# Class 2 Permit Modification Request

## Monitor for Hydrogen and Methane until Final Panel Closure

**November 2007**

## Overview of the Permit Modification Request

This document contains a Class 2 Permit Modification Request (**PMR**) for the Waste Isolation Pilot Plant (**WIPP**) Hazardous Waste Facility Permit (**HWFP**), Number NM4890139088-TSDF, hereinafter referred to as the WIPP HWFP.

This PMR is being submitted by the U.S. Department of Energy (**DOE**), Carlsbad Field Office (**CBFO**) and Washington TRU Solutions LLC (**WTS**), collectively referred to as the Permittees, in accordance with the WIPP HWFP, Condition I.B.1 (20.4.1.900 New Mexico Administrative Code (**NMAC**) incorporating Title 40, Code of Federal Regulations (**CFR**), §270.42(b)). In this modification the Permittees propose to:

- monitor for hydrogen and methane until final panel closure;
- establish action levels for hydrogen and methane;
- install substantial barriers and steel bulkheads to isolate a full panel for monitoring purposes;
- evaluate the monitoring data to determine an appropriate final closure system;
- revise the location and frequency of Volatile Organic Compound (**VOC**) monitoring in full panels until final panel closure;
- inspect and certify the isolation walls in Panels 1 and 2 and inspect the bulkheads in Panels 3 through 7 until final panel closure, and
- extend the final closure in Panels 1 through 7 to 2016.

The proposed changes will not reduce the ability of the Permittees to provide continued protection of human health and the environment.

The requested modifications to the WIPP HWFP and related supporting documents are provided in this PMR. The proposed modifications to the text of the WIPP HWFP have been identified using a double underline, and a ~~strikeout~~ font for deleted information. All direct quotations are indicated by italicized text. The following information specifically addresses how compliance has been achieved with the WIPP HWFP requirement, Permit Condition I.B.1 for submission of this Class 2 PMR.

Current Regulatory Status

The Permittees submitted a Class 3 modification to NMED in October 2002 entitled Panel Closure Redesign.

Subsequent to the October 2002 submittal, the Permittees submitted a Class 1* modification to NMED requesting an extension of the time to close Panel 1. Specifically the request was to install the explosion isolation wall component of the approved Option D Panel Closure System, but to delay installing the concrete monolith until the request for the redesigned closure system had been considered. This request to NMED was supported by an engineering assessment of the short-term stability of the explosion isolation wall.

This Class 1* request was approved in a letter to the Permittees from NMED in December 2002.

A similar Class 1* request for Panel 2 was approved by NMED in 2005.

A Class 1* request to extend the closure period for Panels 1-3 was submitted to the NMED in January 2007 and approved by the NMED in February 2007. The request, as it related to Panels 1 and 2, was supported by an updated engineering assessment of the stability of the explosion isolation walls.

The Permittees are currently emplacing waste in Panel 4.

After discussions with the NMED and stakeholders, the Permittees believe that it would be premature for the NMED to act upon the October 2002 Class 3 PMR. Therefore, the Permittees have requested that the Class 3 PMR be withdrawn.

**1. 20.4.1.900 NMAC (incorporating 40 CFR §270.42(b)(1)(i)) requires the applicant to describe the exact change to be made to the permit conditions and supporting documents referenced by the permit.**

This Permit Modification Request (**PMR**) is being submitted to request the following changes to Module IV, Attachment D, Attachment I, Attachment N and a new attachment (Attachment N1) in the HWFP, to incorporate changes to the monitoring program, closure plan and inspection program:

1) Monitor each full panel for methane and hydrogen until final panel closure.

2) Establish action levels for methane and hydrogen that would trigger various activities which may include the installation of the explosion isolation wall component of the existing panel closure system.

3) Beginning with Panel 3, add a substantial barrier and a steel bulkhead, in the intake and exhaust drifts of the panel as part of the monitoring program. The bulkhead will be of the type typically in use at WIPP with no personnel access.

4) Collect data to be used in determining the final closure for each panel.

5) Initiate an inspection schedule and inspection criteria for the explosion isolation walls in Panels 1 and 2 as well as the bulkheads in Panel 3 through 7 until final panel closure.

6) Revise VOC monitoring locations in full panels and revise the frequency of VOC monitoring in full panels to monthly until final panel closure.

7) Extend final closure dates for Panels 1 through 7 to 2016.

The exact changes to permit conditions and revised text are included.

**2) 20.4.1.900 NMAC (incorporating 40 CFR §270.42(b)(1)(ii)) requires the applicant to identify that the modification is a Class 2 modification.**

The proposed modification is classified as a Class 2 permit modification in accordance with 20.4.1.900 NMAC incorporating 40 CFR §270.42, Appendix I, item A.4.b, "Changes in the frequency of or procedures for monitoring, reporting, sampling, or maintenance activities by the permittee; other changes" and item B.4 "Changes in the frequency or content of inspection schedules".

Also, Appendix I, Item D.1.b. states "Changes in the closure schedule for any unit, changes in the final closure schedule for the facility or extension of the closure period" is a Class 1 modification with prior approval of the Secretary. The Permittees request that this change be processed as a Class 2 permit modification as allowed in 20.4.1.900 NMAC incorporating 40 CFR §270.42(a)(3).

**3) 20.4.1.900 NMAC (incorporating 40 CFR §270.42(b)(1)(iii)) requires the applicant to explain why the modification is needed.**

This PMR is needed to establish a hydrogen and methane monitoring program for hazardous waste disposal units that have received waste but have not undergone final closure.

**<u>Definitions</u>**

| | |
|---|---|
| Substantial Barrier | Salt or other non-combustible material installed between the waste face and the bulkhead to protect the waste from events such as ground movement or vehicle impacts. The substantial barrier incorporates the chain link and brattice cloth room closure specified in the HWFP. |
| Bulkhead | A steel structure, with flexible flashing, which is used to block ventilation. |
| Explosion Isolation Wall | The 12-foot wall intended as an explosion isolation device which is part of the approved panel closure. |
| Lower Explosive Limit | The lowest concentration in air at which a gas will ignite and explode. The terms lower explosive limit and lower flammability limit are used interchangeably in fire science literature. |
| Filled Panel | A hazardous waste disposal unit which will no longer receive TRU mixed waste. |

**<u>Hydrogen and Methane Monitoring Program</u>**

**<u>Protection of Human Health and the Environment</u>**

The hazardous waste constituents which might escape from the panels are volatile organic compounds (**VOCs**). Hydrogen and methane which might accumulate in panels are non-VOC gases. Nine VOCs are monitored during waste operations in a panel through a network of tubing installed in the rooms, as well as in the repository as a whole. Disposal room VOC monitoring is used in conjunction with the chain link and brattice cloth room closures to confirm that harmful levels of VOCs will not accumulate and protection of workers is assured. Repository VOC monitoring measures VOC concentrations in the air that is being discharged from the repository to again confirm that harmful levels of VOCs will not accumulate and protection of workers and members of the public outside the repository is assured. Action Levels have been established for both disposal room and repository VOCs to assure that they are not released in concentrations that would pose a threat to human health. These Action Levels are currently part of the HWFP and are not being proposed for change in this PMR.

Hazardous wastes in particulate form will not escape from waste panels because wastes are disposed in intact containers that remain closed. Ventilation barriers and panel closure components prevent the release of particulate material under conditions that would breach disposed containers.

The non-VOC gases of concern in full panels are the flammable gases methane and hydrogen, which may be generated by waste degradation. These flammable gases, although not directly regulated as hazardous waste constituents, are of concern because of the potential for them to buildup to harmful levels.

The Permittees propose to begin monitoring for hydrogen and methane in each filled room in full panels 3 through 7 until final panel closure, and on the inside and outside of each monitoring bulkhead to ensure that these gases do not accumulate to harmful concentrations.

