ONGOING OPERATIONAL AND REGULATORY ISSUES AT WIPP

Matthew K. Silva, James K. Channell, Lokesh Chaturvedi,
Ben A. Walker, Jim W. Kenney, Donald H. Gray
Environmental Evaluation Group
7007 Wyoming Boulevard NE, Suite F-2
Albuquerque, New Mexico 87109, USA

ABSTRACT

Even though the Waste Isolation Pilot Plant (WIPP) has been receiving Contact-Handled transuranic (CH-TRU) wastes since March 1999 there are many ongoing issues that need to be resolved. Two major proposed modifications are expected soon involving waste characterization at WIPP and permitting of Remote-Handled transuranic (RH-TRU) waste disposal. There are also transportation and facility issues as well as effluent and ambient monitoring activities. The Environmental Evaluation Group (EEG) is the independent state-oversight group.

INTRODUCTION

Although the WIPP facility received its first shipment of transuranic (TRU) waste in March 1999, it is still basically in a start-up mode of operation. Only four generating sites have shipped any CH-TRU wastes to WIPP and the total receipt rate continues to be only about four shipments per week (one-fourth of the design receipt rate). The CH-TRU wastes being shipped at this time are from lesser activity, more easily characterized waste streams. The permit modifications needed before RH-TRU waste can be received at WIPP will probably not be in effect before mid 2002. The U.S. Department of Energy's (DOE's) Carlsbad Field Office (CBFO) has submitted several proposed Permit Modifications to the New Mexico Environment Department (NMED) and is planning to resubmit one allowing for waste characterization at WIPP.

Now that the WIPP is partially operational, it has become very clear that there is a continuing need for studies, evaluations and regulatory activities. Moreover, the issues have become arguably more important now that waste characterization, transportation, and emplacement activities are underway and the need for changes to the facility are being identified based on actual operational experience.

The near-term technical issues facing the project include facility modifications for receipt and emplacement of RH-TRU waste, generator site audits, waste characterization, the suitability and safety of transportation systems, changes in the mining of new panels, and analysis of new information as part of the re-certification cycles mandated by the WIPP Land Withdrawal Act (LWA) (1).

The EEG, in its role of providing an independent technical oversight of the WIPP Project, remains significantly involved with these issues. Moreover, EEG continues to sustain and develop its radiation surveillance program, maintain and refine its proven radiochemical analytical capability, evaluate reports issued by the DOE, and publish its analyses. This paper

summarizes EEG's findings, conclusions and recommendations during the last year on several of these facility changes and ongoing issues.

WASTE CHARACTERIZATION

Status of Waste Generating/Storage Sites

As of December 2000, four waste generator/storage sites (Los Alamos National Laboratory, LANL; Idaho National Environmental Engineering Laboratory, INEEL; and Rocky Flats Environmental Technology Site, RFETS; and Hanford) had met certification requirements to ship CH-TRU debris wastes to the WIPP, and all four had provided multiple shipments to the repository. A fifth site, Savannah River (SRS), was well into the certification process, and had marginally passed a certification audit. Both RFETS and INEEL have also successfully completed certification audits for homogeneous solids, and were awaiting certification to allow shipment of those waste streams. These five sites will send over 95% of the CH-TRU waste currently planned for disposal to the WIPP. Development of other sites is apparently tied to the Central Characterization Facility currently proposed to be located at the WIPP site.

Modifications to the Hazardous Waste Permit

In March 1999, the NMED issued the Hazardous Waste Permit, which allowed for the disposal of mixed CH-TRU waste at the WIPP facility. Although the Resource Conservation and Recovery Act (RCRA) regulated materials pose only 1/10,000 the risk of disposal of the radioactive constituents (2), a large fraction of the DOE effort has focused on submitting requests for modifications to the RCRA Part B permit. Hundreds of Class 1 modifications, the designation reserved for minor corrections and changes, have been submitted. Three sets of proposed Class 2 modifications, which require a public comment period and approval prior to implementation, were submitted. The last set of proposed Class 2 modifications was withdrawn, as discussed in the next section.

Upon review, EEG found that the changes requested by the DOE in the first two sets of Class 2 modifications were technically justified with some cautionary notes to the state regulator. For example, the EEG agreed with the DOE proposal that miscertification rates can be determined by summary category groups. However, we recommended that wording be included in the permit modification to insure that representative samples would be taken. Similar wording was also recommended to insure statistical sampling for head space gas analyses (3). EEG found that DOE was also justified in its proposal to rely on a solid volatile organic chemical sample from a single site along the core, while retaining the flexibility to use the three sub-sample method (4).

