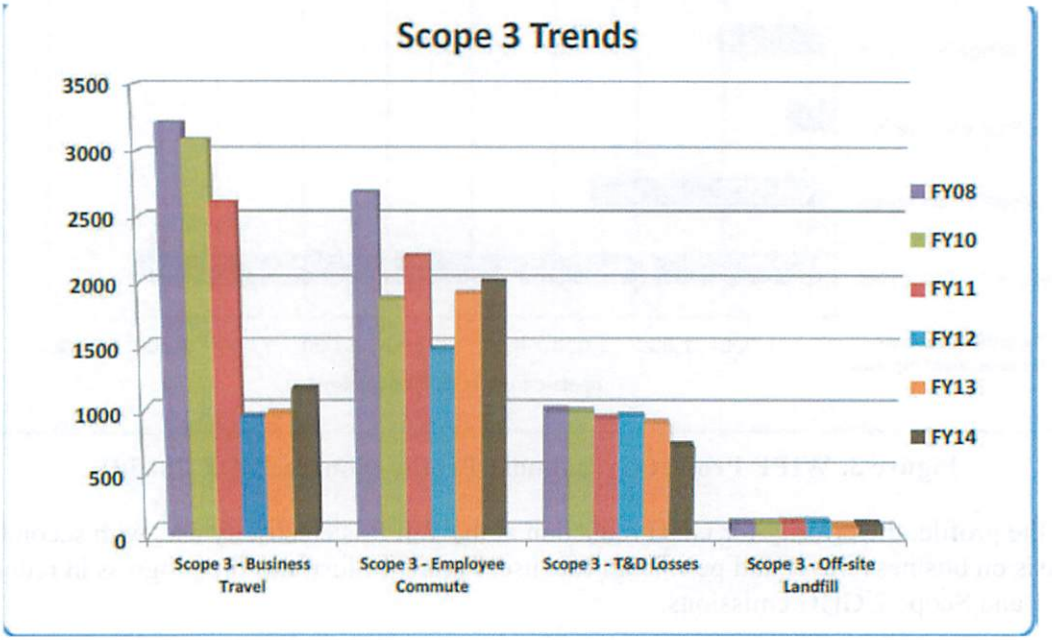


Figure 4. Scope 1 and 2 Greenhouse Emission Trend (Source: DOE 2015d)

Figure 5 presents the Scope 3 GHG trend at WIPP. As that figure demonstrates, Scope 3 GHG emissions continue to decrease compared to the 2008 baseline. The overall Scope 3 reduction in 2014 was 44 percent, a significant improvement from baseline levels. These reductions resulted from personnel increasing their use of options such as teleconferencing or webcasting. Another contributing reason was the suspension of emplacement operations. The small increases in business travel and employee commute compared to 2013 were a result of increases in travel needed to support recovery activities.



T&D: transmission and distribution

Figure 5. Scope 3 Greenhouse Gas Trend (Source: DOE 2015d)

Taking into consideration the changes discussed in Chapter 2 and the ongoing efforts to reduce greenhouse gas emissions at WIPP, it is anticipated that GHG emissions resulting from the resumption of emplacement activities are expected to be analogous to FY 2013 emissions (*i.e.*, before the cessation of emplacement activities resulting from the February 2014 incidents).

4 CUMULATIVE IMPACTS

This chapter presents an analysis of the cumulative impacts resulting from changes and new circumstances that are relevant to environmental concerns since issuance of the 2009 SA, and compares the impacts to those analyzed in the 1997 SEIS-II to determine if any of the changes are substantial or new circumstances are significant. CEQ regulations at 40 CFR 1508.7 define cumulative impacts as "the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

Past and present actions at WIPP are represented in the description of the Proposed Action discussed in this document in the preceding chapters and in the numerous NEPA analyses referenced herein. This chapter accordingly focuses on reasonably foreseeable future actions that could contribute to cumulative impacts within the same geographic and temporal space as the Proposed Action.

