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Review of the Restart of Unfiltered Ventilation at the Waste Isolation Pilot Plant (WIPP)

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Consortium for Risk Evaluation with Stakeholder Participation (CRESP)

May 28, 2020

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Acknowledgment and Disclaimer

This document was developed and authored by Prof. Kathryn Higley, Oregon State University, Prof. Steve Krahn, Vanderbilt University and Prof. David S. Kosson, Vanderbilt University.

This report is based on work supported by the U. S. Department of Energy, under Cooperative Agreement Number DE-FC01-06EW07053 entitled 'The Consortium for Risk Evaluation with Stakeholder Participation III' awarded to Vanderbilt University. The opinions, findings, conclusions, or recommendations expressed herein are those of the authors and do not necessarily represent the views of the Department of Energy or Vanderbilt University.

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Background: DOE Office of Environmental Management (DOE-EM) is evaluating the temporary (ca. 2 years) use of the 700C exhaust system during operations at WIPP. This would represent a return to unfiltered discharges, but would provide an increased margin for subsurface air quality compliance. The restart of the 700C exhaust system would also provide improved mission efficiency, with the operating constraint that waste emplacement would still require the use of filtered ventilation. As has been the previous standard operating procedure, a return to filtered discharge would be required upon detecting airborne contamination. Use of the 700C exhaust system represents an unfiltered discharge from a Category 2 nuclear facility; therefore, high confidence in WIPP's ability to protect human health and the environment is needed to proceed.

A limited release of radioactive material occurred through the 700C ventilation system at WIPP in February 2014, associated with an energetic reaction in one of the emplaced waste drums. The 700C ventilation system, which has an unfiltered atmospheric discharge, was rapidly shutdown during the event and currently remains out of use. In the aftermath of this event, the facility transitioned to continuous filtering of exhaust ventilation prior to its discharge to the environment. This resulted in decreased airflow through the underground facility. Another action taken following the incident was the design, and ongoing construction, of an augmented filtered ventilation system to improve subsurface airflow rates. This system is scheduled to be completed in about two years. However, in 2019, DOE put in place revised air quality requirements. As a consequence, the current filtered ventilation flow rate lowers the margin available to meet air quality requirements in the underground of WIPP. The limited flow rate also constrains the number of parallel activities that can take place in the underground of the WIPP facility without compromising air quality.

Process: WIPP is proposing short duration tests (first for 4 hours, then for 5 days) of the 700C ventilation system. These tests will be done prior to returning the system to service. The intent is to verify that discharge of residual radioactive materials in the system ductwork, if any occurs, will be less than applicable standards and limits for protection of human health and the environment. If these short duration tests achieve the anticipated results, then the 700C ventilation system would be returned to service for non-waste emplacement operations, following appropriate Readiness Assessments by DOE and its contractor. Future completion of the new filtered ventilation system would result in permanent retirement of the 700C ventilation system.

The Consortium for Risk Evaluation with Stakeholder Participation (CRESP) was requested by DOE-EM and the Carlsbad Field Office (DOE-CBFO) to review 1) the assessment of potential release of radioactive material; 2) the monitoring strategy as part of return to service; and 3) the decision logic associated with resuming limited use of the 700C ventilation system.

CRESP's Analysis: Our assessment is that the situation described presents a benefit-to-risk decision. The following is a brief discussion of benefits, drawbacks, the present WIPP strategy to mitigate the drawbacks, and uncertainties that frame the benefit and risk tradeoffs that surround the restart of unfiltered ventilation at WIPP. We also provide several recommendations for DOE's consideration as it evaluates this decision.

Benefits to Unfiltered Ventilation Restart:

1. Increased Safety Margin to Ensure Subsurface Air Quality Requirements are Met
    a. WIPP monitors air quality underground to ensure personnel safety;
    b. New rules have placed more stringent requirements, particularly on elements of diesel exhaust—most equipment used in the underground is powered by diesels (although some limited electric-powered equipment is available); and,
    c. Re-equipping to all electric-power equipment in the underground is impractical in the short-term.
2. Improved Mission Efficiency
    a. Limiting the operation of diesel-driven equipment in the underground constrains the rate at which:
        i. New salt can be mined;
        ii. Bolting to enhance the stability of ceilings and walls, to assure worker safety, can be accomplished; and,
        iii. TRU waste received on-site can be emplaced.
    b. The above limitations also impact the rate at which other DOE sites can ship TRU waste to WIPP—resulting in:
        i. Extended time periods for TRU waste to be in interim storage configurations at multiple DOE sites; and,
        ii. Potential delays to TRU waste remediation efforts at DOE sites.

Drawbacks to Unfiltered Ventilation Restart:

1. Potential for Release of Contamination During Operations
    a. Short duration testing is intended to provide an initial benchmark of the amount of contamination likely to be released.
    b. Anticipated radionuclide release is expected to be limited, and likely from erosion of salt containing residual contamination from within the exhaust flow path (exhaust shaft, ductwork, and dampers). The amount of residual contamination along the exhaust flow path has been estimated to be small based on limited surface wipe samples within the 700 C ducts, but extensive sampling in the underground leading to the exhaust duct has not been completed (e.g., bottom of subsurface exhaust shaft).
    c. The amount of radionuclides that could be released would be limited to the amount of contamination that was released during the energetic event minus the amount that has been isolated by post-incident site actions.

d. A reasonable best estimate of the amount that may be released during 700C restart is that the amount potentially released is less than the amount that was released through the 700 C system during the February 2014 incident. During the February 2014 incident, radioactive material was dispersed in the subsurface air by an energetic event, transported through the Underground Ventilation System (UVS) ductwork which had automatically switched to filtration mode and was mostly captured by the system HEPA filters with a small amount being discharged through design leakage through two bypass dampers to the system exhaust stack and then to atmosphere above ground. In the current situation, the dampers where the February 2014 release occurred have been sealed off, and residual contamination from previously released radioactive material likely has been incorporated into accumulated salt deposits in the UVS ductwork over the past 6 years. The processes that might release encrusted material include potential erosion or sloughing of salt during increased air flow or bolting operations in affected areas.