Class 1 modifications have also been problematic. The NMED has not thoroughly reviewed the bulk of these changes, but on August 8, 2000 rejected many of those submitted prior to February 2000 as requiring a Class 2 modification. More recently, a November 13, 2000 modification originally submitted as a Class 1 change to the drum age criteria was rejected and has since been resubmitted as a Class 2 modification. The rejection of Class 1 modifications can be a problem, as sites develop waste characterization practices to meet the Class 1 modifications as soon as they are submitted. In the case of the drum age criteria, INEEL's shipments were dependent on

its approval, and the delays resulted in the loss of several shipments to the WIPP in the November 2000 time frame.

At the present time (December 2000) WIPP is receiving about eight shipments per month from RFETS, 3-9 shipments per month from INEEL and one shipment per quarter from Hanford. LANL is expected to begin sending about two shipments per month in February 2001.

Small Quantity Site/Central Characterization Facility Initiative

In a major change to long-established plans for WIPP operations, the DOE has begun efforts to build waste characterization facilities at the WIPP site. This process would allow small quantity sites to ship wastes characterized to meet only the transportation requirements to the WIPP. The additional characterization requirements for disposal would be addressed at the proposed facility after arrival at WIPP. The establishment of a waste characterization facility at the WIPP would also allow confirmation of characterization provided by other sites.

Development of the program is apparently in the early stages. Submission of a July 21, 2000 modification to the WIPP Hazardous Waste Facility Permit (HWFP) was withdrawn by DOE on September 29, 2000 and indications are that the proposal has undergone significant revision since that time. It is anticipated that such a change to the HWFP will likely involve public hearings on the matter and require certification of the WIPP as a waste characterization site by the U.S. Environmental Protection Agency (EPA). Moreover, this new activity will require a safety analysis report, a hazard assessment and appropriate National Environmental Policy Act (NEPA) documentation. These activities could delay implementation of the Central Characterization Facility initiative significantly.

The EEG formally commented on the HWFP Class 2 modification request, noting that it lacked several significant types of information necessary to properly assess the request. Based on observations from three proposed small quantity sites that will provide 90% of the TRU waste intended for the central characterization, the EEG concluded that acceptable knowledge should be viewed with appropriate caution (5). There were numerous other concerns identified by the EEG (4).

RH-TRU Waste Developments

RH-TRU wastes were included in the original certification of the WIPP by the EPA, but the HWFP specifically prohibits the acceptance of RH-TRU waste. According to the NMED, the HWFP regulator, submissions of the HWFP by the DOE were not adequate in describing how RH-TRU wastes would be characterized. The DOE has since prepared draft documentation for radionuclides and hazardous waste characterization of RH-TRU waste that would rely much more heavily on acceptable knowledge and process knowledge than is presently allowed for CH-TRU waste. However, DOE's failure to meet their initial schedule for submitting modifications to the HWFP, the RH-72B (the RH-TRU waste shipping container) Safety Analysis Report, the WIPP Safety Analysis Report, and the RH-TRU Waste Acceptance Criteria (WAC), indicate that the entire program is being re-thought.

Consideration is also being given to transporting RH-TRU wastes from Battelle Memorial Institute's Columbus Laboratories in 208-liter (55-gallon) drums using the CNS 10-160B shipping cask. This would require changes in RH-TRU waste handling at WIPP that would have to be addressed in the appropriate reports and may require an EPA rule-making. EEG has commented on draft documentation for a HWFP modification and for the RH-TRU WAC and will evaluate DOE's formal proposals when they are submitted.

TRANSPORTATION ISSUES

A significant issue at present is whether rail should be used to transport CH-TRU waste to WIPP (6). The NAS WIPP Subcommittee has recommended use of the ATMX rail car (7) and others have expressed interest. Prior to cessation of its use in 1989, this rail car was used for TRU waste shipments between RFETS and INEEL. The ATMX is a single contained, vented package that can not be certified by the U.S. Nuclear Regulatory Commission (NRC).

The WIPP LWA and the Consultation and Cooperation Agreement with the State of New Mexico require that all shipments to WIPP be in NRC certified packages. Moreover, a representative of the Western Governor's Association testified to agreements with various tribes and corridor states that required shipping in an NRC approved package (8).

For DOE, the primary attractiveness of using the ATMX is that it would not have to comply with the decay heat limits that NRC requires for TRUPACT-II and other certified packages. The decay heat requirement limits the amount of radioactivity that can be present in waste drums or boxes in order to prevent potentially explosive concentrations of hydrogen gas and flammable volatile organic compounds. Under present TRUPACT-II certification requirements some existing waste (especially plutonium-238 heat-source waste) would need to be repackaged.

EEG opposes the use of the ATMX for shipments to WIPP. The hydrogen gas problem is real and should not be ignored for the sake of expediency. Also, the single contained ATMX has not been tested with the 10 CFR 71 (9) hypothetical accident tests and would be expected to be more vulnerable than the TRUPACT-II in the event of a serious transportation accident. DOE is gradually obtaining higher decay heat limits from NRC as a result of experimental tests, analyses, and from data on actual waste drums. Also, DOE does not plan to ship most of the heat-source wastes for many years. There should be plenty of time to develop cost-effective procedures for shipping heat source waste and still provide the same level of transportation safety that is required of commercial shippers.