This section identifies additional past, present, and reasonably foreseeable future actions and the updated resource area impacts identified in this SA (Chapter 3) and provides an assessment of potential cumulative impacts resulting from continued site-wide and transportation operations at WIPP.

4.1 New Activities Considered for Cumulative Impacts

DOE evaluated the DSA and consulted other planning documents to identify past, present, and reasonably foreseeable actions that were being implemented or planned for the same geographical area and temporal space as the Proposed Action. The actions identified include those that would support the resumption of a pre-2014 receipt rate for TRU waste. They also include actions that could be implemented to improve the operational flexibility of WIPP. These WIPP-related actions are not part of the Proposed Action because they are in the preliminary planning stages. The following paragraphs describe those actions that DOE has identified as possibly having a bearing on potential cumulative impacts.

4.1.1 Permanent Ventilation System

As a result of the February 2014 events (Section 2.1), the existing ventilation system is being operated in its HEPA filtration mode. Operating the system in this mode cannot provide the UG with sufficient air to support simultaneous mining and waste emplacement operations. DOE has begun implementing a three-phase ventilation system upgrade to support increased UG operations. The first phase, the IVS, is already operational. The second phase is the addition of the SVS. These first two phases were identified in Section 2.3 and included in the discussion of impacts in Chapter 3. The third phase of the ventilation upgrade includes construction and installation of a new PVS. The PVS would support simultaneous mine maintenance, mining, and waste emplacement operations. The PVS would consist of the Safety Significant Confinement Ventilation System project (15-D-411) and the Exhaust Shaft project (15-D-412) (DOE 2015). The Safety Significant Confinement Ventilation System project would include a new filter building on the surface and the Exhaust Shaft project would require the design and mining of a new 2,150-foot vertical exhaust shaft and two new horizontal drifts to the WIPP UG. The project would also include an emergency diesel generator to provide backup power.

The PVS is expected to be operational in the 2021 timeframe and will be the subject of a project-specific NEPA evaluation.

4.1.2 Above Ground Storage Capability

DOE has proposed to develop additional storage capacity as part of the surface facilities at WIPP. The purpose of the Above Ground Storage Capability (AGSC) project is to develop an onsite surface storage capability. The AGSC would have the capability to store 42,000 cubic feet

of TRU waste shipments from generator sites on the surface at WIPP for a period of up to one year to accommodate planned and unplanned outages or transportation schedule interruptions. The AGSC project would support:

- An increase in the number of weeks during the year in which TRU waste shipments can be received at WIPP (subject to inclement weather);
- Continued TRU waste receipt during normal operational fluctuations including mining operations (until PVS is installed), short-term planned and unplanned maintenance outages and transportation interruptions;

Temporary storage of TRU waste at the AGSC would be accomplished through engineered concrete overpacks placed on or in an outdoor concrete storage area. The AGSC is scheduled for construction within the next year and will be the subject of a project-specific NEPA evaluation.

4.2 Potential Environmental Impacts of the Reasonably Foreseeable Future Actions

Table 5 presents a qualitative estimate of the potential environmental impacts that could be associated from the reasonably foreseeable future actions identified in Section 4.2.

Table 5. Reasonably Foreseeable Future Actions at WIPP

Resource Area	Potential Impacts by Activity	
	Permanent Ventilation System	**Above Ground Storage Capacity**
Land Use, Visual Resources, and Biotic Resources	Ground disturbance. No notable change to aesthetics. Potential impacts to species, individuals, or habitat unlikely. Salt mined from new horizontal and vertical shafts would be handled in the same manner as other salt mined from WIPP.	Minor additional disturbance on an already disturbed area within an industrial environment. No notable change to aesthetics. Potential minor disturbance of fauna during construction activities. Minimal impact to habitat (depending on final location)
Cultural Resources	Ground disturbance. Surveys would be conducted prior to construction activities should they include previously unsurveyed areas.	Potential additional disturbance of an already disturbed area within an industrial environment. Surveys would be conducted prior to construction activities should they include previously unsurveyed areas.
Waste Management	Minor, industrial waste from construction. No radiological wastes anticipated.	Minor, industrial waste from construction. No radiological wastes anticipated.
Transportation	Minor increases of temporary construction traffic	Minor increases of temporary construction traffic
Water	No increase in water usage; no discharges.	No increase in water usage; no discharges.