**Monitoring of Hydrogen and Methane**

Hydrogen and methane may be generated in full panels that contain waste. Methane may be generated under humid or inundated conditions by the microbial degradation of organic material such as cellulosics, plastic and rubber (**CPR**) in the waste. Hydrogen is generated by radiolysis and may be generated by corrosion of the steel drums and other steel materials in the waste under inundated (flooded) conditions. However, inundated conditions are not expected to occur during operations and closure. For both gases, there are considerable uncertainties in the rates of gas generation under the conditions expected at the WIPP. These include brine/moisture availability, the viability of microbes in the WIPP and ; the extent to which certain CPR components are susceptible to microbial degradation. As a result of the uncertainty, panel closures designed assuming the worst possible conditions for flammable gas generation (e.g., availability of moisture, availability of microbes and nutrients, lack of alpha source depletion).

Monitoring the quantities of hydrogen and methane present in Panels 3 through 7 until final panel closure is an effective way to gather data to establish whether generation of these gases actually occurs and if so, determine more realistic generation rates. More realistic generation rates may lead to panel closure designs that are less complex than the current design. In addition, collecting data under a monitoring program assures worker safety during operation of the repository.

This PMR concentrates on monitoring hydrogen and methane for the following reasons:

- Hydrogen and methane are the only gases which could be generated in quantities that could pose a threat to human health or the environment.
- Hydrogen and methane generation rates are uncertain.
- Methane as a generated gas will provide data useful for evaluating the current microbial gas generation models.

- Hydrogen as a generated gas will provide data useful for evaluating the current radiolysis and corrosion models.

The Permittees anticipate that hydrogen and methane will not be generated at levels of concern throughout the operational life of the WIPP facility. This monitoring will provide data to evaluate the radiolysis and corrosion models.

**Target Gases to be Monitored**

The target gases proposed for monitoring are methane and hydrogen.

Oxygen, which is also needed for an explosive mixture to develop, will not be monitored. The reason for this is that the LELs for both methane and hydrogen are inversely related to oxygen content, that is, as the oxygen level decreases the LEL increases. Thus, setting action levels for methane and hydrogen assuming an oxygen content equivalent to that of air is a conservative approach.

**Potential Sources of Hydrogen**

Hydrogen can be generated by radiolysis and by corrosion of iron based materials under inundated conditions. In order for radiolysis to occur, there must be a source of alpha radiation and material containing hydrogen. A conservative, constant estimate of the production rate of hydrogen by radiolysis of waste, based on the actual inventory of hydrogenous waste materials in Panel 3, is about 4.5E-05 moles per second. Generation at this rate might lead to an average concentration of 5% by volume in a filled and closed WIPP panel in about 20 years after inundated conditions exist ("*Estimation of Hydrogen Generation Rates From Radiolysis in WIPP Panels*", July 26, 2006), neglecting any loss of hydrogen by diffusion. However, hydrogen generation by radiolysis should decrease asymptotically to a very low value due to depleting the matrix of the available hydrogen. That is, as hydrogen in the localized waste that surrounds the radioactive materials is released via radiolysis, the amount of remaining hydrogen will be depleted and the rate of hydrogen generation will decrease.

In addition to radiolysis, hydrogen can be generated by anoxic corrosion of various metal components of the waste and packaging (primarily iron and aluminum based materials) under inundated conditions. It should be noted that aluminum and aluminum alloy corrosion rates are much slower than those for iron based materials. Estimates of the rates of hydrogen production under anoxic and fully brine inundated conditions may be made however these rates are quite uncertain in the short-term being considered here. Inundated conditions cannot reasonably be expected during the operational and closure periods of the repository. Information presented in the WIPP HWFP application shows that during the operational and closure periods of the repository the maximum brine saturation in the repository is predicted to be extremely low.

Specifically:

- Active corrosion of the metals requires inundated conditions, which modeling has shown is highly unlikely to occur. Some corrosion may occur under humid conditions, but the rates will be very low as indicated in the HWFP Application (Appendix D-11).

- Initially corrosion will be inhibited until paint on the drum surfaces is removed, and internal steel components are accessible.
- On initial closure of a panel oxic (oxygen rich) conditions will prevail, and oxic corrosion may be expected to commence in the presence of brine. Under these conditions oxygen is consumed and iron oxides formed and no hydrogen is generated. If brine were present in enough abundance, at some point the oxygen in the full panels would be expected to be consumed due to corrosion and microbial degradation reactions, though some oxygen may be produced by radiolysis. Only after the oxygen is depleted and in the presence of brine, could anoxic corrosion be expected to occur with generation of hydrogen.

Therefore it is likely that the rates of hydrogen generation by corrosion will be very low for some extended period of time after the repository is closed and sealed. This notwithstanding, the accumulation of hydrogen is mitigated by the ease of diffusion of hydrogen through highly impermeable materials.

## Potential Sources of Methane

Methane can be produced from microbial degradation of organic materials such as CPR. Microbial processes are conceptualized to occur sequentially, with the organic carbon being consumed by denitrification (bacterial reduction of nitrates and nitrites to nitrogen), followed by sulfate reduction, both of which produce carbon dioxide, and ultimately by methanogenesis (bacterial formation of methane) which produces carbon dioxide and methane (Brush 1990; Brush 1995; Wang and Brush 1996). In the WIPP, nitrate ($NO_3^-$) and sulfate ($SO_4^{2-}$) will be present in the waste and it is assumed that methane will not be produced until these electron acceptors are exhausted.

Under some scenarios envisaged for the WIPP sufficient sulfate will be available (from the waste, the Salado brine, and the sulfate minerals in the surrounding rock mass) to inhibit methane generation. Under other scenarios the sulfate is limited to that in the waste and Salado brines: in this case it is estimated that denitrification, sulfate reduction, and methanogenesis consume 4.72%, 0.82%, and 94.46% of the organic carbon in the CPR materials, respectively (DOE 2004, Appendix BARRIERS). If it is assumed that the processes are indeed purely sequential, then it may be assumed that no methane will be generated until about 5.5% of the CPR has been degraded. With the shortest time for full degradation of the CPR estimated at about 200 years, this means no methane will be generated for at least the first 10 years after degradation starts. If it is assumed that the generation rate will be 0.1 moles per drum per year, then it will take about 20 years after the start of methane generation for a 5% methane concentration to be achieved (DOE 1996, Appendix PCS).

## Flammable VOCs

There are flammable VOCs in the waste. However these represent a fixed source which will deplete over time, and a source which is limited to levels well below flammability by the transportation requirements. Since additional VOCs are not generated in large quantities, if at all, the quantities of the flammable VOC components are expected to remain quite small and further diminish over time and hence are not considered a significant issue related to the development of an explosive atmosphere in a full panel.

