NO-MIGRATION VARIANCE PETITION FOR THE WASTE ISOLATION PILOT PLANT

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ABSTRACT

The U.S. Department of Energy (DOE) is petitioning the U.S. Environmental Protection Agency (EPA) to allow the emplacement of hazardous wastes subject to the Resource Conservation and Recovery Act (RCRA) (1) land disposal restrictions in the Waste Isolation Pilot Plant (WIPP). The basis of the petition is that there will be no migration of hazardous constituents from the repository for as long as the wastes remain hazardous.

The EPA regulations in 40 CFR Section 268.6 identify specific criteria that must be addressed in making a demonstration of no migration. EPA's approval of this petition will allow the WIPP facility to accept wastes otherwise prohibited or restricted from land disposal.

INTRODUCTION

The "cradle to grave" management of hazardous wastes is regulated under RCRA, which is administered by the EPA and authorized state agencies. In 1984, RCRA was amended by the Hazardous and Solid Waste Amendments Act (HSWA). Stringent new provisions were added that prohibit the land disposal of hazardous wastes unless they meet treatment standards established by the EPA or are subject to an EPA-approved variance or exemption. However, the EPA did not formally determine that the hazardous waste components of radioactive mixed wastes are subject to regulation under RCRA until July 3, 1986 (5).

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The hazardous components of the TRU mixed wastes proposed to be emplaced at the WIPP are characterized through a multi-stage process utilizing existing data, generator knowledge of the wastes, real-time radiography, and limited analyses. This process yields information on the potential hazardous constituents (or properties) present, their physical form and relative volumes.

An initial survey of TRU mixed waste generators was undertaken, using pre-existing waste information as a starting point. The DOE had already classified the wastes into "waste forms" based on the physical characteristics of the material. Examples of waste forms are "solidified aqueous sludges," "filters," and "metals." Because the waste forms are largely process-specific, the generators were asked to identify the hazardous materials entering each process for each waste form. The survey was conducted from an "input" rather an "output" perspective, resulting in the identification of all hazardous constituents that could be potentially present in the wastes. Such an approach takes no credit for the consumption or removal of a constituent during a production process; thus, it is highly conservative.

Verification of the physical waste form is provided by real-time radiography (RTR) and visual examination. RTR is an x-ray technique that permits examination of a container's contents without opening the container and exposing workers to radiation. RTR is an effective tool for identifying free liquids, bulk particulates, metallic objects, and other items and materials (for example, it can detect liquid ink in a ballpoint pen). Visual examination of containers after inspection through RTR have confirmed the effectiveness of the technique, as well as the reliability of historical records.

Finally, available analytical data were reviewed. The TRU Waste Sampling Program and the Stored Waste Examination Pilot Plant (SWEPP) Certified Waste Sampling Program conducted at the Idaho National Engineering Laboratory have provided verification of waste characterization information obtained from existing records, process knowledge, and RTR. The results of container headspace gas analyses indicate that the source of volatile organic compounds in the waste is limited and that the physical and chemical forms of the wastes restrict the release of vapors into the headspace of containers.

In addition, some inorganic and organic sludge in stored waste of various ages from the Rocky Flats Plant (RFP) were analyzed for total halogenated and nonhalogenated organic compounds. These results further confirmed that the source of volatile organic compounds is limited in the waste. Toxicity Characteristic Leaching Procedure (TCLP) analyses were also performed on a limited number of inorganic sludges from the RFP. Most hazardous constituents were below detection limits and all were below the treatment standards established in 40 CFR 268.41.

Waste Properties and Transformation Mechanisms

With regard to waste transformation mechanisms following emplacement in the WIPP, changes in the waste will occur over time, as radiolytic and microbiological processes affect temperatures, degrade organics, generate gases, and alter the chemistry of brine (e.g., Eh and pH), if present, in the area immediately surrounding the wastes. Changes in temperature are expected to be slight and may increase the rate of other processes to some extent. The degradation or microbial decomposition of organics renders them nonhazardous, although gases such as carbon dioxide, carbon monoxide, methane, oxygen, and hydrogen are produced. The breakdown of plastics, paper, rubber, and other solid wastes will contribute the largest portion of decomposition products. Acids may also be produced, although the excess of basic cement used in waste solidification will neutralize them.