Resource Area	Potential Impacts by Activity	
	Permanent Ventilation System	**Above Ground Storage Capacity**
Air	No change to National Ambient Air Quality Standards emissions under routine operations, although a new backup power generator to provide emergency power is included in the proposal.	No change to National Ambient Air Quality Standards emissions.
Socioeconomics	No change in workforce.	No change in workforce.
Human Health	Additional industrial safety hazards during construction. Increased ventilation would benefit human health.	Additional industrial safety hazards during construction. Increased worker exposure during operations.
Facility Accidents	Addition of the PVS would increase ventilation and ability of WIPP workers to respond to UG accidents.	Types of accidents would be similar to those evaluated for existing above ground storage.
Environmental Justice	No significant impacts expected, therefore no significant or disproportionate impact to low-income and minority populations.	No significant impacts expected, therefore no significant or disproportionate impact to low-income and minority populations.

4.3 Cumulative Impacts

The resource areas evaluated in more detail in Chapter 3 of this SA include human health, accidents and industrial safety, transportation, and air quality. The differences in the implementation of the Proposed Action and changes in the affected environment (as identified in Chapter 2) did not significantly alter the potential impacts identified in the SEIS-II for the other resource areas. The reasonably foreseeable future actions identified in Table 5 have the potential to add incremental impacts to the following resource areas: land use and cultural resources (for additional land disturbance) and human health.

The following paragraphs discuss the potential cumulative impacts for land use, cultural resources, and human health, accidents and industrial safety.

4.3.1 Cumulative Impacts from Land Disturbance Activities

The construction of the PVS would include the construction of a new vertical exhaust shaft and new horizontal drifts to connect with the WIPP UG. It would also include a new filter building on the surface. Construction of the AGSC would also involve a new surface facility, although its location would likely be in an area that has already been disturbed. All of the construction would occur within the LWA on land that is already controlled by DOE. The surface disturbing activities are expected to result in fugitive dust from grading, drilling, and mining; diesel emissions from heavy equipment, emergency diesel generators, and drilling. These impacts are typical of industrial mining sites in general and to the WIPP facility in particular and would not represent a significant contribution to the existing impacts at the WIPP site.

4.3.2 Cumulative Impacts to Human Health, Accidents, and Industrial Safety

The construction of the upgraded ventilation systems and AGSC would temporarily increase the construction workforce at WIPP. Considering that these projects would be unlikely to increase the workforce over the long term beyond the assumptions in the SEIS-II, there would be no additional non-radiological impacts to workers that were not already identified and considered in SEIS-II.

The system would have two circuits by which air is routed in the WIPP UG. The construction circuit of the ventilation system routes the air through areas of the UG where maintenance and construction activities occur. These areas include ventilation and access drifts, utility rooms, shops, and alcoves. The construction circuit does not include waste disposal panels or rooms where TRU waste is present.

The disposal circuit of the ventilation system routes the air to the area of the underground where the TRU waste disposal panels are situated. The ventilation air is routed to the appropriate areas through a system of bulkheads and ventilation overcasts (air bridges to permit one airway to pass over another without mixing). CAMs are placed at strategic locations to detect airborne radiation. In the event of a TRU waste container breach, CAMs alert the Central Monitoring Room to take appropriate action to protect the workers and the public. The exhaust shaft ventilation ductwork is equipped with HEPA filters to prevent airborne radioactive particles (e.g., alpha and beta particles) from reaching the accessible environment. Because of the way the underground ventilation system is segregated and operated, construction and operation of the upgraded ventilation system would not contribute to worker or offsite radiological consequences. Rather, it would enhance protection of the workforce, members of the public, and the environment from potential accidental radiological releases.