**Consideration of RH TRU Mixed Waste**

As stated previously, gas can be generated in TRU waste by one of three mechanisms:

- Corrosion of metals
- Microbial degradation of CPR materials
- Radiolysis, primarily of CPR materials and water

These gas generation mechanisms are the same for CH and RH TRU mixed waste. The contribution of RH waste to gas generation is expected to be small since the volumes of potential sources of gas in RH are much smaller than in CH. The WIPP Compliance Recertification Application (**CRA**) (DOE 2004, Appendix TRU WASTE, Section 2.1.2) confirms this as indicated below:

> *"The WIPP Land Withdrawal Act (LWA), Pub. L. No. 104-201, 110 Stat. 2422 defines the amount of TRU waste allowed in the WIPP to 175,564 $m^3$ (6,200,000 $ft^3$). The "Agreement for Consultation and Cooperation" limits the remote handled (RH)-TRU waste inventory to 7,079 $m^3$ (250,000 $ft^3$) (State of New Mexico vs DOE, 1981). By difference, the contact handled (CH)-TRU waste inventory is limited to 168,485 $m^3$ (5,950,000 $ft^3$)"*

Data from Table TRU WASTE-1 of this reference gives the following current densities for those solid materials which can generate gas.

| Waste Material | CH-TRU Waste | | RH-TRU Waste | | RH as a % of Total TRU Waste |
|---|---|---|---|---|---|
| | Average Mass Density ($kg/m^3$) | Projected Mass (kg) | Average Mass Density ($kg/m^3$) | Projected Mass (kg) | |
| Fe-based Metal/Alloys | 110 | $1.8 \times 10^7$ | 110 | $7.8 \times 10^5$ | 4.2 |
| Al-based Metal/Alloys | 14 | $2.4 \times 10^6$ | 2.5 | $1.8 \times 10^4$ | 0.7 |
| Total Fe + Al | | $2.1 \times 10^7$ | | $7.9 \times 10^5$ | 3.8 |
| Cellulosic Materials | 58 | $9.8 \times 10^6$ | 4.5 | $3.2 \times 10^4$ | 0.3 |
| Rubber Materials | 14 | $2.4 \times 10^6$ | 3.1 | $2.2 \times 10^4$ | 0.9 |
| Plastic Materials | 42 | $7.1 \times 10^6$ | 4.9 | $3.5 \times 10^4$ | 0.5 |
| Total CPR | | $4.0 \times 10^7$ | | $8.7 \times 10^4$ | 0.5 |

Radiolysis and microbial generation of gas from CPR will be small for RH compared to CH given the relatively small content of CPR (less than 1% of that in CH). Thus the percentages of the gas generating solids in RH-TRU are small relative to CH-TRU waste and do not merit special consideration.

The Permittees contend that hydrogen and methane will not be generated at levels of concern throughout the operational life of the WIPP facility by either CH or RH waste. This monitoring will provide data to evaluate the radiolysis and corrosion models.

**Substantial Barrier and Bulkhead**

The proposed substantial barrier and bulkhead, which is part of the monitoring system that will be used in the panel entries, will be constructed similar to those currently used for ventilation control in the WIPP underground.

The substantial barrier serves to protect waste from events such as ground movement or vehicle impacts. This barrier will be constructed from available non-flammable materials such as mined salt (Figure 1).

The bulkhead serves to block ventilation to the panel. The bulkhead will consist of a steel member frame covered with galvanized sheet metal, and will not allow personnel access. Rubber conveyor belt will be used as a gasket to seal the steel frame to the salt. (Figure 2). Over time it is possible that the bulkhead may be damaged by creep closure around it. If the damage is such as to indicate a possible loss of functionality which cannot be repaired then an additional bulkhead will be constructed outside of the original one. The following provides a description of the materials and construction of bulkheads used at the WIPP.

The materials are rectangular steel bracing, galvanized sheet metal, rubber conveyor belt, and steel fasteners (e.g. bolts, screws, battens). The bulkheads are fabricated using the rectangular steel tubes for the posts, headers, horizontal, and vertical members of the frame. Steel is used because it is a non-combustible material. Pre-drilled steel plates are welded across the bottoms of the posts. These plates are bolted to the salt floor to hold the bottom of the bulkhead in place.

The physical properties of the salt in the repository are such that the salt will "creep" or slowly deform into any opening. Gradually over time the cross-section area, or size, of the drifts (passageways) underground becomes smaller. To account for the movement of the ground and the diminishing size of the drifts, the bulkheads are attached to the roof of the drifts using a moveable system. The system consists of a large bracket welded to the top of the post. A pre-drilled plate is welded to a piece of tubular steel that is small enough to fit into the bracket. The piece of tubular steel is placed into the bracket and the plate is bolted to the roof. The tubular steel can slide in the bracket and this allows the top fastening of the bulkhead to accommodate the slow convergence of the roof and floor.

Once the frame has been bolted to the floor and the roof, it is covered with galvanized sheet metal. The sheet metal is fastened to the posts, vertical, and horizontal members of the bulkhead frame.

Even though the salt roof, sides and floor of the drifts are carefully scaled before installation, these surfaces are not perfectly smooth. The steel sheet metal used over the tubular framework is rigid and will not bend to conform to these salt surfaces. For this reason, the main posts and headers of the bulkhead are placed about 12” to 18” from the roof, sides and floor of the drift. This gap, between the bulkhead frame and the salt, is covered with rubber conveyor belt. The conveyor belt is attached to the salt using a 1" steel strap and special nails that are shot from a nail-gun. The rubber is attached to the steel frame with screws and 1” steel strap. The strap acts as both a washer, so that the screws and nails will not pull through the rubber, and a batten, so that the belting conforms closely to the surface to which it is attached. (see details in

Figure 2)

Bulkheads at WIPP are prefabricated before installation and a bulkhead of the sizes likely to be used for panel monitoring purposes requires about two shifts (15 to 20 hours) to install. Bulkheads of these sizes typically require minimal maintenance.

The bulkheads for panel isolation will be constructed without vehicle doors, man doors, or regulators. Figure 2 shows a typical bulkhead of the size that will be used for panel isolation. They will be solid in the sense that there will be no openings of any sort such that a vehicle or person could pass through to the waste side of the bulkhead. While the bulkhead installations at the WIPP are solid and tight, they are neither leak-proof nor explosion-proof. However, the amount of air that can pass through the very small openings that occur between the rubber flashing and the salt is so small that it cannot be measured with the low speed anemometer in use at WIPP. This equipment has an air speed range of 30 to 5,000 feet per minute. The Permittees estimate that the velocity around the bulkhead would be in the range of 0.6 to 1.8 feet per minute. A solid bulkhead of the type described will effectively remove the panel from the active ventilation system.

Experience at the WIPP shows that bulkheads constructed as described stand up to substantial pressures without failing in any way and are conservatively constructed for the conditions encountered at the WIPP. Many WIPP bulkheads typically experience a pressure of 3" water gage but it is not uncommon to expose them to pressures of 5" water gage or more, for example during testing and balancing of the ventilation system.

Bulkhead inspection and maintenance activities are detailed in proposed modifications to Attachment D of the HWFP. The accessible portions of the bulkheads will be inspected monthly for deterioration and integrity. WIPP procedures will detail the specific inspection criteria and the Cognizant Engineer will determine what actions are required should deterioration or loss of integrity be noted during an inspection.

**Monitoring Methods**

Monitoring of hydrogen and methane will be conducted using SUMMA® canister methods similar to those described in Attachment N of the HWFP. General information on this method is provided below:

Samples for analysis of hydrogen and methane concentrations will be collected using the subatmospheric pressure grab sampling technique described in USEPA Method TO-15. This method uses an evacuated SUMMA® passivated canister (or equivalent) that is under vacuum (0.05 mmHg) to draw the air sample from the sample lines into the canister. The sample lines will be purged prior to sampling as recommended by the method. The passivation of tubing and canisters used for hydrogen and methane sampling effectively seals the inner walls and prevents compounds from being retained on the surfaces of the equipment. By the end of each sampling period, the canisters will be near atmospheric pressure.

There are no EPA specific analytical methods which address hydrogen or methane. However, non-EPA methods are available (e.g., ASTM D 1945-03). The Carlsbad Environmental Monitoring and Research Center (**CEMRC**) has developed a procedure for analyzing these gases (CEMRC Procedure "*CCP-TP-143, Carlsbad Environmental*

*Monitoring and Research Center Headspace Gas Analysis*").  Alternate procedures or laboratories may be used as approved by the Permittees.

**Monitoring Locations**

The existing VOC monitoring lines will be used for sample collection in each disposal room for Panels 3 through 7.  The sample lines and their construction are shown in Figure 3 of this PMR.

In addition to the existing VOC monitoring lines, five more sampling locations will be used to monitor for hydrogen and methane. These additional locations include:

- the inlet of room 1
- the  waste side of the exhaust bulkhead,
- the accessible side of the exhaust bulkhead,
- the waste side of the intake bulkhead,
- the accessible side of the intake bulkhead.