The rate at which gases will be generated within the repository is not currently well understood, but excessive pressurization of the repository, if in fact it occurs at all, would happen in the period after repository closure. To determine the rate of gas generation within the repository, experiments will be conducted during the test phase, and the results will be used to determine whether engineering changes to the facility or other measures are necessary to ensure the long-term integrity of the repository.

Waste Compatibility

The waste that will be emplaced in the WIPP facility is limited to solid or solidified material. There will be no corrosives, explosives, or pyrophorics placed in the repository. These and other restrictions are detailed in the WIPP Waste Acceptance Criteria (WAC) (2) and, prior to shipment, each waste container must be certified to be in compliance with the WAC. The certification program is described in both the petition and the addendum.

With regard to the WIPP facility, all materials must be compatible to ensure that reactions or by-products do not threaten human health, the environment, or the integrity of the repository. Chemical compatibilities were considered from several perspectives: waste-waste interactions, waste-brine interactions, waste-salt interactions, and waste-seal interactions.

SITE CHARACTERIZATION

Geology and hydrology are important site characteristics with regard to waste isolation. The WIPP site has a long history of study and evaluation directed at these and other environmental factors. A complete bibliography of literature on the environment of the WIPP site is included in the petition and supporting materials, as well as a thorough description of all pertinent local and regional characteristics.

The WIPP facility is located in the Salado Formation because it is hydrologically isolated and the plastic nature of the salt causes any potential fractures to heal before they could spread to connect with any water-bearing formation. Several features of the Salado Formation, including the presence of zones of pressurized gas, brine seepage and marker bed undulations and fractures, have been extensively evaluated with regard to their potential impacts to repository integrity.

FACILITY INFORMATION

The WIPP project was authorized by Congress to provide a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from national defense activities and programs. To meet this objective, the WIPP facility initially will serve as an experimental pilot plant and tests will be performed at laboratory-, bin-, and alcove-scale; the results will be used to collect, interpret, and refine data necessary for the performance assessment required for radioactive waste disposal by the EPA in accordance with 40 CFR Part 191. They also will be evaluated to determine if any additional measures are necessary to ensure that no migration of hazardous constituents will occur beyond the unit boundary.

During the test phase, all wastes emplaced will be readily retrievable. In this manner, should the results of evaluations undertaken during the test phase indicate that the WIPP facility is not the appropriate location for the permanent isolation of these wastes, they can be retrieved with minimal risk. The DOE is currently preparing a plan that describes the requirements for retrieval of waste from the underground. Upon completion, this plan will be provided to EPA and made available to the public as supporting documentation for the No-Migration Variance Petition.

The facility will enter full-scale operations upon successful completion of the test phase. The petition provides a detailed description of the facility and all waste handling procedures.

WASTE HANDLING

Petitioners for a no-migration variance are required to describe waste handling procedures at their facility. Appropriate waste handling procedures are those that comply with regulatory requirements, provide a high degree of safety to workers, and prevent releases to the environment.

Prior to shipment to the WIPP facility, wastes must be certified to meet the WIPP Waste Acceptance Criteria (WAC). The WAC specifies requirements regarding the chemical, physical and radiological characteristics of the waste to ensure safe disposal in the repository. Each container of CH TRU wastes must be additionally certified to meet the Transuranic Package Transporter II

(TRUPACT-II) Authorized Methods for Payload Control (TRAMPAC) requirements. The TRAMPAC specifies packaging and payload requirements for compliance with the Nuclear Regulatory Commission (NRC) certification conditions for the TRUPACT-II for shipment of Type B quantities of waste to the WIPP facility.

During transportation to the WIPP facility, the TRANSCOM satellite communication system will track each shipment and provide continuous, real-time feedback to the DOE on the status of each shipment. Any anomalies, such as route changes and delays, will be immediately noted and investigated. No other shipments of hazardous wastes are known to be so thoroughly monitored.

