

THE CONDITIONS OF THE NO-MIGRATION DETERMINATION FOR THE WASTE ISOLATION PILOT PLANT*

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ABSTRACT

On November 14, 1990, the U.S. Environmental Protection Agency (EPA) published its No-Migration Determination for the Waste Isolation Pilot Plant (WIPP). By issuing the Determination, the EPA will allow the Department of Energy (DOE) to place untreated hazardous waste, subject to the Land Disposal Restrictions, in the WIPP facility for the purposes of conducting the Test Phase. During the Test Phase, experiments will be conducted with mixed wastes, that is, transuranic (TRU) wastes that are also contaminated with hazardous waste regulated under the Resource Conservation and Recovery Act (RCRA). In order to ensure that no-migration would occur during the Test Phase, the EPA imposed eight specific conditions on the DOE as part of the Determination. These conditions include limits on testing activities, limits on the quantity of waste, requirements to maintain retrievability of the waste, and to retrieve the waste if DOE cannot subsequently demonstrate that the facility is suitable for long-term disposal. Additional conditions 1) require the control and monitoring of volatile organic compounds (VOCs) that may offgas from the waste during the test period; 2) require waste characterization activities to ensure that no flammable mixtures of gases are emplaced, and to assure that the wastes that are emplaced are consistent with the waste described in the DOE's No-Migration Petition. There are also conditions and requirements for reporting to the EPA. None of these conditions is considered to be an obstacle to proceeding with the Test Phase at the WIPP. DOE is challenged by the Determination, however, to increase waste characterization activities in order to collect sufficient data to support a subsequent No-Migration Determination for the operational phase and for permanent disposal.

INTRODUCTION

On November 14, 1990, the EPA, Office of Solid Waste issued its No-Migration Determination for the WIPP. This determination was based on documentation submitted to the EPA by the DOE and an independent assessment, including extensive public comment, by the EPA. The determination was made in accordance with the requirements of 40 CFR 268.6 and was based on a "demonstration" by the DOE that no hazardous constituent would migrate from the WIPP. After a "careful review" of the public comments made on the Agency's proposed determination, published on April 8, 1990, the EPA was able to conclude that "to a reasonable degree of certainty, . . . hazardous constituents will not migrate from the disposal unit" over the term of the testing period. The testing period referred to here is the Test Phase, which includes a series of experiments using TRU waste at the WIPP facility. The EPA's determination imposed several conditions on the DOE. It is these conditions that form the subject of this presentation.

The specific conditions placed on the DOE under the No-Migration Determination include the following:

1. No waste can be placed in the WIPP for purposes other than testing as defined in the DOE's test planning document WIPP Test Phase: Performance Assessment, dated April 1990 (DOE/WIPP 89-011, Revision 0). An Operations Demonstration is prohibited.
2. Wastes placed in the repository cannot exceed 8500 drums or one percent of the capacity of the facility (62000 cubic feet).
3. All waste must be removed if DOE cannot demonstrate compliance with the standards of 40 CFR Part 268.6 with respect to permanent disposal at the facility
4. All wastes must be readily retrievable.
5. DOE must install and operate a carbon adsorption device designed to achieve a control efficiency of 95 percent in the discharge system of the bins (experimental containers).
6. DOE must operate an air monitoring system as described in the determination.
7. With regard to waste analysis:

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- a. DOE must assure that no layer of confinement contains flammable mixtures of gasses or mixtures of gasses that could become flammable when mixed with air.
- b. DOE must analyze representative samples of head-spaces of containers.
- c. Waste analysis records must be maintained at either the generating site or the WIPP facility.

8. DOE must provide annual written reports.

In addition, the EPA reiterated the notification requirements of 40 CFR Part 268.6 with regard to 1) changes in the test plans or facility configuration; and 2) the occurrence of migration of hazardous wastes from the facility. Finally, the EPA specified that the term of the determination is ten years.