These additional sampling locations will use a single inlet sampling point placed near the back.  This will maximize the sampling efficiency for these lighter compounds.  These sampling locations are shown in Figure 4 of this PMR.

The concern has been raised that the small tubular lines used to withdraw air samples from closed rooms in filled panels could be restricted or blocked by salt dust or fluid accumulations.

With regard to salt dust, blockage of the lines would require movement of the air at a sufficient rate to entrain the dust particles.  However, because of the chain link, brattice cloth, substantial barriers and bulkheads it is reasonable to conclude that the air within the filled panels will be stagnant.  This means there will be no salt particulate entrained in the air near the sampling line intakes.  Particulate matter will settle out and none will be available to encrust the sampling line intakes.

Mechanical damage to the tubing is also unlikely.  The tubing used in disposal room monitoring is stainless steel. This ensures that it is a substantial, tough sampling line. The tubing is installed on chain link used as a ground control measure. This chain link actually acts as a buffer to any specific point damage that could occur from the wall of the panel.  The tubing is also coiled during production, and therefore has some flexibility. This is a positive feature that allows for the tubing to bend as room creep occurs.

The tubing has been in use at WIPP in panels 1, 2, 3 and 4.  The tubing installed in panel 3 was installed in early 2005 and continues to perform without problems. It is expected that the tubing would last well beyond the data collection period associated with the methane and hydrogen monitoring.

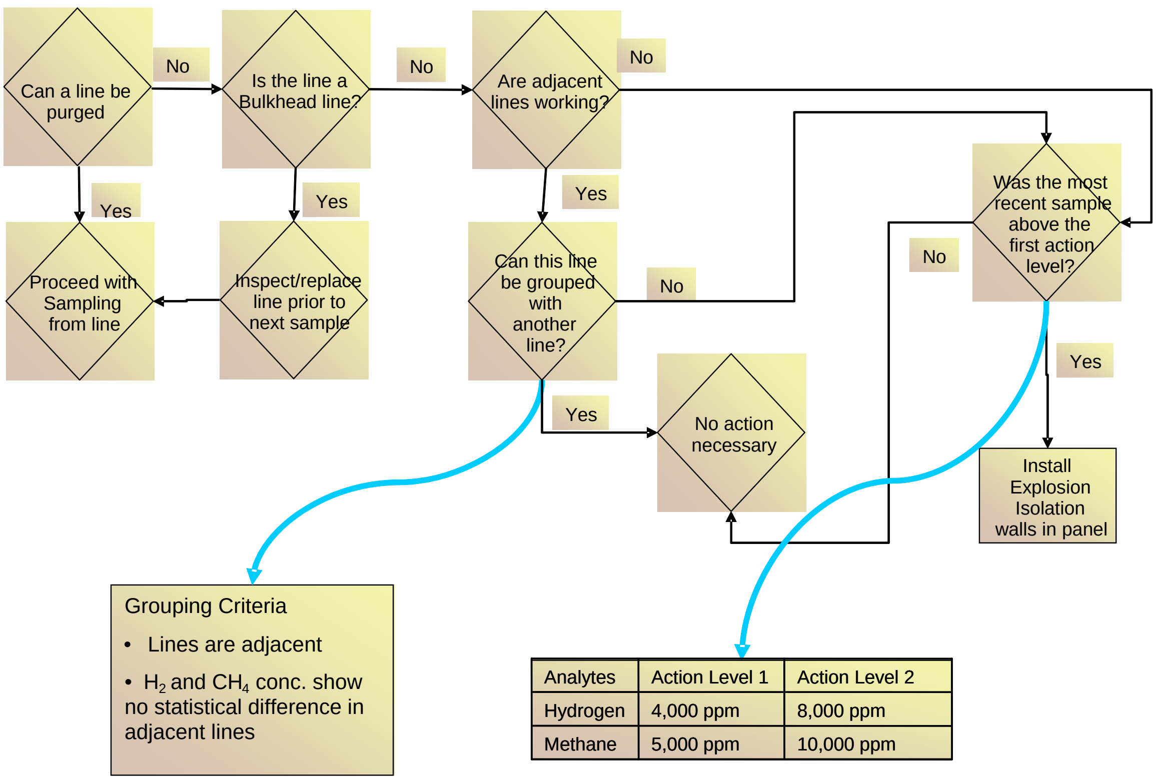
However, should a sample line not be useable, the Permittees have developed criteria and a logic diagram that will be used to determine if the loss of one or more sampling lines is significant (Flow Diagram 1).  It should be noted that the Permittees will first suspect that a line is not useable when it is purged prior to sampling.  If the line cannot be purged, then it will not be used for sampling unless the line is a bulkhead line that can be easily replaced.  Replacement of bulkhead lines will occur before the next scheduled sample.  Non-bulkhead lines will be evaluated by first determining if adjacent sampling lines are working. If the answer is no, then the previous sample from the failed line will be examined. If the previous sample was between the Action Level 1 and Action Level 2, then the explosion isolation wall will be installed since without the ability to monitor it is unknown whether the area is approaching the second action level or decreasing. If the previous sample was below Action Level 1 then continued sampling is acceptable.

If any adjacent lines are working, the prior concentrations measured in these lines will be evaluated to determine if they are statistically similar to the prior measurements from the lost line. If the prior sampling results are statistically similar, the lines can be grouped. Statistical similarity will be determined using the Student's "t" test to evaluate differences.

The magnitude of *t* will be compared to the critical *t* value from SW-846, Table 9-2 (EPA 1996), for this statistical test.

If the lost line can be grouped with an adjacent line, no further action is necessary because the unmonitored area is considered to be represented by the adjacent areas. If the lost sample line cannot be grouped with an adjacent line, the previous concentration measurement will be compared to the Action Levels. If the concentration is below Action Level 1 monitoring will continue. If the concentration is between Action Level 1 and Action Level 2, the explosion isolation wall will be installed in the panel.

Flow Diagram 1




| Analytes | Action Level 1 | Action Level 2 |
|---|---|---|
| Hydrogen | 4,000 ppm | 8,000 ppm |
| Methane | 5,000 ppm | 10,000 ppm |

Logic Diagram for Evaluating the Inability to Purge a Sample Line

## Monitoring Frequency

The monitoring interval will vary depending upon the levels of hydrogen and methane that are detected. Two frequencies are proposed:

- If monitored concentrations are below Action Level 1 monitoring will be monthly. Action Level 1 is achieved when the concentration of hydrogen reaches 4,000 parts per million (**ppm**) or the concentration of methane reaches 5,000 ppm.

- If monitored concentrations are above the Action Level 1 the frequency will be increased to weekly.

## Action Levels and Required Actions

The monitoring plan includes Action Levels based on the LELs for hydrogen and methane in order to ensure that if an explosive mixture continues to develop within a panel, the explosion isolation wall component of the approved panel closure design will be installed. These Action Levels have been designed to ensure the protection of human health and the environment.

The flammable gases which might be generated are hydrogen and methane. In air, hydrogen has a LEL of 4 percent while the LEL for methane is 5 percent.

Action Level 1 for hydrogen and methane in a panel is 10 percent of the LEL which, for hydrogen, is 0.4 percent or 4,000 ppm and for methane is 0.5 percent or 5,000 ppm. If this Action Level is achieved or exceeded, the monitoring will be increased to weekly. If the concentrations fall below Action Level 1, the frequency may be reduced from weekly to monthly.

Action Level 2 for hydrogen and methane in a panel is 20 percent of the LEL which, for hydrogen is 0.8 percent or 8,000 ppm and for methane is 1 percent or 10,000 ppm. If Action Level 2 is achieved or exceeded for two successive weekly samples, the Permittees will cease monitoring and install the explosion isolation wall.

