DEFENSE NUCLEAR FACILITIES SAFETY BOARD
Washington, DC 20004-2901

February 19, 2016

The Honorable Monica Regalbuto
Assistant Secretary for Environmental Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0113

Dear Dr. Regalbuto:

The Defense Nuclear Facilities Safety Board (Board) issues project letters in conjunction with critical decisions for major modifications of Department of Energy (DOE) defense nuclear facilities. This project letter is for Critical Decision 1, *Approve Alternative Selection and Cost Range*, for the Underground Ventilation System (UVS) at the Waste Isolation Pilot Plant. The enclosure, provided for your information and use, documents the results of our staff's review of the safety design strategy and supporting technical documents. The new UVS will have a much larger capacity for filtering air from the underground waste storage area than the currently employed system. Additionally, the design includes an option that allows for an unfiltered pathway from the waste disposal area that automatically switches to high efficiency particulate air filtration upon detection of airborne radioactive contaminants. UVS mechanical components exposed to the harsh environment created by the exhaust from the underground are prone to material degradation, as explained in DOE's Accident Investigation Report, *Phase 1, Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014*. The enclosure describes potential safety issues with this option due to reliability concerns when the UVS is required to change mode to active confinement ventilation for the waste disposal area. We will continue monitoring the integration of safety into the UVS design to ensure adequate protection of the public and workers.

Sincerely,

Joyce L. Connery
Chairman

Enclosure

c: Mr. Joe Olencz

ENCLOSURE

Summary of the Underground Ventilation System Project and Related Observations

Project Summary. On December 23, 2015, the Department of Energy (DOE) approved the Critical Decision (CD)-1, *Approve Alternative Selection and Cost Range*, milestone for the Underground Ventilation System (UVS) Project at the Waste Isolation Pilot Plant (WIPP). The UVS will play a critical role in restoring WIPP to an operational status necessary for DOE to meet its legislative and regulatory requirements for transuranic waste disposition. At CD-1, DOE has elected to proceed with a design alternative that provides a new unfiltered exhaust shaft for mining operations and uses the existing exhaust shaft with additional high-efficiency particulate air (HEPA) filtration capacity for waste disposal operations. The anticipated safety classification of the UVS is safety significant.

WIPP Confinement Strategy. Nuclear facility design requirements in DOE Order 420.1C, *Facility Safety*, specify that nuclear facility designs must include multiple layers of protection to prevent or mitigate the unintended release of radioactive materials into the environment. WIPP Waste Acceptance Criteria (WAC) compliant containers provide the primary confinement barrier for the hazardous radioactive wastes stored within the WIPP underground. Revision 5 of the WIPP Documented Safety Analysis (DSA), which is now in draft form undergoing DOE review, will describe key safety attributes of the WIPP WAC compliant containers. As a second barrier, the UVS provides active confinement in the event that there is an airborne release of radioactively contaminated material from the underground waste disposal area. The new UVS will have a much larger capacity for filtering air from the underground waste storage area than the currently employed system. Additionally, the design includes an option that allows for an unfiltered pathway from the waste disposal area that automatically switches to high efficiency particulate air filtration upon detection of airborne radioactive contaminants. The decision with regard to keeping the bypass option as part of the design will be made during the preliminary design phase. If a natural phenomenon hazards event compromises the operability of the UVS, WIPP operations would be suspended and covers over the facility's shafts would be employed to limit air exchange between the underground and the outside environment until the UVS could be restored. The action to cover the facility's shafts is consistent with current practice.

UVS Conceptual Design. The UVS conceptual design uses two ventilation zones, one for the mining operations and experimental areas (clean) that do not involve radiological materials and another for waste disposal operations (potentially contaminated) involving hazard category 2 quantities of radionuclides. As shown in Figure 1, new supply air fans will draw air into the underground from the existing air intake and salt handling shafts, and bulkheads and dampers will segregate the clean and potentially contaminated zones. The supply air fans can move 257,000 actual cubic feet per minute (ACFM) of air through the clean zone that exits the underground unfiltered through a newly constructed exhaust shaft. The potentially contaminated zone uses fans in a new filter building to draw air through the waste disposal area and the existing contaminated exhaust shaft at a flow rate of 283,000 ACFM. This push/pull arrangement between the clean and potentially contaminated zones ensures that air leakage

between zones would preferentially flow into the potentially contaminated zone that provides HEPA filtration of the air before exhausting it to the environment. As will be discussed in further detail below, this configuration allows for a bypass of the HEPA filters. Exhaust from the potentially contaminated zone will be redirected from the bypass though the HEPA filters when detected airborne contamination exceeds a yet to be determined threshold.