WIPP FACILITY

Abandonment of Panel 1

The WIPP repository consists of eight Panels of seven rooms each. Panel 1 was excavated in 1986-88 with a plan to emplace waste for "experiments" and "operational demonstration". Those plans were abandoned in 1993, and the waste emplacement did not begin until 1999, after the EPA certification. Panel 2 was excavated in 1999-2000. Because of the age of Panel 1 and the difficulty of performing maintenance operations in areas where the waste has been emplaced,

the EEG has questioned the continued use of Panel 1. The DOE desires the option to continue using selected areas of Panel 1 until June 2002 by stacking the drums only two high instead of three. One reason for continuing use of Panel 1 is to preserve space in the walls of Panel 2 for RH-TRU waste. The EEG and DOE have discussed the programmatic and safety implications of this decision. The DOE addressed the roof fall for the two drum stack scenario with an Unresolved Safety Question calculation. Using the actual inventory emplaced thus far, the EEG calculated that breaches of containers could occur and there is no factor of safety to offset uncertainties inherent in a natural system. EEG's analysis of the roof-fall scenario leads to the conclusion that a radiological release will not exceed regulatory limits. However, the DOE needs to consider public perception of such an event. Since DOE's current projection of the RH-TRU inventory is approximately 70% of the design RH-TRU waste capacity, it appears that saving space in the walls of Panel 2 will not be crucial. While the EEG appreciates the DOE's desire to maximize use of resources, the EEG has advised DOE that it may be prudent to cease using Panel 1 and begin using Panel 2 (10).

Exhaust Shaft Leakage

The WIPP exhaust shaft has leaked water from deteriorating grout lining at shallow depths of 15 to 35 meters (50 to 115 feet) since at least 1995 (11,12). This has affected the efficacy of air monitoring at the top of the shaft because wet salt-dust accumulates on the air filters. After many years of debate about the source of water, the DOE has finally agreed to examine the feasibility of stopping, or at least minimizing, the water inflow by grouting the shaft from outside. The EEG looks forward to the completion of this effort so that reliable air monitoring at the top of the shaft may continue.

Change of Repository Horizon

The DOE has proposed elevating the geologic horizon of the portions of the repository yet to be excavated by about two meters. The EEG has concurred with this proposal because it would enhance roof stability of the excavations by removing the salt beam between two thin anhydrite layers that parts and fractures due to salt creep (13). The floor will also display less heave because of the increased distance from Marker Bed 139, a 1-1/2-meter (5-foot) meter thick fractured layer of anhydrite and clay. With the concurrence of both the EEG and the EPA (14), the DOE has made the decision to implement this plan.

Non-WIPP Experiments Underground at WIPP

The DOE has proposed to allow using a part of the WIPP facility for conducting astrophysical and other basic science experiments unrelated to the WIPP's primary mission of disposal of TRU waste. The EEG has reviewed the draft environmental assessment (15) and agrees that the facility should be used to its maximum potential, assuming that such activities do not create problems for operational safety or for long-term isolation for TRU waste disposal. The issues to be addressed in the final environmental assessment for this activity include: securing authority to conduct non-disposal experiments in the facility from the U.S. Congress; providing a detailed description of the planned additional excavations for the experiments; specifying hoist needs; providing plans to maintain the structural integrity of the underground research facility for the

several decades duration of the proposed experiments; and providing plans to handle large quantities of liquids needed for the experiments (16).

Re-certification Issues

EPA certified in May 1998 that the WIPP meets compliance with the EPA standards for long-term isolation of transuranic waste, specified in subparts B and C of 40 CFR 191 (17). The WIPP LWA requires a re-certification decision by the EPA every five years after the initial receipt of TRU waste to show that compliance with 40 CFR 191, subparts B and C, can still be met in light of any new information. The first shipment of waste arrived at WIPP on March 26, 1999, and therefore, the first re-certification application is due from DOE to EPA by March 25, 2004. EEG has identified a number of performance assessment issues that should be resolved through additional experimental work and/or analyses in order to prepare a satisfactory application for re-certification (18, 19, 20, 21).

Of the issues that were raised by the EEG during the WIPP's certification process (18), some have acquired new significance due to additional data and/or analyses available. The issues that should be addressed during the first five-year re-certification are:

- The effects of shallow hydrology
- Microbial degradation of organic material in waste containers
- Room conditions and direct human intrusion scenarios
- Nonrandom emplacement of waste containers
- Plutonium chemistry
- Backfill evolution and effectiveness

MONITORING OF RELEASES

Air Monitoring Status Summary

The WIPP facility is designed for the disposal of several alpha-emitting TRU elements including 13 metric tons of weapons grade plutonium. The inhalation hazards associated with alpha-emitting particles are well recognized and after revision 5 to the WIPP WAC (22), there is no limit to the amount of respirable material in a container of CH-TRU waste. The WIPP facility includes air monitoring at the top of the exhaust shaft at a location referred to as Station A. Station A consists of three probes, each with three legs. Each leg leads to a filter designed to accumulate a sample of material discharged through the exhaust shaft.