The Permittees understand that when two flammable gases are mixed, the mixture may have a different LEL than the individual gases. This is referred to as the composite LEL for the mixture. The Permittees evaluated whether or not the composite LEL should be used in determining the Action Levels. The conclusion was that using the 10 percent and 20 percent thresholds was sufficiently conservative to assure action is taken before potentially explosive levels of hydrogen or methane build up in filled panels. The additional conservatism added by using the composite LEL was not justified considering the additional complexity for demonstrating compliance (i.e., compliance using the composite value is based upon application of a mathematical formula and not on fixed, tabulated values in the permit).

The use of the bulkhead, the accompanying monitoring, and related Action Levels will maintain safe and protective operations by ensuring that:

- physical access to the full panel is prevented,
- the panel is removed from active ventilation, and
- conditions inside the panel are regularly monitored so that preventive actions can be taken well in advance of the existence of a hazardous condition.

**Actions After Sufficient Data Are Collected in Panels 3 Through 7**

Hydrogen and methane monitoring in Panels 3 through 7 will continue until final panel closure is initiated. It is anticipated that once sufficient data are collected the Permittees can perform a comprehensive assessment of the data and determine the final panel closure design based upon observed gas generation rates. A PMR will be developed and submitted to initiate a panel closure which may incorporate an explosion isolation wall, substantial barriers and bulkheads, or other closure components such as run of mine salt.

**Closed Room VOC Monitoring**

This modification proposes to reduce disposal room VOC monitoring in filled panels to

Room 1 only on a monthly basis to assure worker safety and protection. Only VOCs in the adjacent closed room (Room 1 in filled panels) pose a health risk to workers in the immediate vicinity. VOC sampling will occur as specified in Attachment N of the HWFP. Both the intake and exhaust sides of Room 1 will be monitored.

**Extension of Final Closure in Panels 3 Through 7**

In order to allow sufficient time to collect and analyze data on hydrogen and methane in Panels 3 through 7 it is necessary to extend the final closure date for those disposal units.

The Permittees propose to monitor Panels 3 through 7 until final panel closure. At that time an assessment of the data will be performed and a PMR developed and submitted to the NMED requesting the appropriate panel closure design.

This modification will request an extension of final closure as indicated in Attachment I, until 2016 which will allow sufficient time for the data evaluation, PMR development and action on the PMR by the NMED.

**Changes to the Inspection Schedule**

The Permittees are proposing a change to the Inspection Schedule in Attachment D of the HWFP to include inspections of the accessible portions of the explosion isolation walls in Panels 1 and 2 (and any other explosion isolation walls that may be constructed prior to final panel closure) on a quarterly basis and have a registered professional engineer certify the stability of the explosion isolation walls on an annual basis. The certification with supporting information will be submitted to the NMED annually no later than October 27. If the Permittees cannot certify that an explosion isolation wall is sufficiently stable to serve its intended purpose, an additional explosion isolation wall will be constructed.

The Permittees will also inspect on a monthly basis, the accessible portions of each bulkhead in each filled panel for integrity and deterioration and include the results of those inspections in the WIPP Operating Record. WIPP procedures will detail the specific inspection criteria and the Cognizant Engineer will determine what actions are required should deterioration or loss of integrity be noted during an inspection.

**Notifications and Monitoring Results**

If any Action Level is exceeded, notification will be made to the NMED and the notification posted to the WIPP web page and accessed through the email notification system within 7 calendar days of obtaining validated analytical data.

If any sampling line loss occurs, notification will be made to the NMED and the notification posted to the WIPP web page and accessed through the email notification system within 7 calendar days of learning of a sampling line loss. After the evaluation of the impact of sampling line loss as shown in Flow Diagram 1, notification will be made to the NMED and the notification posted to the WIPP web page and accessed through the email notification system within 7 calendar days of completing the sampling line loss evaluation.

The annual Professional Engineer certification report on the stability of the explosion isolation walls will be transmitted to the NMED no later than October 27 of each year and the transmittal letter posted to the WIPP web page and accessed through the email notification system within 7 calendar days of submittal of that report.

A summary of the hydrogen and methane monitoring results will be made available, semi-annually, to the NMED.

The proposed changes to the WIPP HWFP text are presented in Attachment B of this PMR.

**4. 20.4.1.900 NMAC (incorporating 40 CFR §270.42 (b)(1)(iv)) requires the applicant to provide the applicable information required by 40 CFR §§270.13 through 270.21, 270.62, and 270.63.**

The regulatory crosswalk describes those portions of the WIPP HWFP that are affected by this PMR. Where applicable, regulatory citations in this modification reference Title 20, Chapter 4, Part 1, NMAC, revised June 14, 2000, incorporating the CFR, Title 40 (40 CFR Parts 264 and 270). 40 CFR §§270.16 through 270.22, 270.62, 270.63, and 270.66 are not applicable at WIPP. Consequently, they are not listed in the regulatory crosswalk table. 40 CFR §270.23 is applicable to the WIPP Hazardous Waste Disposal Units (**HWDUs**). This modification does not impact the conditions associated with the HWDUs.

**5. 20.4.1.900 NMAC (incorporating 40 CFR §270.11(d)(1) and 40 CFR §270.30(k)) requires that any person signing applications and reports must certify the document in accordance with 20.4.1.900 NMAC.**

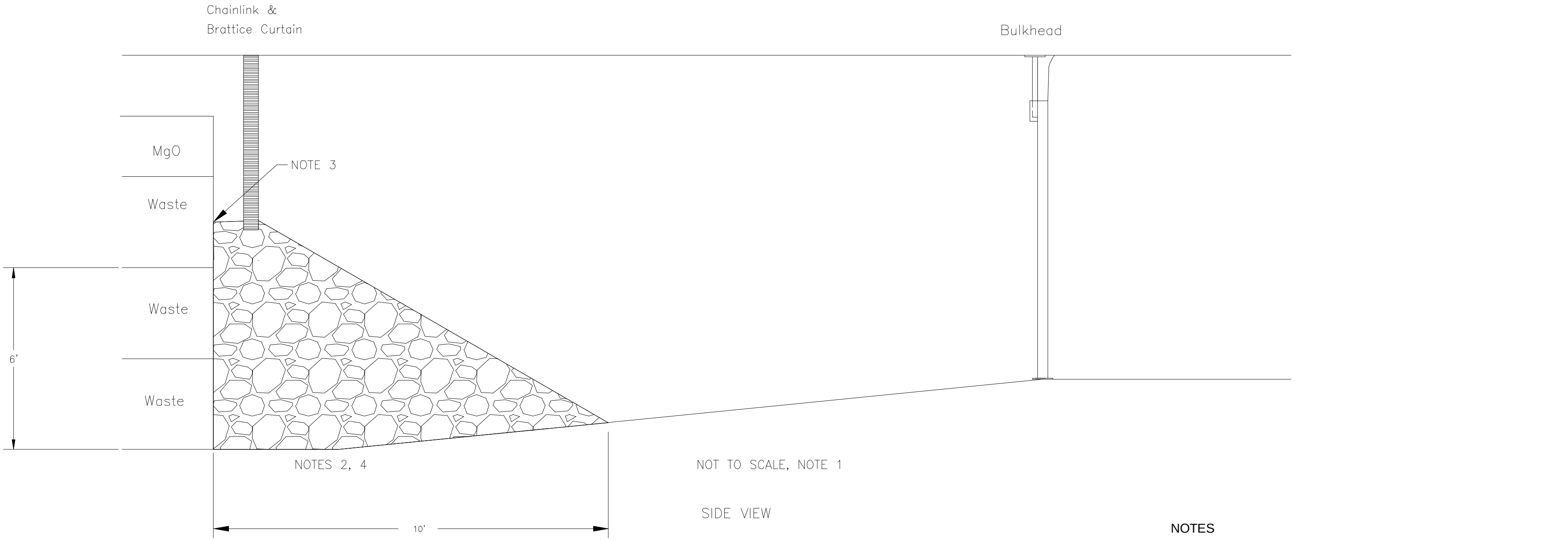
The transmittal letter for this PMR contains the signed certification statement in accordance with Module I.F of the WIPP HWFP.