The construction of an AGSC would not involve radiological material. Operation of the AGSC would be similar to existing receipt, staging, inspection and monitoring, and eventual placement operations. The additional waste package handling in the AGSC would likely increase the total collective worker dose but would be unlikely to impact the maximally exposed worker since workers would operate the AGSC under the same processes and administrative controls currently in place for operations of the WHB. The design of the AGSC would ensure that its operations would not have any health impact to the offsite public.

5 DETERMINATION

DOE prepared this SA in accordance with 10 CFR 1021.330(d) and 10 CFR 1021.314, to evaluate the Proposed Action to resume and continue the transportation of waste to WIPP by truck and the operation of the WIPP for the disposal of TRU waste generated by atomic energy defense activities. Based on the analysis in this SA, DOE's Proposed Action does not represent substantial changes to either the SEIS-II or 2009 SA that are relevant to environmental concerns, and there are no significant new circumstances or information relevant to environmental concerns and bearing on the Proposed Action or its environmental impacts. DOE has therefore determined that no further NEPA documentation is required.

Approved: December 21, 2016

Todd A. Shrader, Manager
U.S. Department of Energy Carlsbad Field Office

Concurrence:

Myles Hall, Legal Counsel
U.S. Department of Energy Carlsbad Field Office

6 REFERENCES

10 CFR Part 61. "Licensing Requirements for Land Disposal of Radioactive Waste." *Energy*. U.S. Regulatory Commission. http://www.ecfr.gov/cgi-bin/text-idx?SID=5a899ae148aa1c9d7378b73b2161018a&mc=true&node=pt10.2.61&rgn=div5.

10 CFR 71.51. "Additional requirements for Type B packages." Packaging and Transportation of Radioactive Material. *Energy*. U.S. Nuclear Regulatory Commission. http://www.ecfr.gov/cgi-bin/text-idx?SID=5a899ae148aa1c9d7378b73b2161018a&mc=true&node=pt10.2.71&rgn=div5#se10.2.71_151.

10 CFR Part 835. "Occupational Radiation Protection." *Energy*. U.S. Department of Energy. http://www.ecfr.gov/cgi-bin/text-idx?SID=5a899ae148aa1c9d7378b73b2161018a&mc=true&node=pt10.4.835&rgn=div5.

10 CFR Part 1021, "National Environmental Policy Act Implementing Procedures." *Energy*. U.S. Department Energy. http://www.ecfr.gov/cgi-bin/text-idx?SID=5a899ae148aa1c9d7378b73b2161018a&mc=true&node=pt10.4.1021&rgn=div5.

40 CFR 761.50. "Applicability." Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions. *Protection of Environment*. U.S. Environmental Protection Agency. http://www.ecfr.gov/cgi-bin/text-idx?SID=304d40f4ecdaf01b355c6b06a2bf0b82&mc=true&node=pt40.34.761&rgn=div5#se40.34.761_150.

40 CFR 761.61. "PCB Remediation Waste." Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions. *Protection of Environment*. U.S. Environmental Protection Agency. http://www.ecfr.gov/cgi-bin/text-idx?SID=304d40f4ecdaf01b355c6b06a2bf0b82&mc=true&node=pt40.34.761&rgn=div5#se40.34.761_161.

40 CFR 194.33. "Consideration of Drilling Events in Performance Assessments." Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations. *Protection of Environment*. Http://Www.Ecfr.Gov/Cgi-Bin/Text-Idx?Sid=0d5a2e1daf51c0a4efe96fe419014036&Mc=True&Node=Pt40.27.194&Rgn=Div5#Se40.27.194_133

40 CFR Part 1500. "Purpose, Policy, and Mandate." *Protection of Environment*. Council on Environmental Quality. http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1500&rgn=div5.

