VOLATILE ORGANIC COMPOUND (VOC) AIR MONITORING PROGRAM DESIGN FOR THE WASTE ISOLATION PILOT PLANT*

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ABSTRACT

The Waste Isolation Pilot Plant (WIPP) Volatile Organic Compound (VOC) Monitoring Program has been developed as part of the Department of Energy's (DOE's) No-Migration Variance petition submitted to the Environmental Protection Agency (EPA). The program is designed to demonstrate that there will be no migration of hazardous chemicals past the unit boundary in concentrations which exceed any health-based standards. The monitoring program will use EPA compendium Method TO-14. Both air and carbon sorption media samples will be collected as part of the program. Eleven separate monitoring sites have been selected where both 24-hour integrated and 1-hour grab samples will be collected and analyzed for five target compounds. the bin-scale experimental test rooms will be configured with a gas collection manifold and an activated carbon sorption bed to remove VOCs before they can be emitted into the WIPP underground atmosphere.

INTRODUCTION

The VOC Monitoring Program (DOE, 1990) has been developed and submitted to the U.S EPA as part of the DOE No-Migration Variance Petition (DOE, 1989). The program has been developed for monitoring of air emissions of VOCs from the WIPP underground waste disposal facility. The program is designed to demonstrate that there will be no migration of hazardous chemicals from WIPP in concentrations which exceed EPA established health-based levels. The program is responsive to the requirements of 40 CFR 268.6 and supports DOE's No-Migration Variance Petition. The EPA has made a conditional no-migration determination for the WIPP Test Phase (55 FR 47700 November 14, 1990). This determination allows the DOE to emplace waste in the WIPP that is subject to Resource Conservation and Recovery Act (RCRA) land disposal restrictions without prior treatment.

The WIPP is located in southeastern New Mexico approximately 26 miles east of Carlsbad. The mined underground repository is constructed in a massive salt bed called the Salado Formation at a depth of approximately 2,150 feet below the ground surface. The WIPP is a DOE research and development facility designed to demonstrate the safe and environmentally sound disposal of radioactive waste resulting from defense and research programs of the United States. The facility is designed to receive, handle, and dispose of transuranic (TRU) waste. TRU waste is defined as waste with an alpha activity of 100 nanocuries per gram or greater and contains radionuclides with an atomic number greater than 92 (e.g., plutonium, americium, curium) and half-lives greater than 20 years.

Initially, mixed waste will be emplaced underground only for the purposes of conducting tests to determine more precisely the impacts of the waste on the long-term performance of the repository. Mixed waste is defined as a mixture of waste components that consist of hazardous waste regulated under Subtitle C of RCRA and radioactive waste regulated by the Atomic Energy Act.

This paper describes the sampling, analysis, and quality assurance (QA) programs that will be implemented during the WIPP Test Phase. The program is aimed at quantifying VOC emissions to the underground air of the repository that may potentially be emitted to the outside atmosphere through the main facility Exhaust Shaft. The EPA has determined, through their evaluation of the DOE No-Migration Variance Petition, that air is the only credible pathway for the potential transport of contaminants during the Test Phase at WIPP.

MONITORING PROGRAM DESIGN

The sampling and analysis method selected for the VOC Monitoring Program is EPA Compendium Method

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TO-14 (EPA, 1988). This method uses specially designed self-contained canister samplers. Samples will be analyzed using high-resolution gas chromotography, followed by full scanning mass spectroscopy (GC/MS/SCAN) to provide the capability to identify a wide variety of VOCs. The method is capable of detecting the hazardous constituents targeted for quantification with a sensitivity of less than one part per billion.

Waste Description

Approximately 60 percent of the waste proposed to be emplaced at WIPP during the lifetime of the facility is classified as mixed waste, which consists of waste that contains both radioactive and RCRA-regulated hazardous chemical components (DOE, 1989). Generator knowledge of the wastes and analytical data from sampling of headspace gases from waste drums (Clements and Kudera, 1985), have been used to provide preliminary definition of the most prevalent VOCs in TRU mixed waste. The average headspace gas concentrations are presented in Table I (Clements and Kudera, 1985).

TABLE I

Average Headspace Gas Composition

Compound	Concentration (g/l)
Carbon tetrachloride	1.85×10^{-3}
Methylene chloride	4.76×10^{-4}
1,1,1-Trichloroethane	1.32×10^{-2}
Trichloroethylene	6.99×10^{-4}
1,1,2-Trichloro-1,2,2-trifluoroethane	1.22×10^{-3}

Representative samples of TRU mixed waste will be placed in experimental steel bins and transported to WIPP for use during the Test Phase. These bins will generally contain the equivalent of approximately six 55-gallon drums of waste. The waste included in the test bins contains small amounts of several VOCs as well as other RCRA-regulated constituents. The VOCs most commonly present in the wastes are:

- 1,1,2-Trichloroethane (1,1,1-TCA)
- Carbon tetrachloride
- 1,1,1-Trichloro-1,2,2-trifluoroethane (freon 113)
- Methylene chloride
- Trichloroethylene

These five VOCs are the target compounds which will be routinely quantified by the WIPP VOC Monitoring Program. In addition to these five compounds, several other VOCs have been identified in some waste samples and may be added to the monitoring program in the future, these include:

- Perchloroethylene
- Chloroform
- Bromoform
- Dichloroethane
- Dichloroethylene
- Toluene
- Chlorobenzene

The EPA has required that these additional compounds or any other identified VOC be targeted for routine quantification if the average concentration at the point of sampling is one ppm or more during any four-month period and the compound is detected in at least 10 percent of the samples collected at any sampling location.