MONITORING PROGRAMS

The EPA regulations concerning no-migration petitions require monitoring to demonstrate that waste migration does not occur. The DOE will maintain several monitoring programs at the facility:

Initiated in 1985, the Radiological Baseline Program (RBP) was designed to establish statistically sound background radiological data against which operational and post-operational radiation measurements can be assessed. It consists of five subprograms to establish the following baselines: 1) atmospheric radiation; 2) ambient radiation; 3) terrestrial radiation; 4) hydrologic radiation; and 5) biotic.

The Ecological Monitoring Program (EMP) was initiated in 1975 to perform nonradiological baseline studies over a wide area prior to the initiation of construction activities. Seven permanent ecological monitoring plots continue to be studied. This program consists of six subprograms: 1) meteorology; 2) air quality; 3) water quality; 4) aerial photography; 5) vertebrate census; and 6) salt impact studies. To date, the EMP has identified no significant impacts attributable to construction of the WIPP facility.

The goal of the Operational Environmental Monitoring Program (OEMP) is to determine what impacts, if any, will be experienced by the local ecosystem and geographic area as a result of WIPP operations. It is directed at measuring potential radionuclide releases and is similar to the RBP, except that it is much more flexible to allow investigation of trends or anomalies.

The Occupational Monitoring Program (OMP) was established to ensure a safe working environment for all personnel involved in waste handling operations. Continuous air monitors, explosive gas monitors, and area radiation monitors are located throughout the facility.

Air exiting the underground will be monitored for the presence of volatile organic compounds to support the DOE's demonstration of no-migration of hazardous substances beyond the unit boundary.

Radiation and volatile organics will be monitored during the opening of TRUPACT-IIs in the Waste Handling Building. Monitoring of the air evacuated by the vacuum pump will indicate whether any breaching of drums within a TRUPACT-II has occurred so that special measures can be taken to prevent releases to the environment or exposure to workers. All air will be filtered for particulates prior to discharge.

With regard to the monitoring of groundwater during operations, the DOE maintains an interim status groundwater monitoring waiver for the WIPP facility, having demonstrated that there is no potential for the generation of leachate or other mechanisms for groundwater contamination during the operational period. The waiver is provided as an appendix to the petition.

The objective of the Long-Term Monitoring Program (LTMP) will be the detection of substantial and detrimental deviation from established baseline data and expected performance conditions. It will be, in a broad sense, a continuation of preoperational and operational monitoring activities. Additional elements of the program will be developed and implemented on an as-needed basis, with input provided by the results of the test phase and actual conditions during operations.

DECOMMISSIONING AND CLOSURE

Decommissioning and closure of the WIPP facility will involve decontaminating and dismantling the surface structures. The panels, drifts, and shafts underground will be backfilled and sealed. The primary function of the overall seal system is to limit the release of radionuclides and hazardous constituents through man-made penetrations. The seal system will also limit or prevent the inflow of groundwater from overlying formations to the Salado Formation. The seal system will include multiple seals to carry out different functions and allow for redundancy. A detailed description of the seal system components is provided in the addendum to the petition. Contaminated equipment and debris will be placed underground prior to backfilling. Post-closure care will include continued environmental surveillance and the maintenance of site security markers. The closure/post-closure care plan is provided as an appendix to the petition.

RISK ASSESSMENT

The environmental consequences of routine releases during waste emplacement operations were assessed through a conservative risk assessment, in which personnel above and below ground were assumed to spend each eight-hour day of their entire working lives at the points of maximum concentration. The nearest off-site residential receptors are assumed to be continuously exposed to postulated releases throughout their lifetimes. The hazardous constituents examined in the risk assessment were carbon tetrachloride; methylene chloride; 1,1,1-trichloroethane; 1,1,2-trichloro-1,2,2-trifluoroethane; and lead. Of these, the first two are classified by the EPA as carcinogens.

Using the above conservative assumptions, the maximum lifetime excess cancer risk level for occupational receptors is about one hundred times less than the one in 10,000 risk level considered by the EPA to be acceptable for workplace exposures. The maximum lifetime excess cancer risk level for the public is about ten thousand times less than the one in 100,000 risk level considered by the EPA to be acceptable for public exposure. The maximum estimated intakes of noncarcinogenic chemicals by occupational workers and the public are well below health-based levels, indicating no adverse human health effects from routine exposures to the low concentrations of chemicals released.