During calendar year 2000, the effluent WIPP air sample extraction probes and transport lines at Station A were periodically removed for inspection and cleaning. Five of 14 inspections of probe A-3 (the sampling point of record) revealed salt encrustation sufficient to compromise the ability of the probe to collect a representative sample. In addition to probe fouling, a more obvious failure occurred when sampling filters from Skid A-3 became wet and lost airflow. It also now appears that Skid A-3 deposits disproportionate amounts of material between the three filters. Regression analysis of September and October gravimetric data of the amount of material collected on the filters reported by EEG, the Management and Operating Contractor (MOC) and

the Carlsbad Environmental Monitoring and Research Center (CEMRC) for legs A-3-1 v A-3-2, A-3-1 v A-3-3, A-3-2 v A-3-3 yielded coefficients of determination (r^2) 0.773, 0.229 and 0.254 respectively.

In an effort to supplement the air sampling program at WIPP, an additional single point air sampling system known as Station D-1 was established in August 2000 at the base of the air exhaust shaft near the intersection of the E300 and S400 drifts (Figure 1). Air in the E-300 drift does not have the entrained water droplets observed at Station A and thus the probe/transport line fouling is not a failure mechanism. The shrouded probe at Station D samples air flowing down the E-300 drift (downstream of the emplaced waste in Panel 1) before the air is diluted with air from the area of the waste shaft or the north end of the mine. Station D, therefore, offers a less dilute sample. However, a final report to confirm Station D compliance with American National Standards Institute (ANSI) N13.1 (23) has not been received from the MOC. During September and October 2000 EEG collected gravimetric data from all three legs at Station D-1 and noted good correlation in sample weight between the three legs. (Coefficients of determination for legs D-1-1 v D-1-2, D-1-1 v D-1-3, D-1-2 v D-1-3 0.978, 0.939 & 0.946 respectively).

At the present time, the MOC is planning to implement several improvements to the air monitoring systems at WIPP. Skid A-3 will be removed once each calendar quarter for disassembly, cleaning and leak testing. A procedure for routine cleaning of the filter support will be developed. The unequal sample distribution between the three legs of Skid A-3 is possibly related to unequal pressure differentials across the filter support material and could be reduced or eliminated by frequent cleaning or use of different filter support material. Consideration is also being given to moving the skid of record (compliance sample) from Skid A-3 to the skid with a history of the least fouling, Skid A-1 (Figures 2 and 3).

In the underground, the MOC is considering addition of Skid D-2 which would sample air flowing east through the S-400 drift from the waste shaft to the exhaust shaft. A third skid, D-3, would be located in the E-300 drift sampling air moving south from the experimental area of the mine toward the exhaust shaft. If the water inflow into the exhaust shaft, which is contributing to the fouling of Station A, cannot be resolved, DOE may choose to rely on samples collected from the underground at three different stations. In the absence of a solution to the water inflow, EEG expects use of Station D will greatly improve the reliability and representativeness of samples collected from the WIPP underground effluent air.

EEG Environmental Results for 1999

The EEG began conducting an environmental surveillance of the WIPP facility to establish the baseline of natural radioactivity in 1985. As expected, analyses of air particulates indicated a detectable presence of naturally occurring radium-226, radium-228, thorium-228 and thorium-232. In 1993, the EEG established its own radiochemical laboratory because of inconsistencies noted with commercial laboratory analysis. The EEG also helped establish a laboratory intercomparison program with the National Institute of Standards and Technology. Participation in this program validated the high level of accuracy and precision for each participant's analysis including that of the EEG laboratory (24). Thus, EEG had established and published a

radionuclide baseline for several years prior to initial receipt of TRU waste at WIPP, which began in March 1999.

During 1999, the EEG measured levels of Pu-238, Pu-239/240, Americium-241 (Am-241), cesium-137, and strontium-90 in samples of air collected from the WIPP underground and from surrounding communities, and in samples of local drinking water, surface water, and ground water. The samples were analyzed in EEG's radiochemical laboratory in Carlsbad. Figure 4 shows average measured concentrations of the transuranics (Am-241, Pu-238, Pu-239/240) in air in the WIPP environment, both prior to (baseline) and after (operational) receipt of waste.

Figure 4 shows that the levels of these radionuclides, after receipt of TRU waste, were not significantly different from the levels present in air in the WIPP environment prior to receipt of waste. Moreover, the EEG results in 1999 were not significantly different from the results of similar measurements by other laboratories conducting WIPP surveillance. Based on these results, the EEG concluded that WIPP operations during 1999 did not result in significant releases of radionuclides to the environment (25).