Sources of VOCs

During the Test Phase, VOCs may be emitted from several sources including the test bins, alcoves, and other activities not related to waste management. Test bins emplaced in the underground during the Test Phase will be equipped with a one-way pressure relief valve, which will allow the release of gases when the bins become pressurized. All emission of gases from the bins will be controlled by a system of ducting which will direct emitted gases out of the test room housing the bins. Gases in the ducting system will be directed through a carbon sorption system where VOCs will be removed prior to discharge to the underground atmosphere.

Total gas generation rates for each bin have been calculated and are presented in Molecke (1989). A gas generation rate of five moles per drum per year was used to estimate the maximum potential release. Based on experimental data, this rate is considered a credible maximum. Assuming this rate of gas generation, a total of 670 liters of gas per bin per year may potentially be released. The majority of gases generated by the test bins will consist of hydrogen, methane, carbon dioxide, and nitrogen.

The design of the carbon sorption system is dependent on the quantity of VOCs emitted from the test bins. To estimate the quantity of VOCs that may be present in the waste that will be stored in bins for use during the Test Phase, it was assumed that the average concentration found in drums from the Rocky Flats Plant are continuously present. The total mass in grams of each of the five predominant VOCs in the headspace of the bins were calculated based on the drum headspace gas analysis, and are given in Table II. The quantities of VOCs shown in Table II could be

available for release from the bin-scale experiments to the underground atmosphere of the WIPP facility and then subsequently for release to the outside atmosphere through the Exhaust Shaft if they were not controlled by the carbon sorption system.

TABLE II

Total Quantity of Volatile Organic Compounds Available for Release From the Bin-Scale Experiments

Chemical	Total Quantity (grams/room/year)
Carbon tetrachloride	144
1,1,1-Trichloroethane	1,026
Methylene chloride	37
1,1,2-Trichloro-1,2,2-trifluoroethane	95
Trichloroethylene	54

Numerous other sources of VOCs exist at the WIPP site. These include lubricants, solvents, paints, and other materials not related to the waste. These materials used both above and below ground at WIPP, will contribute VOCs to the underground atmosphere. It can be expected that the ambient atmosphere drawn into the Air Intake Shaft (AIS) will also contain measurable concentrations of some VOCs. The AIS is located just east of the employee parking lot. Gasoline and diesel powered vehicles will be parked and operated in the vicinity of the shaft during most hours of the day. In addition, petroleum extraction and potash mining and refining operations, which may be background sources of VOCs, are located in the vicinity of the site.

At the present time, there are no detailed data for facility or background sources of VOCs at the WIPP. However, during an experimental sampling exercise conducted in March, 1990, background concentrations of some of the five target compounds were measured in the WIPP underground. Operation of the VOC monitoring stations is now planned to begin at least 30 days prior to the receipt of waste at the WIPP. Background sources will be monitored and evaluated prior to waste being emplaced in the WIPP underground.

In order to quantify any releases of VOCs from the experimental waste emplaced in the WIPP underground the distribution of background sources of VOCs will be identified, and their contribution to the total measured concentrations defined.

Sampling Locations

Gas and air samples for determination of VOC concentrations will be collected at multiple locations at the facility to measure concentrations at both the point of potential release in the underground and at the point of emission into the atmosphere (at the top of the Exhaust Shaft). Since the concentration of VOCs at the point of release to the atmosphere may be difficult to quantify with currently available technologies (1 part per billion by volume [ppbv]), sampling will be conducted near the points of potential release prior to dilution with the mine ventilation air. VOC samples will be collected from the bin-scale tests in Rooms 1 and 2 of Panel 1, at the intake and outlet of Panel 1, at the inlet to the AIS, and at the top of the Exhaust Shaft (Fig. 1). Additional sampling stations may be established for the alcove-scale tests should they be conducted in the future. The most intensive sampling will occur near the bin-scale experimental areas. Figure 1 shows the locations of the individual sampling stations.

Bin-Scale VOC Sampling

The bin-scale monitoring system (Stations VOC-10 and VOC-11) is a unique design relative to most RCRA air monitoring programs. The system will sample a completely captive emission stream using an engineered manifold unit which collects and routes all of the gases generated by the bins through an activated carbon sorption system and then to the sampling equipment. The manifold system has been designed to have no impact on the bin-scale experiments.