BACKGROUND

The No-Migration Determination specifically addresses the requirements of the Land Disposal Restrictions which Congress included in the Hazardous Solid Waste Amendments (HSWA) in 1984. Congress specified that the EPA establish treatment standards for all hazardous waste. In addition, Congress specified that an alternate approach to treatment available to an owner/operator is to demonstrate with a reasonable degree of certainty that "there will be no migration of hazardous constituents from the disposal unit or injection zone as long as the wastes remain hazardous" [RCRA Sections 3004 (d) (1), (e) (1), and (g) (5)]. This provision was codified by the EPA as 40 CFR Part 268.6 in November 1986. DOE opted for this approach in lieu of treatment for TRU mixed wastes. The decision was made based on two principal factors. First, there is a lack of treatment technology or capacity to routinely treat hazardous wastes that also contain TRU waste components. Second, the WIPP was designed and constructed to isolate these wastes from the environment for tens of thousands of years; consequently, the DOE believed it could demonstrate to the EPA that placement in the WIPP facility is as protective to human health and the environment as treatment.

The DOE prepared a No-Migration Variance Petition in accordance with 40 CFR Part 268.6 and submitted it to the Administrator of the EPA in March 1989. Subsequently, the EPA performed a completeness check and requested additional information, most of which was provided in October 1989, in response to a Notice of Deficiency. EPA then initiated a comprehensive technical review, including requests for additional information. All additional information was provided as an Addendum to the No-Migration Variance Petition by the end of January 1990. The Addendum contained a large amount of detail regarding waste characterization and the knowledge of processes that

the generating sites use for classifying hazardous waste. EPA completed its technical review in March 1990, and published a proposed notice to grant the determination in the Federal Register on April 6, 1990. In addition to a 60-day public comment period, the EPA conducted three public hearings in New Mexico: one in Carlsbad; one in Albuquerque; and one in Santa Fe. The Agency received 103 written comments and heard testimony from more than 300 individuals. In addition, the Agency conducted a field visit to the WIPP site in July 1990, to resolve several of the public comments regarding site suitability. EPA announced its final determination on October 31, 1990, followed by publication in the Federal Register on November 14, 1990.

In order to reach a conclusion regarding no-migration, the EPA concentrated on determining whether or not releases of nonradioactive hazardous constituents might occur during the Test Phase. Because of the nature of the proposed tests, and because of their short duration, the Agency concluded that "releases of hazardous constituents from the unit through brine, salt, or other geological media is implausible during the Test Phase." Key to the finding is the DOE's commitment to emplace the waste in a readily retrievable manner. EPA concluded that retrieval can be done safely and that the mine is well designed and will remain stable during the Test Phase. On the other hand, the Agency concluded that there are a number of uncertainties that remain to be addressed before a No-Migration Determination can be made for the permanent disposal of untreated wastes in the WIPP facility. Consequently, the EPA ruled that the DOE will have to re-petition the Agency for the permanent disposal of untreated hazardous waste in the WIPP facility.

CONDITIONS OF DETERMINATION

Limitation to Testing and Experimentation: This condition limits the activities that the DOE can conduct at the WIPP facility under the determination to tests and experiments designed to provide data to demonstrate the long-term acceptability of the WIPP. These tests are described in other presentations at Waste Management '91, and involve Bin-Scale Tests and Room-Scale or Alcove Tests as generally outlined in DOE's test plan (WIPP Test Phase: Performance Assessment, DOE/WIPP 89-011, Revision 0, April 1990). Specifically excluded are the "Operations Demonstration," the pilot-room tests, and other non-testing activities. The EPA states that the DOE is not restrained from incidentally testing some of the operational aspects of the facility when DOE places waste underground for permissible testing. Included in the EPA's definition of permissible waste is waste that may be derived from testing activities at the WIPP, but which may not have any experimental purposes (such as test bins that no longer maintain required performance characteristics). This condition is

consistent with the DOE's decision to phase the testing at the WIPP facility and to put off the Operations Demonstration until sometime after the performance assessment testing activity is underway.