40 CFR Part 1501. "NEPA and Agency Planning." *Protection of Environment*. Council on Environmental Quality. http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1501&rgn=div5.

40 CFR Part 1502. "Environmental Impact Statement." *Protection of Environment*. Council on Environmental Quality. http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1502&rgn=div5.

40 CFR Part 1503. "Commenting." *Protection of Environment*. Council on Environmental Quality. http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1503&rgn=div5.

40 CFR Part 1504. "Predecision Referrals to the Council of Proposed Federal Actions Determined to be Environmentally Unsatisfactory." *Protection of Environment*. Council on Environmental Quality. http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1504&rgn=div5.

40 CFR Part 1505. "NEPA and Agency Decisionmaking." *Protection of Environment*. Council on Environmental Quality. http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1505&rgn=div5.

40 CFR Part 1506. "Other Requirements of NEPA." *Protection of Environment*. Council on Environmental Quality. http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1506&rgn=div5.

40 CFR Part 1507. "Agency Compliance." *Protection of Environment*. Council on Environmental Quality. http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1507&rgn=div5.

40 CFR Part 1508. "Terminology and Index." *Protection of Environment*. Council on Environmental Quality. http://www.ecfr.gov/cgi-bin/text-idx?SID=304d40f4ecdaf01b355c6b06a2bf0b82&mc=true&node=pt40.37.1508&rgn=div5.

46 FR 9162. January 28, 1981. "Waste Isolation Pilot Project Record of Decision." U.S. Department of Energy.

55 FR 25689. June 22, 1990. "Record of Decision for the Waste Isolation Pilot Plant." U.S. Department of Energy.

63 FR 3624, January 23, 1998. "Record of Decision for the Department of Energy's Waste Isolation Pilot Plant Disposal Phase." Record of Decision. U.S. Department of Energy. https://www.gpo.gov/fdsys/pkg/FR-1998-01-23/pdf/98-1653.pdf#page=1.

63 FR 35384, June 29, 1998. "Disposal of Polychlorinated Biphenyls (PCBs). Final Rule. Environmental Protection Agency. https://www.gpo.gov/fdsys/pkg/FR-1998-06-29/pdf/98-17048.pdf#page=1.

69 FR 39456, June 30, 2004. "Revision to the Record of Decision for the Department of Energy's Waste Isolation Pilot Plant Disposal Phase." Revision to Record of Decision. Department of Energy. https://www.gpo.gov/fdsys/pkg/FR-2004-06-30/pdf/04-14808.pdf#page=1.

81 FR 19588, April 5, 2016. "Surplus Plutonium Disposition. Record of Decision." National Nuclear Security Administration, U.S. Department of Energy. https://www.gpo.gov/fdsys/pkg/FR-2016-04-05/pdf/2016-07738.pdf#page=1.

Borgstrom, C. 2006. Memorandum. *Need to Consider Intentional Destructive Acts in NEPA Documents*. December 1.

CEQ (Council on Environmental Quality) 2016. "Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Review." Memorandum from C. Goldfuss, Council on Environmental Quality, to Heads of Federal Departments and Agencies. August 1. https://www.energy.gov/sites/prod/files/2016/08/f33/nepa_final_ghg_guidance.pdf

DHS (U.S. Department of Homeland Security) 2008. *National Incident Management System.* December. https://www.fema.gov/pdf/emergency/nims/NIMS_core.pdf. Accessed on December 16, 2016.

DOE Order 420.1C (Change 1, February 27, 2015). "Facility Safety." https://www.directives.doe.gov/directives-documents/400-series/0420.1-BOrder-C-chg1.

DOE-STD-1128-2008. *Guide of Good Practices for Occupational Radiological Protection in Plutonium Facilities*. https://energy.gov/sites/prod/files/2013/09/f2/DOE-STD-1128-2008.pdf

DOE (U.S. Department of Energy) 1980. *Waste Isolation Pilot Plant Final Environmental Impact Statement.* DOE/EIS-0026. October.