All of the bins in the bin-scale tests will be placed in Panel 1, Rooms 1 and 2. The bins in each room will be vented to a common gas discharge system (manifold). Each bin will be equipped with a high efficiency particulate air (HEPA) filter to remove radioactive particulates from the bin emissions prior to entering the gas collection manifold. The gas collection manifold system will also be equipped with an activated carbon sorption bed designed to remove VOCs from the gases emitted by the test bins prior to being released to the atmosphere of Panel 1. VOC samples will be taken at the downstream side of the carbon sorption system (Fig. 2).

Panel 1 Intake and Outlet

VOC sampling stations will be established at the intake (VOC-8) and outlet (VOC-9) of the Panel 1 waste disposal area. The downstream or outlet station in Panel 1 will monitor any VOC emissions potentially released from any leaks in the bin ducting and manifold system and background concentrations entering Panel 1. Subtraction of VOC target compound concentrations in the Panel 1 air intake passageway (background) from those measured in the air outlet will yield an estimate of VOCs that may have been released from the bin rooms.

The sampling equipment used at the Panel 1 stations will consist of single stand alone canister samplers installed in enclosed shelters. The shelters will serve to protect the

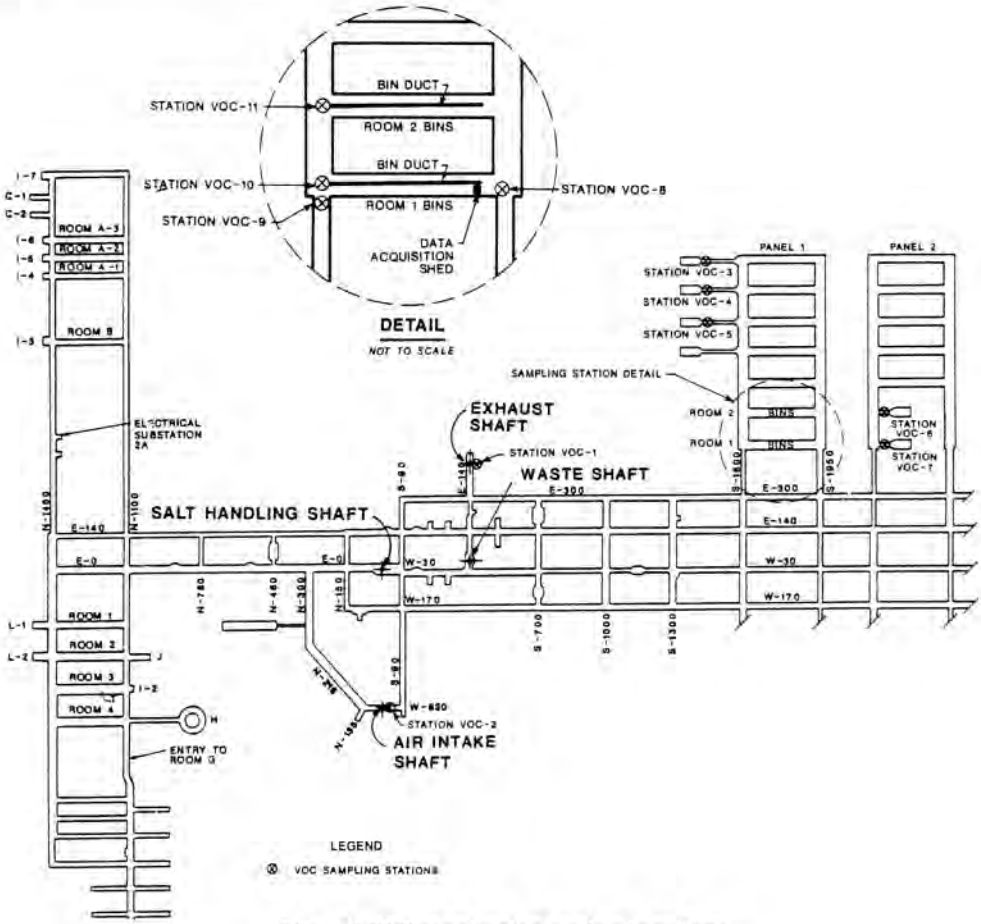

Fig. 1. VOC monitoring station locations.