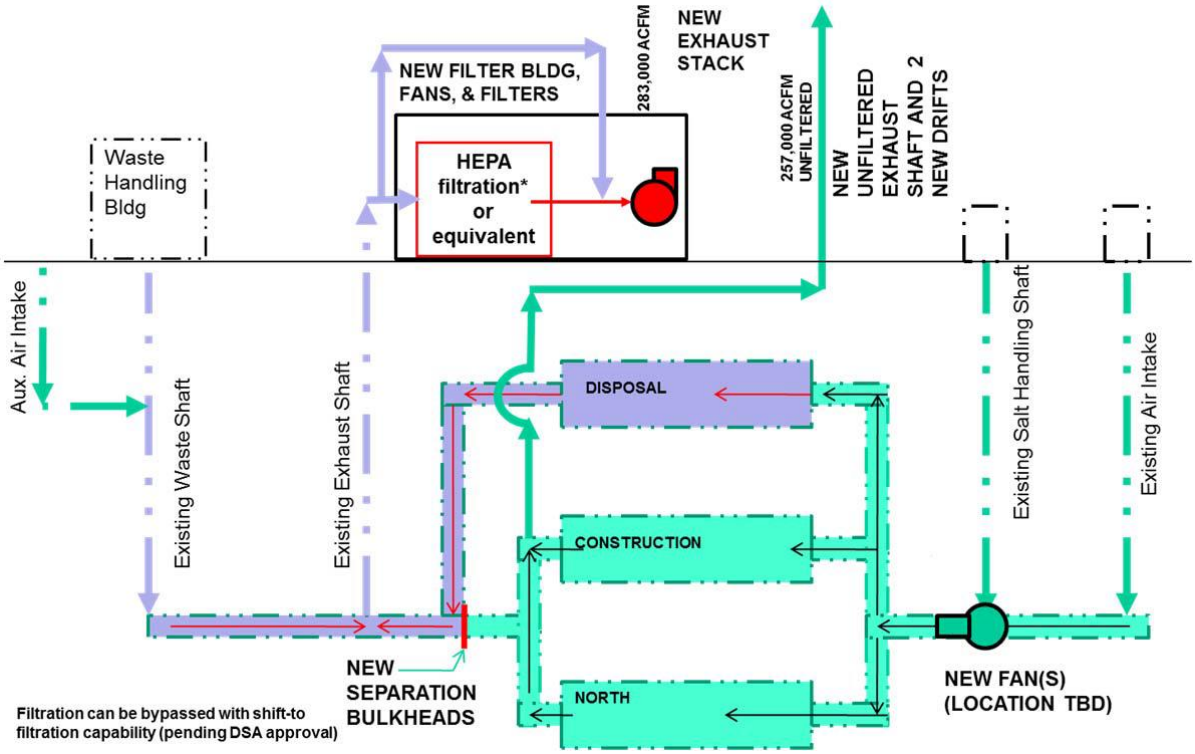

Figure 1. Two Zone Underground Ventilation System (purple is potentially contaminated, cyan is clean). Source: WIPP-UVS-CDR-0036, *Safety Design Strategy for the Waste Isolation Pilot Plant Underground Ventilation System (UVS) Project Implementing Line Items 15-D-411, Safety Significant Confinement & Ventilation System 15-D-412, Exhaust Shaft,* Revision 3.6

Observations and Project Responses. Members of the Board's staff reviewed the project's implementation of the requirements and guidance for content of safety documents as provided in DOE Standard 1189-2008, *Integration of Safety into the Design Process*, and the identification of applicable design criteria related to nuclear safety, fire protection, and relevant natural phenomena hazards as specified by DOE Order 420.1C, *Facility Safety*. The Board's staff review of the conceptual design was focused on the project's Safety Design Strategy, Conceptual Safety Design Report (CSDR), and supporting technical documents. The Board's review team observations and project personnel responses are provided below.