Radon Versus Transuranic Detection

On October 2, 2000 elevated removable alpha radioactivity levels were found on the gloves of waste handlers in underground emplacement Room 7. This caused a shift-to-filtration of the exhaust ventilation air and cessation of waste handling operations. The elevated levels were soon determined to be radon daughter products and not TRU radionuclides. EEG, at the request of DOE, performed an underground survey on October 6, 2000 and found only radon daughter activity. However, we were not able to sample waste drum surfaces. We recommended to DOE that they obtain more data on radon daughter behavior in the underground. Analysis of the data would allow development of a procedure to permit the delay, pending verification of the radionuclides present, of a shift-to-filtration at those times when elevated radon levels are likely.

REFERENCES

1. U.S. Congress 1996. The Waste Isolation Pilot Plant Land Withdrawal Act. Public Law 102-579, October 30, 1992, as amended by Public Law 104-201, September 23, 1996

2. J.K. CHANNELL and R.H. NEILL, "A Comparison of the Risks from the Hazardous Waste and Radioactive Waste Portions of the WIPP Inventory", EEG-72, Environmental Evaluation Group, Albuquerque and Carlsbad, NM (July 1999).

3. M.K. SILVA, "Letter dated June 8, 2000, from Matthew K. Silva, Director, EEG, to Steve Zappe, New Mexico Environment Department, transmitting EEG's comments on proposed Class 2 WIPP Hazardous Waste Facility Permit modifications" (2000).

4. M.K. SILVA, "Letter dated June 23, 2000, from Matthew K. Silva, Director, EEG, to Steve Zappe, New Mexico Environment Department, transmitting EEG's comments on proposed Class 2 WIPP Hazardous Waste Facility Permit modifications" (2000).

5. M.K. SILVA, "Letter dated September 26, 2000, from Matthew K. Silva, Director, EEG, to Steve Zappe, New Mexico Environment Department, transmitting EEG's comments on DOE's July 21, 2000 request for RCRA Class 2 permit Modification in accordance with 20.4.1.900 NMAC (incorporating 40 CFR 270)" (2000).

6. H.R. NEILL and R.H. NEILL, "A Reconsideration of Truck Versus Rail for Two Sites," *Natural Resources Journal*, Winter 2000, Vol. 40, No. 1 (2000)

7. NATIONAL RESEARCH COUNCIL, COMMITTEE ON THE WASTE ISOLATION PILOT PLANT, "Improving Operations and Long-Term Safety of the Waste Isolation Pilot Plant", Interim Report". National Academy Press, Washington, D.C., 44 p. (2000).

8. R. ROSS, "Small Quantity Site, RH and Rail Initiatives, presentation to New Mexico Radioactive Waste Consultation Task Force, October 19, 2000, Santa Fe, NM" (2000).

9. U.S. Nuclear Regulatory Commission 2000. Packaging and Transportation of Radioactive materials. 10 Code of Federal Regulations, Part 71.

10. M.K. SILVA, "Letter dated November 29, 2000, from Matthew K. Silva, Director, EEG to Inés Triay, Manager, Carlsbad Field Office, U.S. Department of Energy" (2000).

11. J.W. KENNEY, D.H. GRAY, S.C. BALLARD, and L. CHATURVEDI, "Preoperational Radiation Surveillance of the WIPP Project by EEG from 1996 - 1998", EEG-73, Environmental Evaluation Group, Albuquerque and Carlsbad, NM (October 1999).

12. D.H. GRAY, J.W. KENNEY, S.C. BALLARD, "Operational Radiation Surveillance of the WIPP project by EEG During 1999", EEG-79, Environmental Evaluation Group, Albuquerque and Carlsbad, NM (September 2000).

13. L. CHATURVEDI, "Letter dated September 22, 2000, from Lokesh Chaturvedi, Deputy Director, EEG, to L.B. Lilly, Assistant Manager, Office of Safety and Operations, Carlsbad Area Office, U.S. Department of Energy" (2000).

14. U.S. ENVIRONMENTAL PROTECTION AGENCY, "Letter dated August 11, 2000, from Frank Marcinowski, Acting Director, Radiation Protection Division, U.S. EPA, to Inés Triay, Manager, Carlsbad Area Office, U.S. Department of Energy" (2000).

15. U.S. DEPARTMENT OF ENERGY, "Environmental Assessment for Conducting Astrophysics and Other Basic Science Experiments at the WIPP Site", DOE/EA-1340, Carlsbad Field Office (2000).

16. M.K. SILVA, "Letter dated November 22, 2000 from Matthew K. Silva, Director, EEG to Mr. Harold Johnson, NEPA Compliance Officer, Carlsbad Field Office, U.S. Department of Energy" (2000).