——— 1990. *Supplement Environmental Impact Statement for the Waste Isolation Pilot Plant.* DOE/EIS-0026-FS. January.

——— 1997. *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement Eddy County, near Carlsbad, New Mexico.* DOE/EIS-0026-S2. September.

——— 2000. *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility*. DOE/EIS-0310. December. http://energy.gov/nepa/eis-0310-accomplishing-expanded-civilian-nuclear-energy-research-and-development-and-isotope

——— 2002. *Recommendations for Accident Analyses under the National Environmental Policy Act*. July. http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-DOE-AccidentAnalysis.pdf

——— 2004a. *Supplement Analysis for Disposal of Polychlorinated Biphenyl-Commingled Transuranic Waste at the Waste Isolation Pilot Plant.* DOE/EIS-0026-SA-02. June.

——— 2004b. *Waste Isolation Pilot Plant Land Management Plan*. DOE/WIPP 93-004. June 21. http://www.wipp.energy.gov/information_repository/Information_Repository_A/Supplemental_Information/DOE%202004.pdf.

——— 2005a. *Recommendations for the Supplement Analysis Process.* Office of NEPA Policy and Compliance. July. http://energy.gov/sites/prod/files/2013/10/f4/Recommendations_for_the_supplement_analysis_process.pdf.

——— 2005b. *Supplement Analysis for the Waste Isolation Pilot Plant Site-Wide Operations (*DOE/EIS-0026-SA-05). April.

——— 2009. *Supplement Analysis for the Waste Isolation Pilot Plant Site-Wide Operations* (DOE/EIS-0026-SA-07). May.

——— 2013a. *Final Long-Term Management and Storage of Elemental Mercury Supplemental Environmental Impact Statement.* DOE/EIS-0423-S1. September.

——— 2013b. *TRU Waste Data Report; FY2013; 4th Quarter*. October 15, 2013.

——— 2014a. *Waste Isolation Pilot Plant Recovery Plan,* Revision 0, September 30.

——— 2014b. *Investigation Report, Underground Salt Haul Truck Fire at the Waste Isolation Pilot Plant.* March 13.

——— 2014c. *U.S. Department of Energy Accident Investigation Report, Phase 1, Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014.* April 22.

——— 2014d. "Categorical Exclusion: Installation of an Interim Ventilation System to Support Recovery Actions at the Waste Isolation Pilot Plant." November 17.

——— 2014e. "Categorical Exclusion: Remove and Replace HEPA Filters." July 7.

——— 2014f. *Supplement Analysis for a Proposal to Temporarily Store Defense Transuranic Waste Prior to Disposal at the Waste Isolation Pilot Plant.* DOE/EIS-0026-SA-09. April.

——— 2014g. "February 14th, Contamination Release Consequence Assessment." http://www.wipp.energy.gov/Special/Modeling Results.pdf. March 10.

——— 2014h. *Waste Isolation Pilot Plant Annual Site Environmental Report for 2013*. DOE/WIPP-14-3532. September.

——— 2015a. *U.S. Department of Energy Accident Investigation Report, Phase 2, Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014.* April 16.

——— 2015b. *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement*. DOE/EIS-0283-S2.

——— 2015c. "Categorical Exclusion: Remove and Replace HEPA Filters." February 25.

——— 2015d. *Waste Isolation Pilot Plant Annual Site Environmental Report for 2014*. DOE/WIPP-15-8866. September.

——— 2016a. *Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste*. DOE/EIS-0375.

——— 2016b. "Data Call to Support the Supplement Analysis for the Waste Isolation Pilot Plant Site-Wide Operations." December 12.

Endangered Species Act of 1973. 16 U.S.C. § 1531 et seq. http://uscode.house.gov/view.xhtml?path=/prelim@title16/chapter35&edition=prelim.