Limitation on Volume: The EPA established a limit on the quantity of waste that can be placed in the facility during the duration of the determination. This limit was set to respond to public comments that no limit would allow the DOE to expand the Test Phase indefinitely, even though the Agency believed that--because of the nature of the experimental program--the DOE needed maximum flexibility in carrying out its experimental purposes. A limit of one percent of the WIPP's capacity was specified as a compromise between the need for flexibility and the public comment that some restraint was needed. The EPA's rationale was that the DOE's plans for the Test Phase activities for performance assessment testing only require 0.5 percent of the total capacity of WIPP; therefore, a one percent limit gives the DOE the flexibility, while also giving the public the assurance, that the DOE would not be allowed to go to higher quantities of waste without the public having another opportunity to comment. The EPA comments that this limit is not based on any technical criteria regarding the amount of waste needed to conduct the tests. Instead, it is merely an upper limit that, if exceeded would be considered by the EPA to be a significant departure from DOE plans for the Test Phase. The DOE has not had to alter any testing plans to accommodate this condition. The one percent certainly allows the Department the flexibility to adjust waste types and quantities if needed to assure that the performance assessment testing is representative of the majority of the TRU waste types that would be shipped to the WIPP facility.

Waste Retrieval: The EPA has specified that the waste be retrieved from the facility in the event that the DOE cannot show compliance with long-term performance standards. Along with the condition for retrieval, the EPA specified that the DOE prepare and submit to the EPA a specific retrieval schedule. This schedule is required within six months after a determination is made that WIPP cannot meet the long-term disposal standards, as specified in 40 CFR Part 191, or six months before the expiration of the No-Migration Determination (whichever comes first). Before retrieval could take place, the plan would be subject to public comment and EPA approval. At the outset, this condition does not pose any serious problems for the DOE since the retrieval commitment has been long-standing. In addition, the preparation of specific plans for retrieval is part of existing DOE policy for closing and decommissioning nuclear facilities. The requirement for public comment is consistent with the use of the National Environmental Policy Act (NEPA) process for making major programmatic decisions, such as the decision regarding retrieval and further disposition of any retrieved waste. The requirement

for EPA approval is presumed to be derived from HSWA and the Land Disposal Restrictions, under which the EPA has the authority to issue and enforce the WIPP No-Migration Determination.

Waste Retrievability: The EPA has stipulated that the waste placed in the WIPP facility for the Test Phase be readily retrievable. This condition is as described by the DOE in the petition and in various other documents, such as the Final Safety Analysis Report for the WIPP. DOE already plans to take extraordinary measures to assure retrievability of the waste. These include pattern rock bolting the experimental rooms, geomechanical instrumentation monitoring, and inspection. Alcoves, which are sealed, will be sized to optimize roof and rib stability in addition to the use of pattern bolting.

Carbon Sorption Device: The EPA has stipulated that the discharge from the experimental rooms be routed through a carbon sorption device to remove any VOCs that offgas from the experiments. By capturing these VOCs, the DOE will thereby prevent migration of hazardous waste from the facility. This device is to address the only plausible pathway that the Agency determined could lead to the migration of hazardous waste. This pathway is the airborne pathway that includes the mine ventilation system and the Exhaust Shaft. The EPA has specified certain design parameters, such as efficiency and expected gas volume. In addition, the Agency requires that the frequency for changing the carbon be verified by testing. The imposition of this condition has resulted in a significant engineering challenge for the DOE. The process of collecting test offgas had to be designed in a manner that was independent of the amount of offgas and did not interfere with the operation or goals of the experiment. The specific design of this system and the associated air monitoring system are the topics of another presentation at Waste Management '91.

Air Monitoring Plan: The EPA is requiring the DOE to implement an air monitoring system to confirm that there is no migration of VOCs above health based levels beyond the unit boundary. The air monitoring plan is described in the DOE's petition. Monitoring locations include the Air Intake Shaft, the Exhaust Shaft, and various locations in the underground. In addition, the Agency has provided requirements on quality assurance/quality control (QA/QC). Five target VOCs have been specified for monitoring. These are methylene chloride, carbon tetrachloride, 1,1,1-trichloroethane, trichloroethylene, and 1,1,2-trichloro-1,2,2-trifluoroethane. The implementation of the air monitoring system has resulted in the installation of air samplers at 11 locations in the facility. The management of the air sampler canisters with subsequent analysis and reporting represents a sizeable task for the DOE.

Waste Analysis: The conditions of the No-Migration Determination that have the greatest impact on the DOE

are those associated with waste characterization. EPA addressed these in three different categories. These are waste characterization requirements with regard to 1) flammability; 2) the Test Phase; and 3) long-term performance.