2. Potential for Release of Contamination During Facility Upsets
    a. Waste emplacements will not occur during unfiltered ventilation, and therefore these actions are not expected to cause an unfiltered release; however,
    b. A potential concern remains regarding the structural integrity of the 700 C system; the concern results from the increased loads associated with salt accumulation in the ducts and corrosion that may have occurred during the past 6 years. A failure of the structural integrity of the duct system during operation has the potential for an unplanned release of radionuclides trapped within the accumulated salt and coating the ducts.

<u>DOE Strategy to Mitigate Drawbacks to Unfiltered Ventilation Restart</u>:

1. Controlled Test of Unfiltered Ventilation
    a. An initial 4 hour test, followed by monitoring evaluation, and then followed by a 5 day test, followed by a second round of monitoring evaluation are planned prior to a decision to return the 700 C system to limited, routine operation.
    b. The current test plan provides an opportunity, under controlled conditions, to understand the mechanical condition of the 700C ventilation equipment and discern the potential for contamination releases under the return to use of this ventilation system.
    c. At present, estimated contamination levels in discharges are low, and were relatively low even during the release event. Initial estimates by CBFO anticipate the possibility of low-level contamination releases (but not zero). Furthermore, a reasonable approach was taken by CBFO to evaluate the potential for contamination release during restart and the results are consistent with releases observed during the February 2014 event. Although a decline in contamination release would generally be expected as operation continues, salt erosion and sloughing in areas of higher contamination may result in sporadic increases in contamination release. Monitoring for this eventuality includes:
        i. Contamination monitoring at predetermined, representative sites on a specified regular basis; and,

ii. Underground Continuous Air Monitoring Systems (CAMS) and above-ground ventilation monitoring to provide indication of whether any legacy contamination is being disturbed.

d. Test procedures with clear assignment of responsibilities and shutdown criteria.
e. These activities will be integrated with, and executed as part of, a readiness assessment and verification process implemented by DOE and its contractor.

2. The 4-hour controlled test and then the 5-day test (incremental reassessment) will assist in determination of whether:
    a. Remediation of the salt piles in the ventilation ducts, and/or
    b. Application of fixative inside the ducts, or
    c. No action on the salt pile in the ductwork is necessary.
3. Operating requirements will shift to filtered ventilation when emplacing waste (limit on operations)
    a. Observed contamination levels were relatively low, even during the release event, and,
    b. A shift to filtered ventilation also will occur upon detection of higher radiation levels during any operations in the underground; however, the shift is a manual rather than an automated operation.
4. Construction of a high capacity filtered ventilation system
    a. Is in process, and,
    b. Scheduled for switchover to filtered ventilation in 2022

<u>Present Unknowns:</u>

1. The physical process for release of contamination from salt;
2. Precise makeup of salt piles in the 700C ventilation ducts;
3. Radionuclide content at the bottom of the subsurface exhaust shaft (sloughed salt and accumulated water/brine pockets that become entrained during exhaust operation);
4. The fixative that would selected and its efficacy; and,
5. Structural integrity of 700C ventilation ducts.

<u>Conclusion:</u>

CRESP believes CBFO and NWP are taking a reasonable approach to evaluating the potential for contamination release during the restart of the 700 C ventilation system, and the approach to restart (as described above) can, if properly implemented, provide adequate protection of the workforce, the public and the environment.

<u>Recommendations:</u>

1. A self-sufficient document (i.e., an engineering/safety analysis document that stands by itself) that is suitable for public release should be developed that clearly articulates the basis and calculation of the estimated potential release during restart, including assumptions, unknowns, uncertainties and comparisons to relevant limits for protection of human health (worker and public) and the environment. This should be used as part of the rationale in a separate decision document which articulates the basis of the decision on whether to proceed with the restart.
2. A structural and system integrity assessment is recommended prior to 700C exhaust system restart. CBFO has indicated that a review in response to this recommendation has been initiated.

3. Further enhancements to the test plan are required (e.g., precise limits for stopping testing based on radiological and mechanical test results). After each test sequence, conformance with the test plan should be verified and data analyzed to determine performance and trends. These enhancements should be reflected in DOE and the contractor's readiness planning. Stakeholder and independent expert participation in these reviews of test results would help add transparency and credibility to the conclusions.
4. If return to 700 C operation occurs, periodic monitoring of the underground corridor radiological conditions and confirmatory contamination monitoring of the surface downgradient of exhaust should be carried out.
5. Personal protective equipment should be readily available during the test. PPE can be selected to be unobtrusive but effective. The basis for use and implementation of more extensive PPE should be evaluated as part of the planning process and test implementation decision criteria.