17. U.S. ENVIRONMENTAL PROTECTION AGENCY, 1993 Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes. 40 Code of Federal Regulations, Part 191.

18. L. CHATURVEDI, R.H. NEILL, M.K. SILVA, D.F. RUCKER, J.K. CHANNELL, and W.T. BARTLETT, "Long Term and Operational Safety Issues at the WIPP", Proceedings, WM '99, Tucson, AZ, February 28 - March 4, 1999 (1999).

19. M. K. SILVA, D.F. RUCKER, and L. CHATURVEDI, "Resolution of the Long-Term Performance Issues at the Waste Isolation Pilot Plant", *Risk Analysis,* Vol. 19, No. 5, 1999, pp. 1003-1016 (1999).

20. D.F. RUCKER, M.K. SILVA, L. CHATURVEDI, "Performance Assessment Issues to be Resolved at the Waste Isolation Pilot Plant", Spectrum 2000, September 24-28, 2000, Chattanooga, TN (2000).

21. R.H. NEILL, L. CHATURVEDI, D.F. RUCKER, M.K. SILVA, B.A. WALKER, J.K. CHANNELL, T..M. CLEMO, "Evaluation of the WIPP Project's Compliance with the EPA Radiation Protection Standards for Disposal of Transuranic Waste", EEG-68, Environmental Evaluation Group, Albuquerque and Carlsbad, NM (March 1998).

22. U.S. DEPARTMENT OF ENERGY, "Waste Acceptance Criteria for the Waste Isolation Pilot Plant, Revision 5", DOE/WIPP-069, Carlsbad, NM (1996).

23. AMERICAN NATIONAL STANDARDS INSTITUTE, 1999, American National Standard-Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities. ANSI/HPS N131-1999

24. J.W. KENNEY, D.H. GRAY and S.C. BALLARD, "Preoperational Radiation Surveillance of the WIPP Project by EEG During 1993 through 1995", EEG-67, Environmental Evaluation Group, Albuquerque and Carlsbad, NM (March 1998).

25. D.H. GRAY, J.W. KENNEY, and S.C. BALLARD, "Operational Radiation Surveillance of the WIPP Project by EEG During 1999", EEG-79, Environmental Evaluation Group, Albuquerque and Carlsbad, NM (September 2000).