Flammability considerations came about as the result of comments from the public regarding the possible buildup of flammable gasses in the test containers. EPA concluded that, whereas such a buildup with a resulting explosion and fire is "unlikely," the possibility should be addressed since its occurrence could compromise the retrievability of waste, and such an event could lead to migration beyond the unit boundary in excess of health based standards. The EPA has required that no waste should be placed underground if it contains flammable mixtures that are in excess of 50 percent of the lower explosive limit (LEL) of the mixture in air. To assess the flammability, each container is to be checked for hydrogen, methane, and flammable VOCs as a class. Further, sampling must be representative of the entire void space in the container, thus requiring sampling within every layer of containment that has waste next to the bag. DOE can reduce this sampling requirement if it can show that sampling fewer layers of containment is representative of the entire void volume. Implementation of this requirement will be mainly the responsibility of the facility preparing the waste for experimentation at the WIPP.

Sampling will involve the headspace in each container selected for placement in a experimental bin, each bag removed from the container and characterized before placement into the bin, and, finally, from the filled bin after it is sealed. A subsequent sample may be taken prior to shipment to WIPP if the previous samples indicate the need. At the WIPP facility, containers could be purged upon receipt so that only nominal levels of flammable mixtures are left in the bin. DOE believes that the sampling during the waste characterization activities associated with filling the test bins will be sufficient to demonstrate that the container headspace is representative of the total void volume, thereby minimizing the sampling requirements for the Alcove Tests.

The second area of waste characterization involves specific wastes to be used in the experiments. In this regard, the EPA is requiring the DOE to compare actual headspace analysis from containers to be used in the Bin-Scale Tests with the values used in the DOE's modelling in the petition. Concentration values are considered to be "comparable" if the measured value is no more than a factor of two over the maximum value reported for the drum in the No-Migration Petition. The EPA provided the following table of maximum allowable headspace concentrations (in volume percent):

TABLE I

Maximum Headspace concentrations

Constituent	Type I	Type II	Type III	Type IV
Carbon tetrachloride	0.08	0.18	0.58	8.18
Methylene chloride	0.44	0.84	0.50	1.42
1,1,1-Trichloroethane	1.88	5.68	2.12	14.96
Trichloroethylene	0.08	0.34	0.28	0.28
1,1,2-Trichloro-1,2,2-trifluoroethane	0.05	1.62	5.74	20.80

In addition, the EPA requires that the headspace data taken during the pretest waste characterization activity for the Bin-Scale Tests be compared on the basis of average concentrations. This requirement is included since the EPA used the average concentrations reported in the petition to perform air release modelling. The specific requirement is that the concentrations not exceed ten times the mean values used in the petition. The limit established by the EPA is based on the safety margin indicated in the No-Migration Determination. This safety margin is, in essence, established by comparing the modelled results with the health based standards used to judge whether or not migration has occurred. Safety margins range from a factor of 11 to seven orders of magnitude, depending on the constituent. For comparison purposes, the EPA established the following table (in volume percent) for determining the suitability of the waste with regard to the average concentration. The two constituents that were left off the table were considered by the Agency as having sufficiently high

TABLE II

Mean Headspace Concentrations

Constituent	Type I	Type II	Type III	Type IV
Carbon tetrachloride	0.24	0.26	0.30	6.90
Methylene chloride	0.39	0.42	0.33	0.93
Trichloroethylene	0.25	0.28	0.29	0.38

safety factors that they could not be high enough to alter the No-Migration Determination.

As with flammability testing, the DOE must measure headspace gasses in every layer of containment until it can show that the headspace of the container is representative of the headspace of the entire void volume within the container. DOE has considered headspace sampling as an important method for characterizing the hazardous

constituents in TRU wastes. This is because headspace samples can be taken with a minimum of radiological impact, provided that the DOE can demonstrate the headspace of the container is representative of the entire void volume. If not, the process of sampling each inner containment greatly complicates the waste characterization process in terms of radiation exposure and facility and hardware requirements. Currently, both the Idaho National Engineering Laboratory and the Rocky Flats Plant are preparing to perform the needed headspace characterizations for the Bin-Scale Test waste.