# REGULATORY CROSSWALK

| Regulatory Citation(s) 20.4.1.900 NMAC (incorporating 40 CFR Part 270) | Regulatory Citation(s) 20.4.1.500 NMAC (incorporating 40 CFR Part 264) | Description of Requirement | Added or Clarified Information | | |
|---|---|---|---|---|---|
| | | | Section of the HWFP | Yes | No |
| §270.13 | | Contents of Part A permit application | Attachment O, Part A | | ✓ |
| §270.14(b)(1) | | General facility description | Attachment A | | ✓ |
| §270.14(b)(2) | §264.13(a) | Chemical and physical analyses | Attachment B | | ✓ |
| §270.14(b)(3) | §264.13(b) | Development and implementation of waste analysis plan | Attachment B | | ✓ |
| | §264.13(c) | Off-site waste analysis requirements | Attachment B | | ✓ |
| §270.14(b)(4) | §264.14(a-c) | Security procedures and equipment | Attachment C | | ✓ |
| §270.14(b)(5) | §264.15(a-d) | General inspection requirements | Attachment D | ✓ | |
| | §264.174 | Container inspections | Attachment D | | ✓ |
| §270.23(a)(2) | §264.602 | Miscellaneous units inspections | Attachment D | ✓ | |
| §270.14(b)(6) | | Request for waiver from preparedness and prevention requirements of Part 264 Subpart C | NA | | |
| §270.14(b)(7) | 264 Subpart D | Contingency plan requirements | Attachment F | | ✓ |
| | §264.51 | Contingency plan design and implementation | Attachment F | | ✓ |
| | §264.52 (a) & (c-f) | Contingency plan content | Attachment F | | ✓ |
| | §264.53 | Contingency plan copies | Attachment F | | ✓ |
| | §264.54 | Contingency plan amendment | Attachment F | | ✓ |
| | §264.55 | Emergency coordinator | Attachment F | | ✓ |
| | §264.56 | Emergency procedures | Attachment F | | ✓ |
| §270.14(b)(8) | | Description of procedures, structures or equipment for: | Attachment E | | ✓ |
| §270.14(b)(8) (i) | | Prevention of hazards in unloading operations (e.g., ramps and special forklifts) | Attachment E | | ✓ |
| §270.14(b)(8) (ii) | | Runoff or flood prevention (e.g., berms, trenches, and dikes) | Attachment E | | ✓ |
| §270.14(b)(8) (iii) | | Prevention of contamination of water supplies | Attachment E | | ✓ |
| §270.14(b)(8) (iv) | | Mitigation of effects of equipment failure and power outages | Attachment E | | ✓ |
| §270.14(b)(8) (v) | | Prevention of undue exposure of personnel (e.g., personal protective equipment) | Attachment E | | ✓ |
| §270.14(b)(8) (vi) §270.23(a)(2) | §264.601 | Prevention of releases to the atmosphere | Module II Module IV Attachment M2 Attachment N | | ✓ |
| | 264 Subpart C | Preparedness and Prevention | Attachment E | | ✓ |
| | §264.31 | Design and operation of facility | Attachment E | | ✓ |
| | §264.32 | Required equipment | Attachment E Attachment F | | ✓ |
| | §264.33 | Testing and maintenance of equipment | Attachment D | | ✓ |
| | §264.34 | Access to communication/alarm system | Attachment E | | ✓ |
| | §264.35 | Required aisle space | Attachment E | | ✓ |
| | §264.37 | Arrangements with local authorities | Attachment F | | ✓ |
| §270.14(b)(9) | §264.17(a-c) | Prevention of accidental ignition or reaction of ignitable, reactive, or incompatible wastes | Attachment E | | ✓ |
| §270.14(b) | | Traffic pattern, volume, and controls, | Attachment G | | ✓ |

| Regulatory Citation(s) 20.4.1.900 NMAC (incorporating 40 CFR Part 270) | Regulatory Citation(s) 20.4.1.500 NMAC (incorporating 40 CFR Part 264) | Description of Requirement | Added or Clarified Information | | |
|---|---|---|---|---|---|
| | | | Section of the HWFP | Yes | No |
| §270.14(b)(11)(i) and (ii) | §264.18(a) | Seismic standard applicability and requirements | Part B, Rev. 6 Chapter B | | ✓ |
| §270.14(b)(11)(iii-v) | §264.18(b) | 100-year floodplain standard | Part B, Rev. 6 Chapter B | | ✓ |
| | §264.18(c) | Other location standards | Part B, Rev. 6 Chapter B | | ✓ |
| §270.14(b)(12) | §264.16(a-e) | Personnel training program | Permit Module II Attachment H | | ✓ |
| §270.14(b)(13) | 264 Subpart G | Closure and post-closure plans | Attachment I & J | ✓ | |
| §270.14(b)(13) | §264.111 | Closure performance standard | Attachment I | | ✓ |
| §270.14(b)(13) | §264.112(a), (b) | Written content of closure plan | Attachment I | ✓ | |
| §270.14(b)(13) | §264.112(c) | Amendment of closure plan | Attachment I | ✓ | |
| §270.14(b)(13) | §264.112(d) | Notification of partial and final closure | Attachment I | ✓ | |
| §270.14(b)(13) | §264.112(e) | Removal of wastes and decontamination/dismantling of equipment | Attachment I | | ✓ |
| §270.14(b)(13) | §264.113 | Time allowed for closure | Attachment I | | ✓ |
| §270.14(b)(13) | §264.114 | Disposal/decontamination | Attachment I | | ✓ |
| §270.14(b)(13) | §264.115 | Certification of closure | Attachment I | | ✓ |
| §270.14(b)(13) | §264.116 | Survey plat | Attachment I | | ✓ |
| §270.14(b)(13) | §264.117 | Post-closure care and use of property | Attachment J | | ✓ |
| §270.14(b)(13) | §264.118 | Post-closure plan; amendment of plan | Attachment J | | ✓ |
| §270.14(b)(13) | §264.178 | Closure/ containers | Attachment I | | ✓ |
| §270.14(b)(13) | §264.601 | Environmental performance standards-Miscellaneous units | Attachment I | | ✓ |
| §270.14(b)(13) | §264.603 | Post-closure care | Attachment I | | ✓ |
| §270.14(b)(14) | §264.119 | Post-closure notices | Attachment J | | ✓ |
| §270.14(b)(15) | §264.142 | Closure cost estimate | NA | | ✓ |
| | §264.143 | Financial assurance | NA | | ✓ |
| §270.14(b)(16) | §264.144 | Post-closure cost estimate | NA | | ✓ |
| | §264.145 | Post-closure care financial assurance | NA | | ✓ |
| §270.14(b)(17) | §264.147 | Liability insurance | NA | | ✓ |
| §270.14(b)(18) | §264.149-150 | Proof of financial coverage | NA | | ✓ |
| §270.14(b)(19)(i), (vi), (vii), and (x) | | Topographic map requirements<br>Map scale and date<br>Map orientation<br>Legal boundaries<br>Buildings<br>Treatment, storage, and disposal operations<br>Run-on/run-off control systems<br>Fire control facilities | Attachment O Part A | | ✓ |
| §270.14(b)(19)(ii) | §264.18(b) | 100-year floodplain | Attachment O Part A | | ✓ |
| §270.14(b)(19)(iii) | | Surface waters | Attachment O Part A | | ✓ |
| §270.14(b)(19)(iv) | | Surrounding Land use | Attachment O Part A | | ✓ |