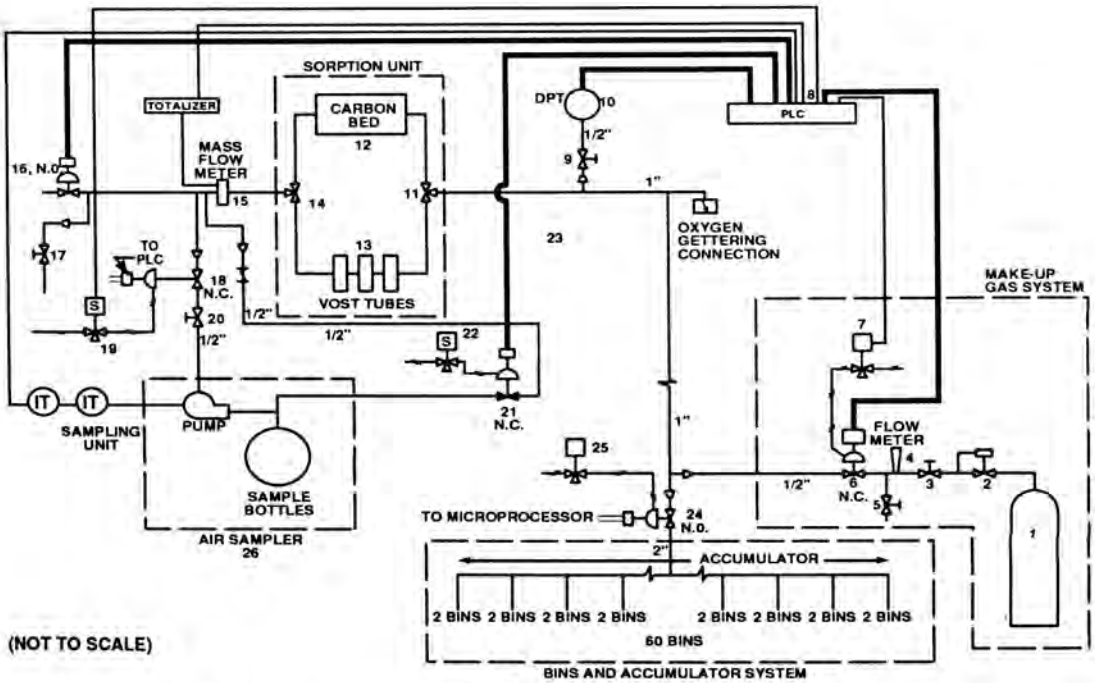

Fig. 2. Schematic diagram of VOC monitoring system for bin-scale rooms.

samplers from salt dust and underground operational hazards.

Air Intake Shaft Sampling Station

The station deployed at the AIS (VOC-2) is designed to measure detectable quantities of the target compounds in the ambient air drawn into the underground. This station will consist of a single stand alone sampler installed in a protective shelter.

Exhaust Shaft Sampling Station

The Exhaust Shaft sampling station (VOC-1) will be deployed in existing Station A, located at the top of the shaft. Station A is an established monitoring station as part of the radioactive particulate monitoring program at WIPP. This monitoring station will represent the facility unit boundary sampling site. This VOC sampler will be integrated into the existing sampling system to measure detectable quantities of the VOC target compounds in the exhaust airstream leaving the underground facility (Fig. 3). Station A has been shown to provide a reliable average sample across the cross-section of the shaft (Newton, et al., 1987).

Sampling Method

The method selected for sampling and analysis is EPA Compendium Method TO-14 (EPA, 1988) using six-liter canisters. SUMMA passivated stainless steel canisters will be used to collect 24-hour integrated samples at all locations except for the test alcoves, where one-hour grab samples will be obtained. The samplers will be operated in the pressurized mode. In this mode, air is pumped into evacuated canisters by the sampler which regulates the rate and duration of the sampling episode. At the end of each sampling episode, the canisters will be pressurized to about two atmospheres.

The frequency of sample collection at each location is shown in Table III. Not all samplers will be operated on the same schedule, nor will sampling begin at each location at the same time. Sampling for the bin-scale rooms, the inlet and outlet to Panel 1, and at the Air Intake and Exhaust Shafts will be conducted over 24-hour integrated time periods. Twenty-four hour composite sampling will provide an integrated sample which will be representative of the entire medium being sampled. Composite sampling will ensure that any potential short-term changes in VOC concentrations will be reflected in the composition of the sample. Grab samples of approximately one-hour in duration will be collected from the test alcoves. Grab sampling will provide representative samples of the alcove gases since the atmospheres in the sealed alcoves will be constantly mixed.

The sampler will generally be programmed to fill one canister per day at all sampling locations. During specific days, duplicate samples will be collected, where the sampler will be programmed to fill two separate canisters simultaneously. During weekends and holidays, the sampler and a secondary sampling module will be programmed to fill up to four separate canisters in sequence, one for each sampling day. Once programmed, the sampler can be left unattended until all sample canisters are filled.

Sample Analysis

The analysis system that will be used with the canister samples is gas chromotagraphy/mass spectroscopy (GC/MS) operating in the SCAN mode. Detailed analysis and definitive quantification will be obtained for the five target compounds: carbon tetrachloride, methylene chloride, 1,1,1-trichloroethane, trichloroethylene, and 1,1,2-trichloro-1,2,2- trifluoroethane. As part of the routine GC/MS/SCAN analyses for all samples, semi-quantitative results will be reported for all identifiable VOC compounds.