Potential risks to personnel during several on-site accident events were estimated based on comparison to Threshold Limit Values (TLVs) and Immediately Dangerous to Life and Health (IDLH) criteria. TLVs are standards established to protect workers from eight-hour-per-day exposures throughout their working lives. The IDLH is the maximum concentration in air from which escape within 30 minutes would not result in any impairing symptoms or irreversible health effects. The use of IDLH criteria is conservative because the postulated accident scenarios are short-term events.

The maximum worker exposure to any hazardous chemical was about 1,000 times less than these health-based levels. Similarly, public exposures to hazardous chemicals during accident scenarios also were extremely low, and no adverse human health effects are indicated.

The WIPP surface facility will be decommissioned and the repository sealed as part of the closure process. For the purpose of the risk assessment, engineered barriers such as the shaft seals are assumed to function as designed. The impacts of releases through four pathways are examined in the petition: air, surface water, soils, and groundwater.

Examination of impacts associated with the groundwater pathway required examining the rate at which hazardous constituents would potentially move through the storage panel, drifts, and seals, along the underlying Marker Bed 139, and up through the Waste Handling Shaft. Movement through the ERDA-9 borehole, the closest borehole to the waste, was also considered.

The SWIFT III computer code was used in performing the modeling. Several conservative conditions were assumed to eliminate any possibility of underestimating the travel time of contaminants. Waste mobility modeling based on extremely conservative assumptions about the characteristics of the waste and the disposal system show that hazardous constituents will not migrate beyond the WIPP facility boundary. The modeling effort can be refined based on actual data obtained from experiments, but the results can realistically be expected to lead to even slower travel times.

UNCERTAINTY ANALYSIS

The uncertainty analysis involves the prediction and assessment of infrequent or unexpected events that could adversely impact the integrity of the disposal unit. Natural events, waste- and facility-induced events, and human-induced events were examined in the petition. None were found to pose a significant threat so as to violate the "no-migration" requirement.

CONCLUSIONS

To obtain a variance from these restrictions, a land disposal facility is required to demonstrate that, to a reasonable degree of certainty, there will be no migration of hazardous wastes beyond the unit boundary for as long as they remain hazardous. The EPA relies on health-based standards as the basis for evaluating such demonstrations, along with other stringent criteria outlined in its guidance manual.

The WIPP facility relies on both the inherent characteristics of the salt in which the repository is constructed to permanently isolate the wastes that will be emplaced, as well as operational procedures that protect workers and the public during waste emplacement activities. The DOE believes that the No-Migration Variance Petition thoroughly demonstrates that there will be no releases of hazardous constituents from the WIPP facility, and that protection of human health and the environment is its primary goal throughout all phases of this important project.

The EPA is now reviewing the DOE's No-Migration Variance Petition for the WIPP. During its review, the EPA has requested considerable additional information, which has been prepared by the DOE. Upon completion of its review of all data submitted by the DOE, the EPA will publish a Federal Register notice describing its intent to approve or deny the petition. This notice will include justification for the EPA decision and offer the public an opportunity to comment on the proposed EPA decision. The EPA decision-making process is currently projected to be completed by mid-1990.

REFERENCES

1. Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6901 et seq.

2. U.S. Department of Energy, "WIPP Waste Acceptance Criteria" (WIPP/DOE 069, Rev. 2), WIPP Project Office, Carlsbad, New Mexico (1985).

3. U.S. EPA, "Guidance Manual for Hazardous Waste Disposal in Geologic Repositories," Washington, D.C. (May 29, 1987, Draft).

4. U.S. EPA, Land Disposal Restrictions for First Third Scheduled Wastes, 53 Fed. Reg. 31138 (August 17, 1988).

5. U.S. Environmental Protection Agency (U.S. EPA), State Authorization to Regulate the Hazardous Components of Radioactive Mixed Wastes Under the Resource Conservation and Recovery Act, 51 Fed. Reg. 24504 (July 3, 1986).

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