| Regulatory Citation(s) 20.4.1.900 NMAC (incorporating 40 CFR Part 270) | Regulatory Citation(s) 20.4.1.500 NMAC (incorporating 40 CFR Part 264) | Description of Requirement | Added or Clarified Information | | |
|---|---|---|---|---|---|
| | | | **Section of the HWFP** | **Yes** | **No** |
| §270.14(b)(19)(viii) | §264.14(b) | Access controls | Attachment O Part A | | ✓ |
| §270.14(b)(19)(ix) | | Injection and withdrawal wells | Attachment O Part A | | ✓ |
| §270.14(b)(19)(xi) | | Drainage on flood control barriers | Part B, Rev. 6 Chapter B, E, F | | ✓ |
| §270.14(b)(19)(xii) | | Location of operational units | Part B, Rev. 6 Chapter B | | ✓ |
| §270.14(b)(20) | | Other federal laws<br>Wild and Scenic Rivers Act<br>National Historic Preservation Act<br>Endangered Species Act<br>Coastal Zone Management Act<br>Fish and Wildlife Coordination Act<br>Executive Orders | Part B, Rev. 6 Chapter K | | ✓ |
| §270.15 | §264 Subpart I | Containers | Attachment M1 | | ✓ |
| | §264.171 | Condition of containers | Attachment M1 | | ✓ |
| | §264.172 | Compatibility of waste with containers | Attachment M1 | | ✓ |
| | §264.173 | Management of containers | Attachment M1 | | ✓ |
| | §264.174 | Inspections | Attachment D<br>Attachment M1 | | ✓ |
| §270.15(a) | §264.175 | Containment systems | Attachment M1 | | ✓ |
| §270.15(c) | §264.176 | Special requirements for ignitable or reactive waste | Attachment E<br>Permit Module II | | ✓ |
| §270..15(d) | §264.177 | Special requirements for incompatible wastes | Attachment E<br>Permit Module II | | ✓ |
| | §264.178 | Closure | Attachment I | ✓ | |
| §270.15(e) | §264.179 | Air emission standards | Attachment E<br>Attachment N | | ✓ |
| §270.23 | 264 Subpart X | Miscellaneous units | Attachment M2 | | ✓ |
| §270.23(a) | §264.601 | Detailed unit description | Attachment M2 | | ✓ |
| §270.23(b) | §264.601 | Hydrologic, geologic, and meteorologic assessments | Permit Module IV<br>Attachment M2 | | ✓ |
| §270.23(c) | §264.601 | Potential exposure pathways | Permit Module IV<br>Attachment M2<br>Attachment N | ✓ | |
| §270.23(d) | | Demonstration of treatment effectiveness | Permit Module IV<br>Attachment M2<br>Attachment N | | ✓ |
| | §264.602 | Monitoring, analysis, inspection, response, reporting, and corrective action | Permit Module IV<br>Attachment M2<br>Attachment N | ✓ | |
| | §264.603 | Post-closure care | Attachment J<br>Attachment J1 | | ✓ |
| | 264 Subpart E | Manifest system, record keeping, and reporting | Permit Module I<br>Permit Module II<br>Permit Module IV<br>Attachment B | | ✓ |




NOTES

1. CONFIGURATION AND PLACEMENT OF THE SUBSTANTIAL BARRIER AND THE BULKHEAD DICTATED BY AS-FOUND (FIELD) CONDITIONS, AS DESIGNATED BY THE COGNIZANT ENGINEER.

2. SUBSTANTIAL BARRIER MATERIAL WILL CONSIST OF RUN-OF-MINE SALT OR OTHER SUITABLE NON-FLAMMABLE MATERIAL AS DESIGNATED BY THE COGNIZANT ENGINEER.

3. SUBSTANTIAL BARRIER MATERIAL SHOULD BE AGAINST THE WASTE FACE. THE HEIGHT OF THE SUBSTANTIAL BARRIER NEAR THE WASTE WILL BE AT LEAST EQUAL TO THE HEIGHT OF THE BOTTOM OF THE TOP ROW OF WASTE.

4. DIMENSIONS INDICATED ARE MINIMUMS. THE HEIGHT OF THE SUBSTANTIAL BARRIER IS MEASURED AT THE WASTE FACE. THE LENGTH OF THE SUBSTANTIAL BARRIER IS MEASURED FROM THE BOTTOM OF THE WASTE FACE TO THE TOE OF THE SUBSTANTIAL BARRIER MATERIAL.