The sample introduction system for the canister samples and standards includes a thermostated oven to allow

TABLE III
Sampling Schedule

Sampling Location	Station Number	Sampling Frequency	Sampling Duration/Type
Bin Gas Discharge System	VOC-10,11	Daily	24-hr./Integrated
Alcoves	VOC-3,4,5, VOC-6,7	Daily	1 to 2-hr./Grab
Panel 1 Air Intake	VOC-8	Daily	24-hr./Integrated
Panel 1 Air Outlet	VOC-9	Daily	24-hr./Integrated
Exhaust Shaft	VOC-1	Weekly	24-hr./Integrated
Air Intake Shaft	VOC-2	Weekly	24-hr./Integrated

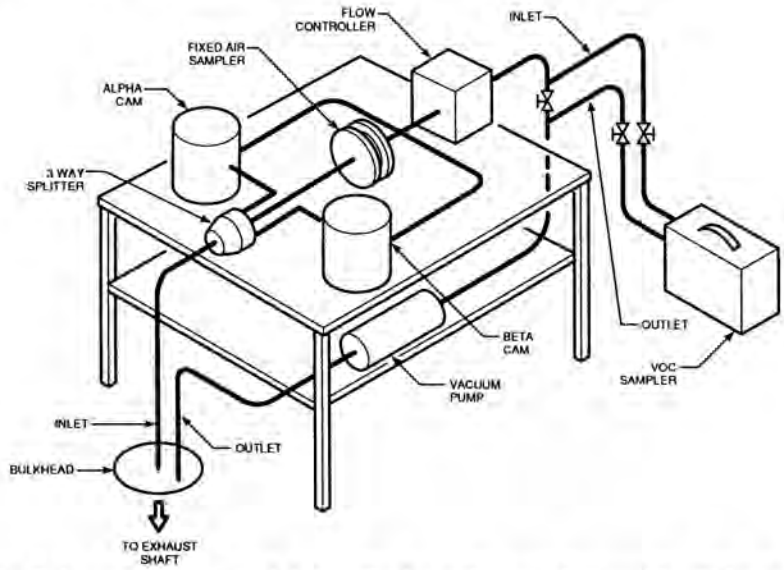

Fig. 3. Layout of tubing inlet & outlet from the sampling unit to skid a in station A.

canisters to be evacuated at a constant temperature. The system also includes a Nafion drying tube to remove moisture from the gas stream and a cryogenic trap to focus and desorb trapped material. Transfer lines, valves, and solenoids are heated so that VOCs are not adsorbed by the system. The introduction system is capable of introducing standards directly into the sample flow path. Forward searches of the National Bureau of Standards (NBS) library of mass spectra will be performed for all chromatographic peaks greater than 10 percent of the nearest internal standard. In addition to the five target compounds, semi-quantitative results will be reported for all identifiable compounds meeting this requirement.

Both the VOC samplers and the sample canisters must undergo rigorous cleaning and certification procedures prior to initial use. In addition, the canisters must be recertified after every use and the samplers after every calendar quarter. EPA Compendium Method TO-14 is being used as the guidance document for the preparation of these procedures.

Sampling systems will be cleaned and leak checked before use. Next, the instruments will undergo a humid zero air certification to demonstrate that less than 0.2 ppbv of the target compounds exists in the systems. Finally the samplers will be challenged with a humid calibration gas to demonstrate a target compound recovery of 90-110 percent. This certification process will be repeated on each sampler quarterly. Sample canisters will also be cleaned and certified to the same concentration level of 0.2 ppbv. All cleaned and certified canisters are then evacuated and are ready for use.

Operation of the Bin-Scale Manifold System

The design of the bin-scale monitoring system will practically eliminate the possibility of emissions of VOCs from the bin-scale experiments by making the entire emission stream from each test room captive. Gases generated by the bins will be collected by a series of two-inch stainless steel tubing installed in the rooms (Fig. 4). This tubing will act as a reservoir for the generated gases. The gases will then be routed to the sampling equipment through a smaller diameter tubing manifold. This manifold will be equipped with a specially designed activated carbon sorption bed. All gases released by the bins will be routed by the manifold through the carbon sorption bed. The carbon sorption bed has been designed to be greater than 95 percent effective in removing VOCs from the gas emission stream. The design as proposed to the EPA in the WIPP No-Migration Variance Petition (DOE, 1989), represents a 400 percent overdesign safety factor. After the gases have passed through the sorption bed, they will be sampled by the canister sampler and then emitted to the atmosphere of Panel 1. The VOC sampler will be located immediately downstream of the carbon sorption bed and just prior to the manifold discharge point (Fig. 2).

The bin-room manifold system has several integrated components which work together to effectively eliminate VOC emissions. The manifold system is a pressure balanced series of tubing and valves, which are instrumented and controlled by an electronic programmable logic controller (PLC). The internal pressure of the manifold is continuously monitored by a differential-pressure transducer. The internal pressure of the manifold is compared by the PLC to the local ambient pressure *in the vicinity of the* monitoring system. When the difference (pressure differential) in these pressures exceeds the range of -0.1 to +0.4 psi, the internal pressure is adjusted to bring it back into the desired range. This pressure balancing activity is required in order