With regard to the waste to be used in the Alcove Tests, the EPA is not requiring testing of the headspace of drums to be used for these tests. The basis for this is twofold. First, the waste in the Alcove Test is the same as the waste in the Bin-Scale Test, so that the characterization of Bin-Scale waste will be applicable to alcove waste. Second, the phasing of the experiments is such that a significant amount of the Bin-Scale waste will be characterized prior to initiating the selection and shipment of waste for the Alcove Tests. Consequently, EPA is requiring that the DOE verify through the results of the headspace characterization up to the point when alcove waste are to be shipped that the concentrations do not exceed the reported mean values by more than a factor of ten. The implication is that sufficient Bin-Scale Test waste characterization must be completed to be relatively certain that the waste is as described in the petition, and that it meets the criteria specified in the determination. This notwithstanding, other programmatic needs will require sampling of a statistically significant population of alcove test waste.

The final area of waste characterization addressed by the EPA has to do with the collection of data to support a subsequent petition for a No-Migration Determination for the long-term disposal of waste at the WIPP. The EPA expressed concern that, whereas DOE has presented sufficient information to demonstrate no-migration during the Test Phase, the amount of data is not sufficient to make a long-term determination. The EPA believes that further characterization is needed so that the DOE can confirm its estimates of waste composition. Further characterization will also ensure that the wastes for future placement are sufficiently similar, to allow the results of the Test Phase experimentation to be extrapolated to wastes that were not specifically included in the testing. Representativeness here applies only to the factors associated with the waste that contribute to the migration of hazardous constituents; representativeness does not mean that every species of waste proposed for the Operational Phase must be tested during the Test Phase. The EPA is encouraging the DOE to proceed with its plans to develop waste sampling protocols and techniques to provide more in-depth characterization of the waste. The EPA has provided a minimum list of

analytes that should be considered in any future waste analysis efforts. These are listed in the following table:

TABLE III

EPA Recommended Analytes

Acetone	Nitrobenzene
Benzene	1,1,2,2-Tetrachloroethane
Bromoform	Tetrachloroethylene
Butanol	Toluene
2-Butanone	1,1,1-Trichloroethane
Carbon tetrachloride	Trichloroethylene
Chloroform	1,1,2-Trichloro-
Chlorobenzene	1,2,2-trifluoroethane
Cyclohexane	1,3,5-Trimethylbenzene
1,1-Dichloroethane	1,2,4-Trimethylbenzene
1,2-Dichloroethane	m-Xylene
1,2-Dichloroethene	o-Xylene
cis-1,2-dichloroethane	p-Xylene
Ethyl benzene	Cadmium
Ethyl ether	Chromium
Formaldehyde	Lead
Hydrazine	Mercury
Methanol	Selenium
Methylene chloride	Silver
4-Methyl-2-pentanone	

The DOE is in the process of developing the protocols and techniques needed to perform these analyses on cemented sludges. In addition, where possible, the DOE will require the generating sites to screen for these constituents during any waste analysis being performed to characterize the waste. In addition, some generating sites may be able to identify the presence (or absence) and possibly the quantity of these constituents through process knowledge. Beyond this, the DOE is currently unable to analytically test typical heterogeneous waste forms.

Reporting Requirements: The final condition of the determination is the requirement for annual reports of testing progress and the status of the DOE's performance assessment. DOE has already scheduled the preparation of an annual report summarizing the progress made toward demonstrating compliance with the long-term performance standard. Consequently, this requirement is not expected to present any particular problems for the DOE.

SUMMARY

The conditions imposed by the EPA on the DOE for the Test Phase at the WIPP facility by way of the No-Migration Determination are not expected to create any major

obstacles to the conduct of the Bin-Scale and Alcove Tests. Waste characterization is perhaps the largest issue facing the DOE with regard to future compliance with RCRA and the Land Disposal Restrictions. Of specific concern is the collection of sufficient test and waste characterization data to support a subsequent demonstration of no-migration for the Operational Phase. The problems associated with this task are compounded by the lack of facilities capable of performing analysis on TRU wastes, the lack of suitable

protocols for sampling and analysis, and the heterogeneous nature of much of the waste. While the DOE is looking into all of these concerns in anticipation of future waste characterization needs, it is incumbent on the DOE, the EPA, and other affected regulators to mutually determine what amount of characterization is needed to ensure that the waste can be safely managed and disposed at the WIPP facility.