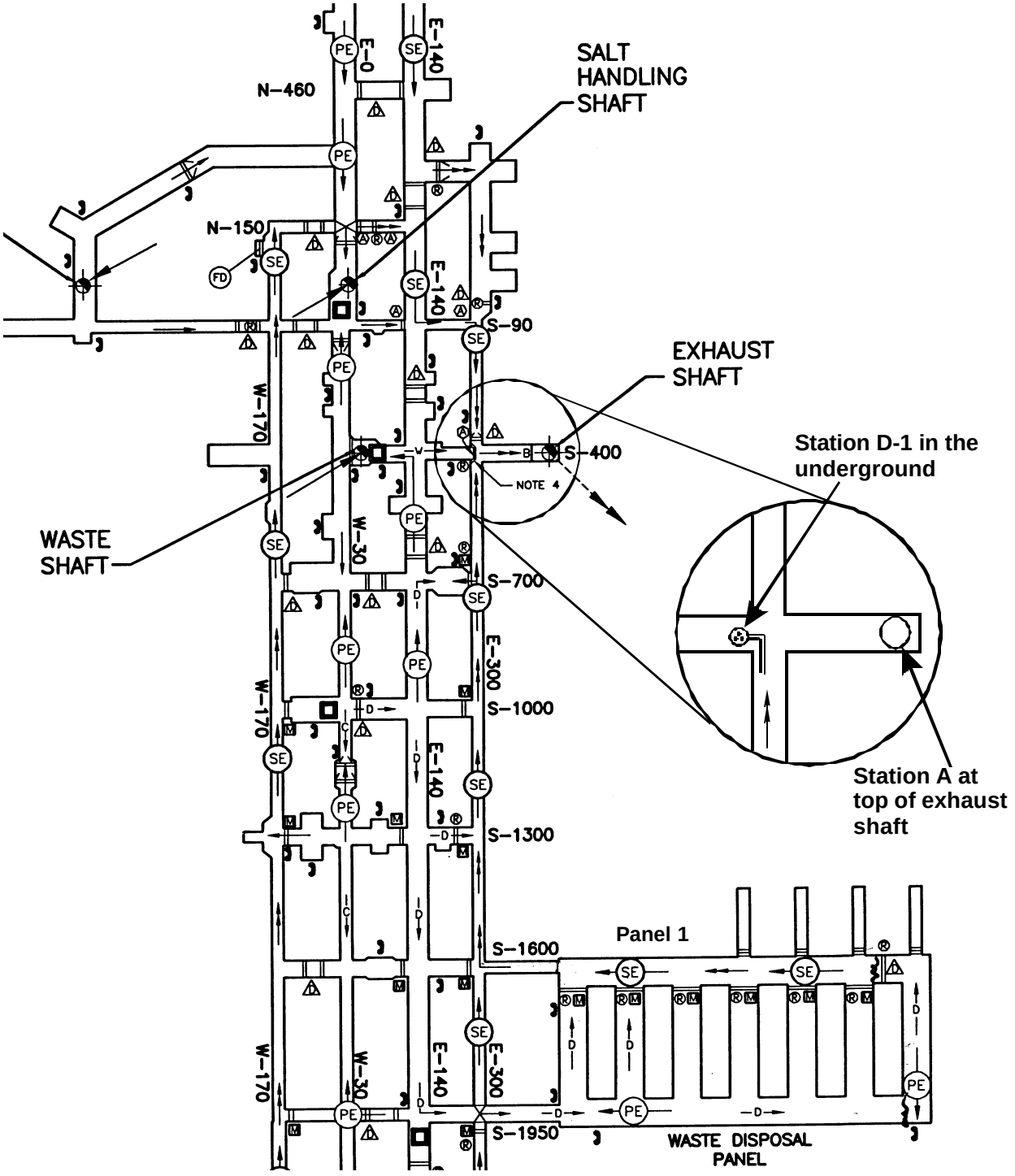

Fig. 1. Location of Station A and D.

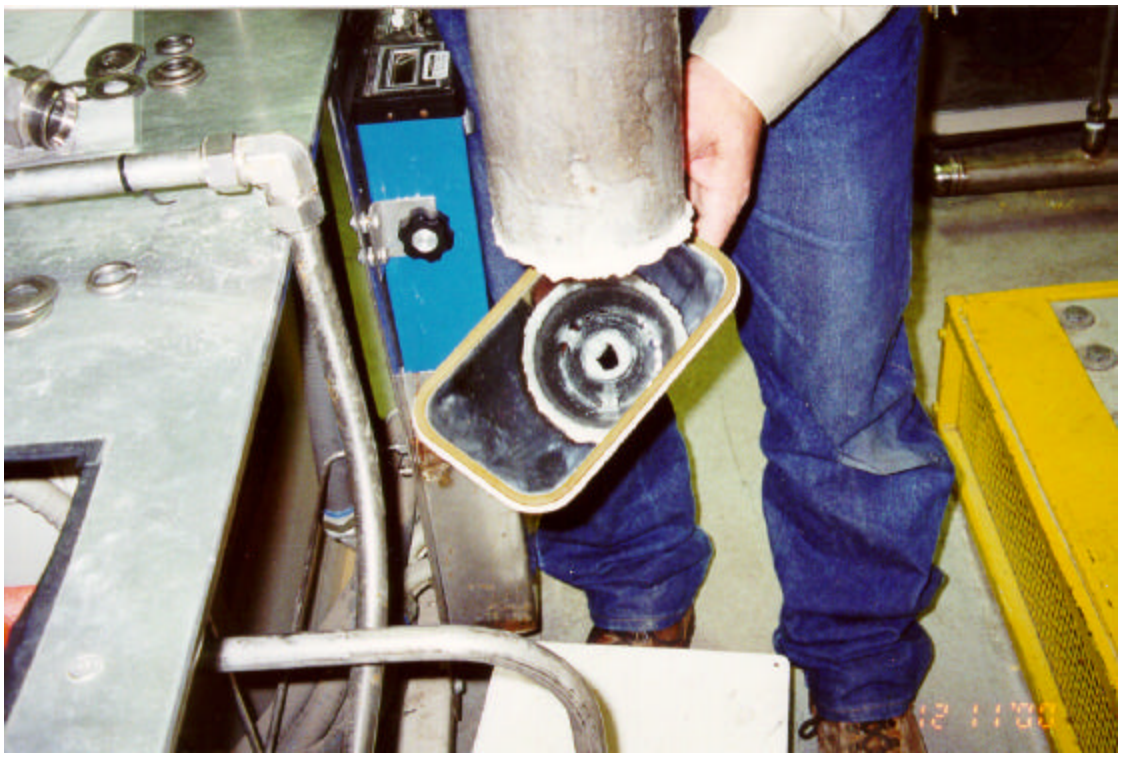

Fig. 2. Probe A-3.