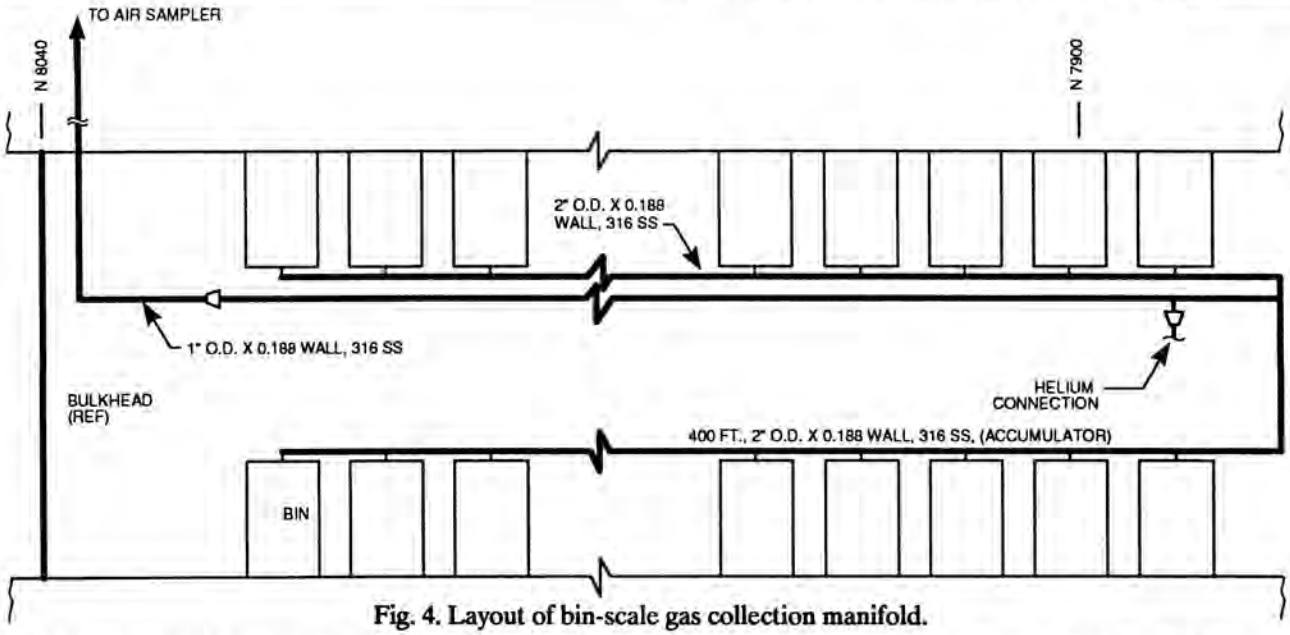

Fig. 4. Layout of bin-scale gas collection manifold.

to maintain the desired external pressure at the outlet of the bin exhaust ports.

The internal pressure balance of the manifold system is maintained by the addition of ultra-pure helium, as a make-up gas, when the manifold pressure falls below the range described above. The helium make-up gas system will be controlled by the PLC and a high quality metering control valve and flow meter. The helium feed will be adjusted daily to a calibrated flow rate which equals the maximum sampling requirement of 10 ml/min. Helium flow into the manifold will be controlled by the PLC, so that when the desired internal manifold pressure has been achieved, flow will be stopped by closing an electronic solenoid valve located between the helium supply tank and the flow control valve.

The discharge point for the entire manifold system is equipped with an electronic solenoid valve, which is normally closed. When the manifold internal pressure rises above the upper limit of the pressure range, the PLC signals the solenoid valve to open and vent the manifold to the atmosphere of Panel 1. This will lower the pressure until it is within the desired range, and the valve will be closed.

The VOC sampler pump will remove gas from the manifold at a rate of approximately 8.0 to 10.0 ml/min. Initial calculations indicate that the bin-gas generation rate may be well in excess of this sampling volume. The addition of helium to maintain the internal manifold pressure would only be required if the bins generate gas at a much lower rate than is anticipated.

For long-term operation, where the bins are potentially generating gas near the calculated rate, the helium make-up gas system will not operate, and the manifold will remain open to the Panel 1 atmosphere to vent bin generated gases. During the early stages of the bin-scale tests, gas generation rates may be much lower than the calculated maximum rate, and they could be essentially zero. In this case, it is possible that all of the gas collected by the sampler would be from the ultra-pure helium make-up gas supply.

The bin-scale monitoring system will include a sampling loop to allow sampling of the activated carbon sorption material (Fig. 2). This sampling loop will consist of three Volatile Organic Sampling Train (VOST) tubes, connected in sequence. The specific lifetime of the carbon sorption bed will be calculated from data developed by conducting VOST tube sampling experiments during the early months of the Test Phase. The design capacity of the sorption bed has been determined through calculations of the total mass of VOCs expected to be emitted annually. The validity of this calculation will be confirmed by the use of the VOST sampling loop.