EPA (U.S. Environmental Protection Agency) 2003. Letter from C.E. Edlund, Director, Multimedia Planning and Permitting Division, Environmental Protection Agency, to Dr. I. Triay, Manager, DOE Carlsbad Field Office. May 15. http://www.wipp.energy.gov/rcradox/final/WIPP-EPAapproval05-15-03.pdf

Executive Order 12898, February 11, 1994. "Federal actions to address environmental justice in minority populations and low-income populations." Office of the President 59 FR 7629. http://www.archives.gov/federal-register/executive-orders/pdf/12898.pdf

Executive Order 13423, January 24, 2007. "Strengthening Federal Environmental, Energy, and Transportation Management. Office of the President 72, FR 3919. https://www.gpo.gov/fdsys/pkg/FR-2007-01-26/pdf/07-374.pdf.

Executive Order 13514, October 5, 2009. "Federal Leadership in Environmental, Energy, and Economic Performance." Office of the President 74 FR 52117. https://www.gpo.gov/fdsys/pkg/FR-2009-10-08/pdf/E9-24518.pdf.

Federal Land Policy and Management Act of 1976. Public Law 94-579. https://www.gpo.gov/fdsys/pkg/STATUTE-90/pdf/STATUTE-90-Pg2743.pdf.

GAO (General Accounting Office) 2016. *Nuclear Waste: Waste Isolation Pilot Plant Recovery Demonstrates Cost and Schedule Requirements Needed for DOE Cleanup Operations*. GAO-16-608. August 4. http://www.gao.gov/assets/680/678858.pdf

ISCORS (Interagency Steering Committee on Radiation Standards) 2002. *A Method for Estimating Radiation Risk from Total Effective Dose Equivalent (TEDE)*. ISCORS Technical Report 2002-02, Final Report." Washington, D.C. http://www.iscors.org/doc/RiskTEDE.pdf.

National Environmental Policy Act of 1969. 42 U.S.C. § 4321 et seq. http://uscode.house.gov/view.xhtml?path=/prelim@title42/chapter55&edition=prelim

NMED (State of New Mexico Environment Department) 2016. *NMED Inspection Waste Isolation Pilot Plant EPA ID# NM4890139088.* Letter from K. Roberts, Director of

Resource Protection Division, to T.A. Shrader, Manager Carlsbad Field Office Department of Energy. December 16.

NWP (Nuclear Waste Partnership LLC) 2016. *Waste Isolation Pilot Plant Documented Safety Analysis.* April 2016.

Resource Conservation and Recovery Act of 1976. 42 U.S.C. § 6901, et seq. http://uscode.house.gov/view.xhtml?path=/prelim@title42/chapter82&edition=prelim.

SNL (Sandia National Laboratories) 2013. *Analysis Package for 2013 Polychlorinated Biphenyl (PCB) Risk Analysis*. October.

Toxic Substances Control Act. 15 U.S.C. § 2601 et seq. http://uscode.house.gov/view.xhtml?path=/prelim@title15/chapter53&edition=prelim

U.S. Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980. Public Law 96-164. https://www.gpo.gov/fdsys/pkg/STATUTE-93/pdf/STATUTE-93-Pg1259.pdf

USCB (U.S. Census Bureau) 2014. *Poverty Thresholds by Size of Family and Number of Related Children Under 18 Years*. http://www.census.gov/.

——— 2016a. "Total Population, American Community Survey 5-Year Estimates." Table B01003. https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

——— 2016b. "U.S. Census Quick Facts." https://www.census.gov/quickfacts/table/PST045215/00.

——— 2016c. "Poverty Status of Individuals in the Past 12 Months by Living Arrangement, 2006-2010 American Community Survey, 5-Year Estimates, New Mexico." Table B17021. https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

Waste Isolation Pilot Plant Land Withdrawal Act of 1992 (LWA). Public Law 102-579. http://wipp.energy.gov/library/CRA/BaselineTool/Documents/Regulatory%20Tools/10%20WIPPLWA1996.pdf