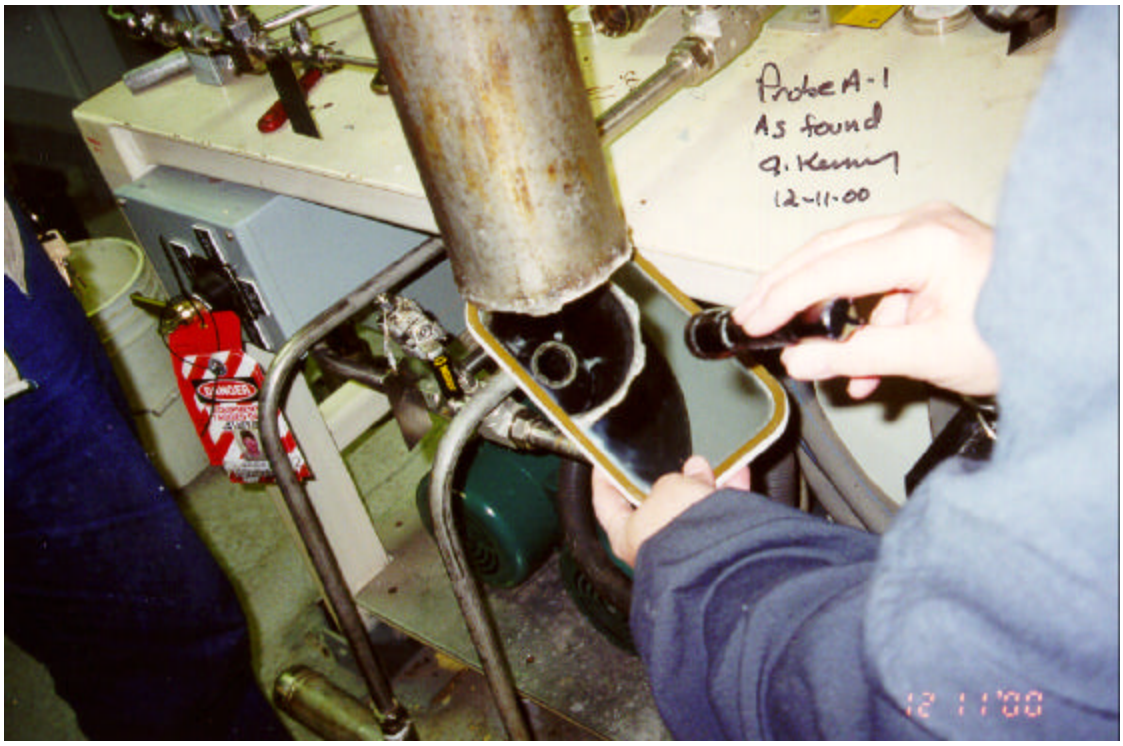

Fig. 3. Probe A-1.

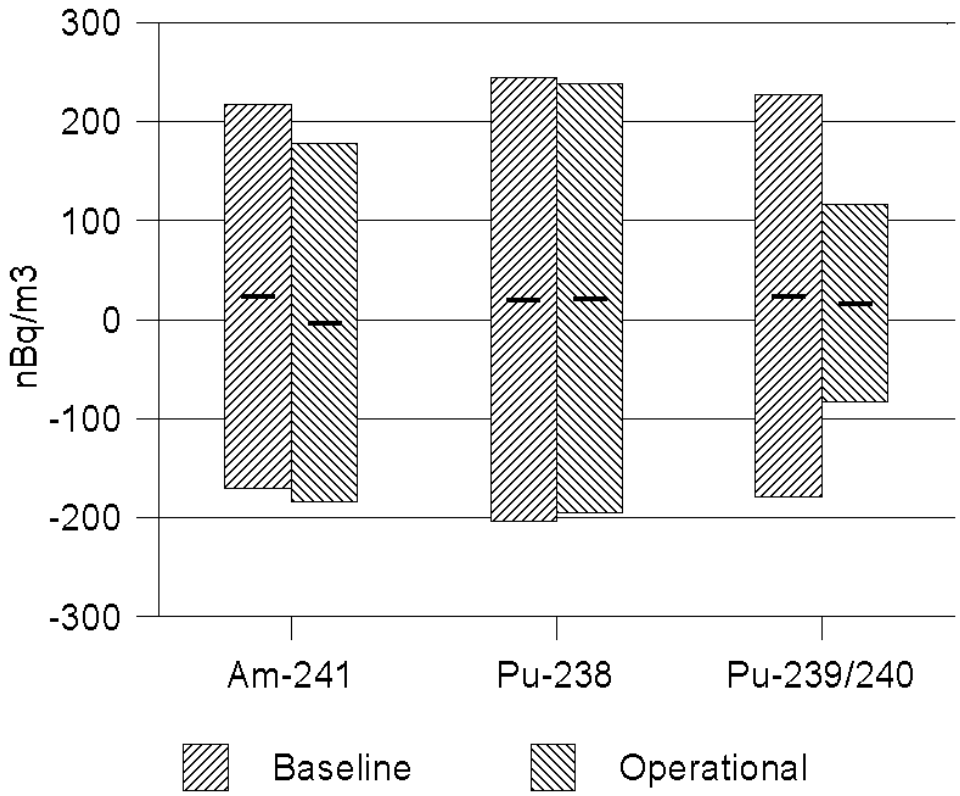

Fig. 4. Baseline and Operational Levels of Radionuclides.