The VOST tubes will each contain approximately eight grams of activated carbon, identical to the type used in the main carbon sorption bed. These tubes will be used and analyzed in manner based on a modification of EPA test Method 0030, as described in SW-846 (EPA, 1986). The data from analysis of the tubes, coupled with the system mass flow data collected during each test period, will provide a basis for estimating more accurately the lifetime of the carbon in the main sorption unit. Once the analytical data from VOST sampling experiments are received and evaluated, the test will be repeated, probably at a modified test duration. This iterative process will continue until the lifetime of the main unit can be predicted with confidence. An additional check on the main sorption bed will be obtained from analysis of the VOC canister samples. As the bed becomes saturated with VOCs, the measured concentrations will rise, indicating a need for replacement of the sorption bed.

Data Reporting and Compliance Determination

To determine if migration of VOCs has occurred (i.e., any of the targeted compounds exceeded health-based levels at the unit boundary), EPA has required that concentrations be averaged over an annual time period and reported in annual data summary reports. To define if migration is occurring, DOE is required to report to EPA within 10 days, if during any three-month period the average concentration of any hazardous constituent measured or calculated in the Exhaust Shaft above background, exceeds a health-based level (EPA, 1990). This reporting requirement coupled with the sampling frequency at the VOC release points will allow early determination of potential failure of the VOC control system and rapid corrective action before any migration occurs.

The determination of compliance with the no-migration standard is based on the contribution of VOCs from the waste emplaced in Panel 1 to the final concentration measured at the unit boundary (top of the Exhaust Shaft). The VOC contribution by the waste, as measured at the top of the Exhaust Shaft, cannot exceed any of the EPA prescribed health-based levels. According to data provided by EPA, the current compliance health-based standard for carbon tetrachloride, one of the five target compounds, is 0.03 ug/m^3. Values for the other compounds are: methylene chloride, 0.3 ug/m^3, and trichloroethylene, 0.3 ug/m^3. EPA has not specified similar values for the other two target compounds. At present there are no commercially available sampling and analysis methods that allow for quantification of multiple VOCs at such low levels. Since the compliance health-based levels apply at the unit boundary, it would be desirable to measure the concentrations of these compounds at this point. However, it is unlikely that detectable quantities of the target compounds will exist at the unit boundary. Therefore, monitoring in the Exhaust Shaft alone cannot be used for compliance determination.

Monitoring at the potential points of VOC release will be performed because measurable concentrations would more likely exist there. Monitoring at these points will be used to determine compliance with the health-based concentrations. The analytical results from the samples collected from the bin-scale and alcove-scale monitoring systems will be combined with the measured gas flow rates from the monitoring systems and with the underground mine ventilation air flow to calculate equivalent concentrations at the unit boundary.

Any VOC emissions from the bin-scale and alcove-scale tests will be greatly diluted by the underground mine ventilation air flow. The volumetric air flow through the underground facility is 12,035 m^3/min (425,000 ft^3/min) or 1.73 x 107 m^3/day. The estimated maximum concentration of VOCs at the unit boundary assuming a complete failure of the carbon sorption system is provided in Table IV.

TABLE IV

Maximum Daily Concentrations of Volatile Organic Compounds at the Unit Boundary Assuming No Carbon Sorption System

Chemical	Concentration (ug/m^3)
Carbon tetrachloride	0.023
Methylene chloride	0.006
Trichloroethylene	0.009
1,1,1-Trichloroethane	0.162
1,1,2-Trichloro-1,2,2-trifluoroethane	0.015

Table V shows the calculated concentrations of the target compounds at the unit boundary, assuming that the carbon sorption system is 95 percent effective in removing VOCs from the gas emission stream from the bin-scale experiments. These concentrations are several orders of magnitude below the EPA established health-based levels.

TABLE V

Maximum Daily Concentrations of Volatile Organic Compounds at the Unit Boundary Assuming 95 Percent Sorption Effectiveness

Chemical	Concentration (ug/m^3)
Carbon tetrachloride	.0012
Methylene chloride	.0003
Trichloroethylene	.0005
1,1,1-Trichloroethane	.0081
1,1,2-Trichloro-1,2,2-trifluoroethane	.0008

QUALITY ASSURANCE PROGRAM

A detailed Quality Assurance Program Plan (QAPP) has been prepared for the program. The QAPP addresses all relevant requirements of NQA-1 (ANSI/ASME 030) and EPA's QAMS document (EPA, 1983). Specific aspects of the study included in the QAPP include: project organization, procurement/control of items and services, work instructions, equipment calibration and maintenance, sampling activities, sample chain of custody, laboratory analyses and procedures, quality control testing, numerical

analyses, data reporting, control of nonconformances/corrective actions, QA audits, and records administration.

To ensure data quality, additional quality control samples will be collected and routinely analyzed as part of the sampling program. These additional analyses include: blank analyses, duplicate samples, and analysis of audit gases of known composition and concentration. EPA has prescribed the project data quality objectives for accuracy, precision, and data completeness (EPA, 1990). These data quality objectives are given in Table VI. The quality control samples that will be collected during the program and the general QA objectives are discussed below.