Figure 1
Typical Substantial Barrier and Bulkhead

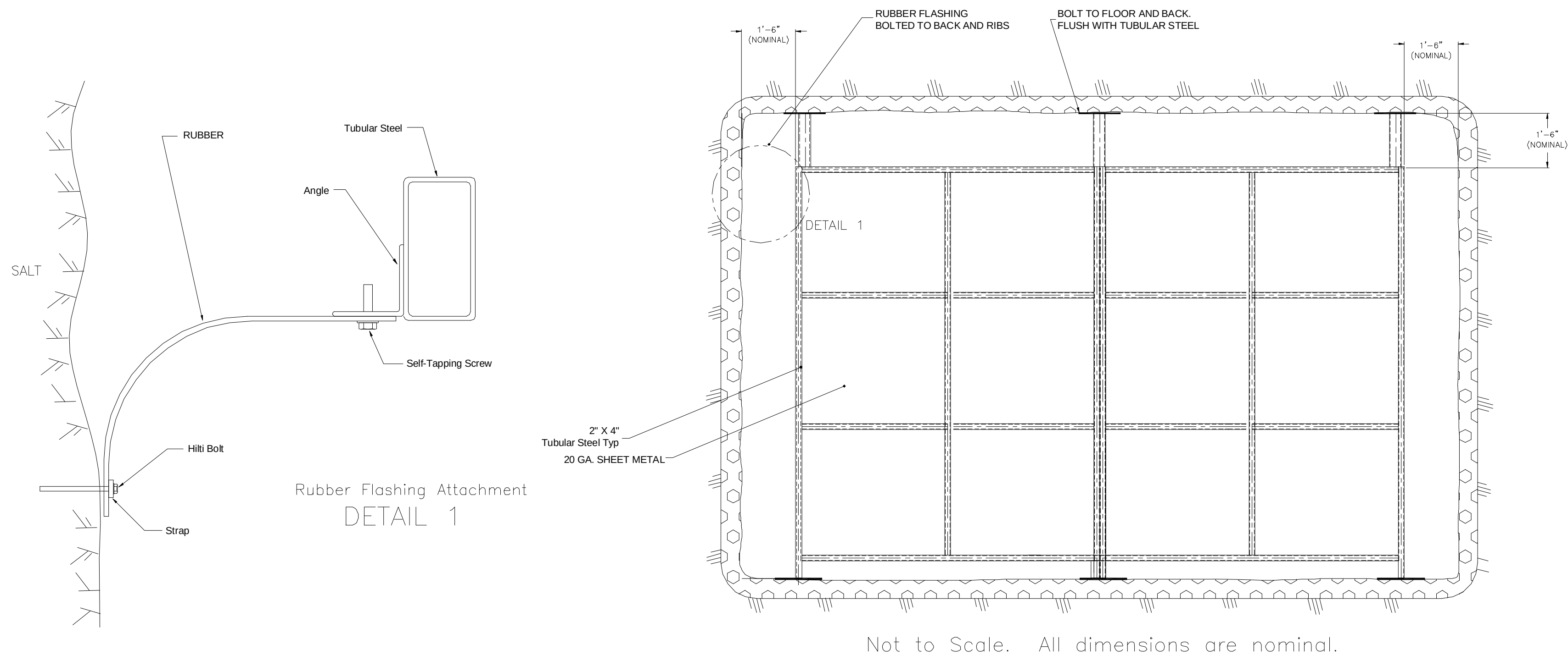
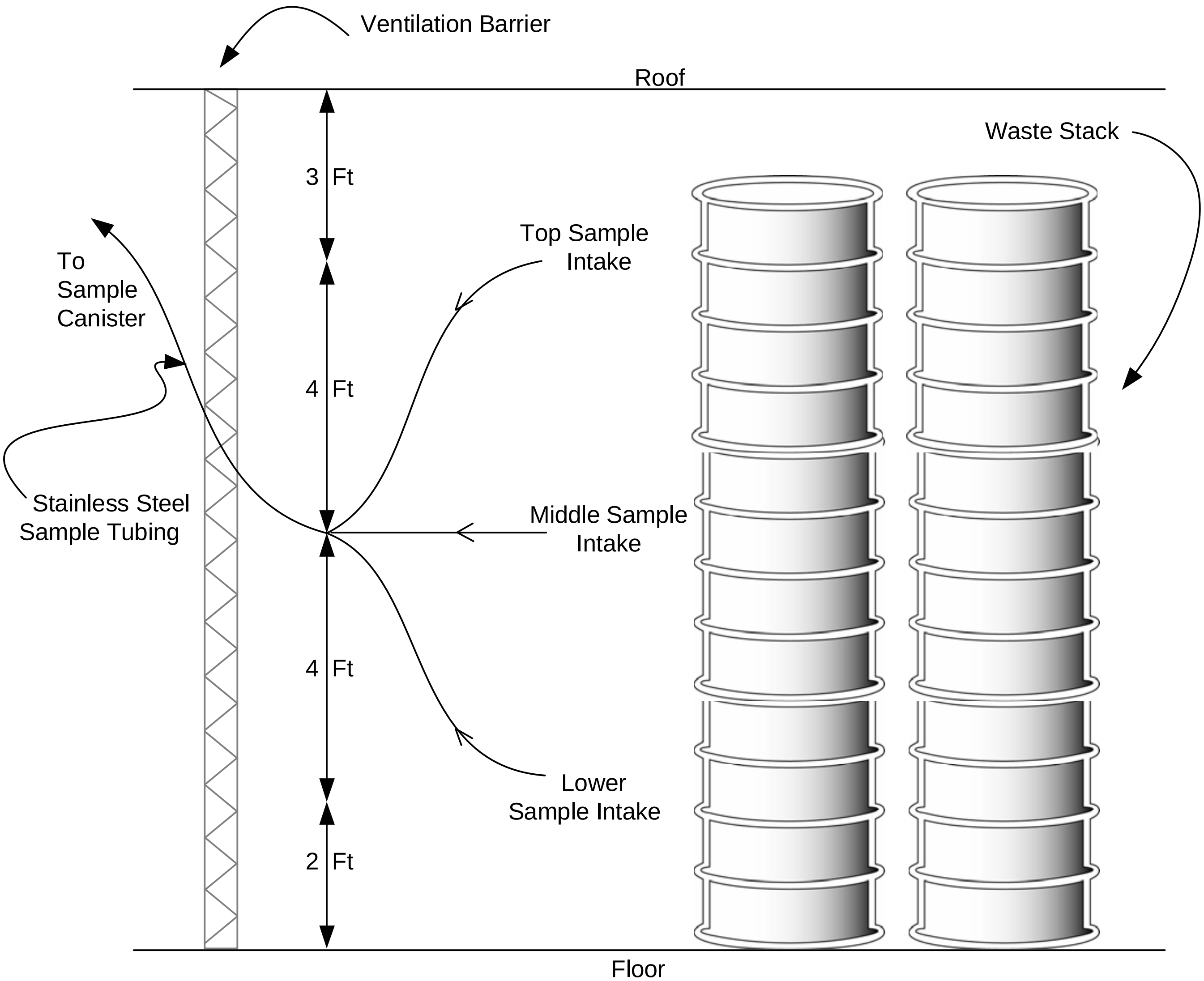



Figure 2
Typical Bulkhead




(not to scale, all measurements approximate)

Figure 3
Typical Hydrogen and Methane Monitoring System

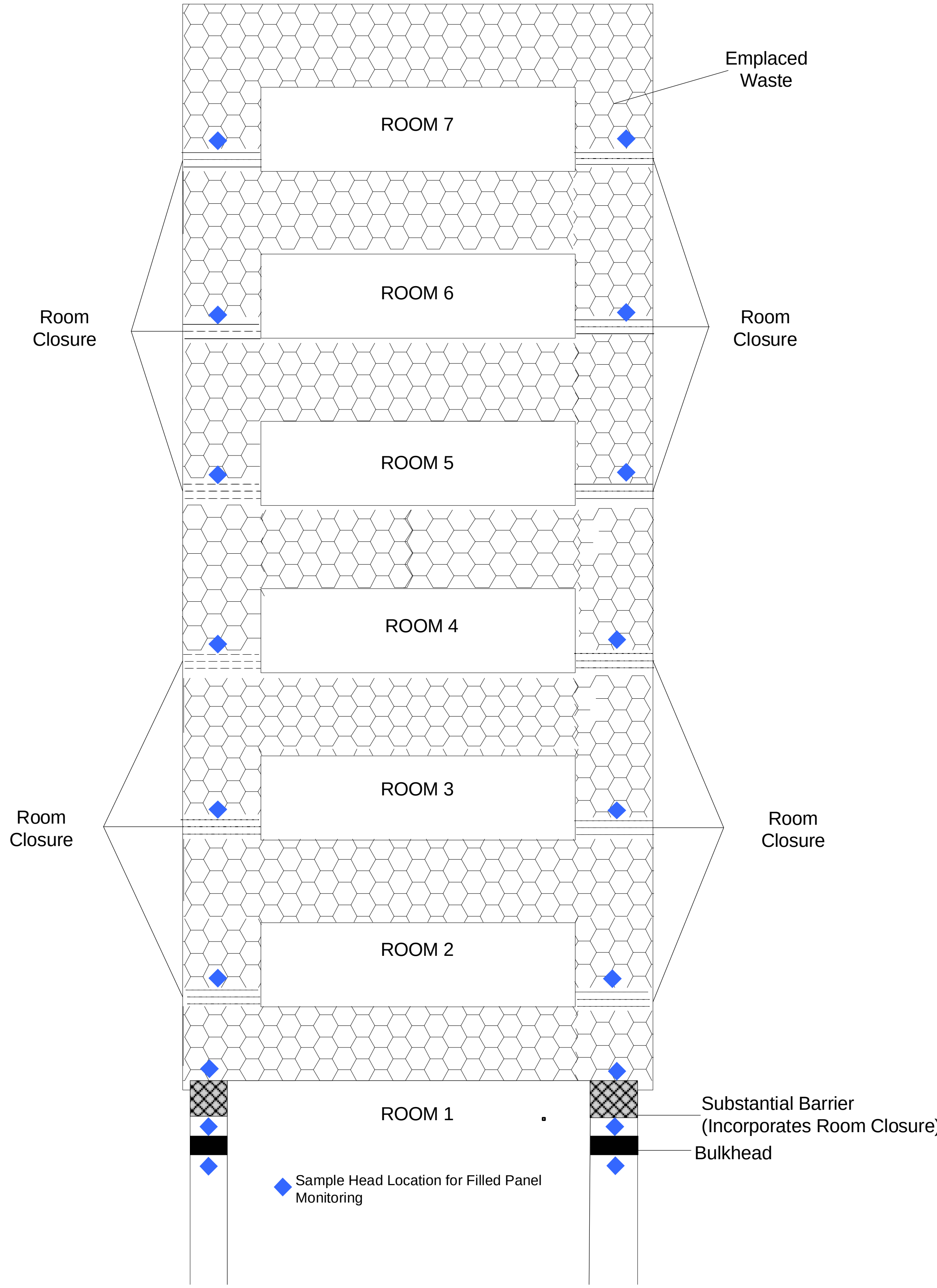



Figure 4
Typical Hydrogen and Methane Sampling Locations