Confinement Strategy Observations—The Board's review team identified a concern regarding potential reliability issues of the bypass switch to confinement capability on the detection of airborne radioactive material in the potentially contaminated zone. The CSDR identifies the potential for re-suspension of contaminated salts in the existing exhaust shaft and

from salt surfaces in the drifts leading to the existing exhaust shaft. Both normal operations and ventilation transients could cause resuspension of contaminated material. The Board's review team remarked how lessons learned from the DOE Accident Investigation Board (AIB) reports regarding the February 14, 2014, release event bear particular significance on the need for reliable continuous air monitors (CAMs) and leak-tight dampers to assure that the potentially contaminated air is directed through the HEPA filters. Specific design challenges that negatively impact the reliability of the UVS to switch from bypass to filtered modes of operation include:

- Ensuring that CAMs can reliably detect airborne radioactive contaminants while operating in a high airborne particulate environment. These airborne particulates could be the result of routine operations or from fire or other accident scenarios.

- Defining the number and locations of CAMs emplaced throughout the underground may be a complex task. Project documents note that existing drifts and exhaust shaft have the potential for renewed suspension of radioactive material released by the February 14, 2014, event. The location of both the source of the re-suspended radiological material and the CAM that detects the airborne contamination could challenge the expected response times for the UVS to switch from the bypass to filtered mode of operation.

- Qualifying and testing bypass isolation dampers that would be integral to directing flow to the HEPA filters in the event of an airborne release of radioactive contaminants in the underground. The effectiveness of the HEPA filters could be diminished if the high dust and salt content in the exhaust air compromise the sealing capability of the bypass dampers.

Project personnel confirmed that meeting the necessary functional and performance requirements commensurate with safety significant structures, systems, and components (SSCs) related to the bypass function will be further evaluated early in the preliminary design phase of the project. Based on the challenging environmental conditions and past performance of the WIPP CAMs and dampers, the Board's staff believes that testing and qualification of these systems to determine if they can meet their safety functions when called upon might require a technology readiness assessment prior to upcoming CD milestones. DOE currently requires that technology readiness level 7 be achieved at CD-2. The next major milestone is a combined CD-2/3 in fiscal year 2017. If the bypass function is found to be infeasible, project personnel indicated that waste disposal operations will be subject to full-time active confinement ventilation.

Project personnel stated that the reason for including the bypass function was to reduce the frequency of filter changes. While this may be an advantage from an operational efficiency perspective, it comes with the need to employ components to actuate the safety significant UVS HEPA filtration function. Among the safety design guiding-principles in DOE Standard 1189-2008 is the preference of passive SSCs over active SSCs in formulating the control selection strategy to address hazardous material release events. While an active confinement ventilation

system is by its nature an active SSC, active subsystems associated with instrumentation and control could negatively affect the relative reliability of the system.

Fire Mitigation Strategy Observations—As identified in DOE Standard 1189-2008, the fire mitigation strategy may have a significant influence on the confinement strategy. The size of ordinary combustible fires must be defined to size the HEPA filtration system to provide adequate capacity to avoid HEPA filter plugging. A fire event may also adversely impact CAMs, as experienced in the February 5, 2014, fire event. The Board's staff found that design details on both of these considerations are not mature. DOE project personnel responded that DSA Revision 5 and the Fire Hazards Analysis, which are currently being revised, will be used to guide preliminary design concerning these issues. In addition, these documents will address egress issues associated with ventilation system design. DOE personnel stated that the selected alternative is not expected to significantly impact the primary/secondary egress routes, but the routes would be evaluated in context of the new exhaust shaft.

Conclusions. The Board's review team identified potential reliability problems in implementing the switch to active confinement approach for waste disposal operations. As noted above, project personnel acknowledged that this aspect of the design will be evaluated early in the next phase of the project lifecycle. The Board's review team will assess the safety in design as the project develops the preliminary design.

Revised: 04/08/2015 12:20 PM