TABLE VI

Quality Assurance Objectives for Accuracy, Precision, and Completeness(Values in Percent)

Compound	Accuracy	Precision	Completeness
Carbon tetrachloride	+10	+15	>90
Methylene chloride	+10	+15	>90
Trichloroethylene	+10	+15	>90
1,1,1-Trichloroethane	+10	+15	>90
1,1,2-Trichloro-1,1,2-trifluoroethane	+10	+15	>90

Blank Analyses

A trip blank and a laboratory blank will be analyzed for each batch of canisters shipped to the laboratory. In addition, one field blank and one laboratory blank will be analyzed for each set of three VOST tubes.

Duplicate Analyses

Duplicate analyses will be performed by the laboratory on single canisters and on sets of VOST tubes at a frequency of 10 percent, to determine laboratory precision. In addition, duplicate canister samples will be collected in the field at a frequency of 10 percent to assess field sampling precision.

Audit Cylinders

Audit gas cylinders containing the five target compounds at known concentrations will be used to determine the relative accuracy of the field sampling method. Audit cylinder gas will be sampled through the sampling system into clean certified canisters and submitted to the laboratory for analysis. Sampling of audit gases will be performed at a frequency of 10 percent. In addition, standard audit gas cylinders obtained from an independent source will be introduced to the laboratory at a frequency of one percent to determine laboratory analytical accuracy.

Estimated Analytical Costs for Quality Assurance

The total estimated analytical costs for the project will be highly dependent on the actual implementation of the program. The detailed QA program developed for the project has a significant impact on the overall cost of analytical services. Quality Assurance related samples will increase the cost of laboratory services substantially. Approximately 25 to 30 percent of the total analytical cost can be attributed to the QA related samples planned for the project. The estimated number of samples that will be collected and submitted to the laboratory during the first four months of the project are given in Table VII.

TABLE VII

Estimated Sample Quantity (Initial Four Month Period)

	Canisters	Vost Tubes
Routine Samples	341	39
QC Samples	107	26
Total Samples	448	65

SUMMARY

Under 40 CFR 268.6 and as a required component of the conditional variance granted by EPA for the WIPP, the VOC Monitoring Program has been developed and is being implemented for the Test Phase period at the facility. The program is designed to demonstrate that there will be no airborne migration of hazardous chemicals, resulting from the emplaced waste, above health-based criteria. It is likely that the air monitoring program will continue at the facility during the operational phase.

Air monitoring will be performed at up to 11 individual locations on a daily or weekly basis. Most sampling will be performed over 24-hour integrated time periods, resulting in highly representative samples. Considering the parts per trillion health-based criteria specified by EPA for some of the target compounds, monitoring will be performed at the points of potential release of VOCs in the underground facility. In addition, an ambient background sampling station will be established at the AIS on the surface.

The selected sampling method, EPA Compendium Method TO-14, uses evacuated stainless steel canisters to collect air samples for subsequent analysis by GC/MS/SCAN for VOCs. The sampling equipment is self-contained and can be operated for up to four days unat-

tended. A unique gas collection manifold and carbon sorption system has been designed for the bin-room experiments to collect gases released by the experiments and remove VOCs from the emission gas stream.

A comprehensive QA program has been developed to ensure data quality. QC samples planned as part of the QA program are a significant component of the monitoring program.

REFERENCES

1. AMERICAN NATIONAL STANDARDS INSTITUTE, ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities, 030 No. M-41385.
2. T. L. CLEMENTS, JR., and D. E. KUDERA, TRU-Waste Sampling Program: Volume I: Waste Characterization, and Volume II: Gas Generation Studies, EEG-WM-6503, Idaho National Engineering Laboratory (1985).
3. DOE, Waste Isolation Pilot Plant No-Migration Variance Petition, DOE/WIPP 89-003, Carlsbad New Mexico (1989).
4. DOE, VOC Monitoring Plan, (1990).
5. M. A. MOLECKE, Test Plan: WIPP Bin-Scale CH TRU Waste Tests, Sandia National Laboratories, Albuquerque, New Mexico (1989).
6. G. J. NEWTON, K. J. SHENK, Y. F. SU, H. C. YEH, M. D. HOOVER, and B. B. BOECKER, 1987, Inhalation Toxicology Research Institute, Aerosol Studies for Evaluation of "Isokinetic" Sampling at the Waste Isolation Pilot Plant: Phase 1, Measurements in the 14-ft Diameter Exhaust Shaft, Albuquerque, New Mexico 87185.
7. U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA), Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80, EPA-600/4-83-004, Washington, D.C. (1983).
8. U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA), SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition, Office of Solid Waste and Emergency Response, Washington, D.C. (1986).
9. U.S ENVIRONMENTAL PROTECTION AGENCY (EPA), Compendium Method TO-14, The Determination of Volatile Organic Compounds (VOC) in Ambient Air Using SUMMA Passivated Canister Sampling and Gas Chromatographic Analyses, May 1988, Quality Assurance Division, Environmental Monitoring Systems Laboratory, Research Triangle Park, North Carolina (1988).
10. U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA), Department of Energy Waste Isolation Pilot Plant; Notice of Final No-Migration Determination, Federal Register, Vol. 55, No.220, P.47700, November 14, 1990, (55FR 47700) (1990).