CO-DETECTION OF HAZARDOUS AND RADIOACTIVE WASTE RELEASES

1.0 PURPOSE

Within the Resource Conservation and Recovery Act (RCRA) Permit Application for the Waste Isolation Pilot Plant (WIPP), the concept of radiological monitoring is used to determine if a release of hazardous constituents has occurred. This method is used in addition to the visual examinations and container inspections mandated by the RCRA. The purpose of this paper is to provide a justification for this approach.

2.0 DEFINITION

Co-detection is used to describe the detection of hazardous waste releases from containers by virtue of detection of a radioactive constituent release. Co-detection applies to all releases except the release of volatile organic compounds (VOCs) from TRU mixed waste containers.

3.0 DISCUSSION

Co-detection provides the WIPP facility with a very sensitive method of detecting the release of non-VOC hazardous waste constituents through the use of surface sampling (swipes) and radioactivity counting. The feasibility of this approach depends on the nature of the hazardous waste portion of the TRU mixed waste, the nature of the TRU mixed waste, and the nature of the potential spills. Each of these factors is discussed below.

3.1 Nature of the Hazardous Waste Portion of TRU Mixed Waste

Based on the waste codes listed in the Part A and discussed in the WIPP Waste Analysis Plan (Chapter C of the Permit Application), the hazardous waste constituents consist mainly of F-coded solvents and metals that exhibit the toxicity characteristic. The wastes that are to be shipped to the WIPP facility during the Test Phase have been placed into waste categories based on their physical and chemical properties. Waste category information is summarized in the attached table with emphasis on the process that generated the waste. The waste generating processes can be described in five general categories.

1) There are wastes (such as combustible waste) that result from cleaning and decontamination activities in which items such as towels and rags become contaminated simultaneously with hazardous constituents and radioactivity. In these cases, the hazardous constituent and the radioactive constituent are intimately mixed, both on the rag or towel used for cleaning, and as residuals on the surface of the object being cleaned. These waste forms are not homogeneous in mature, however they are generated in a fashion that ensures that the hazardous and radioactive contaminants coexist throughout the waste matrix.

2) Other wastes are generated when materials that contain metals that are believed to exhibit the toxicity characteristic become contaminated with radioactivity as the result of plutonium operations (Leaded rubber, some glass, and metal waste are typical examples). These materials may also become contaminated with solvents during decontamination or plutonium recovery activities.

3) Another class of processes are those where objects that are not metals are used in plutonium processes and become contaminated with radioactivity. They are subsequently cleaned with solvents to recover plutonium. Surfaces of these objects (such as graphite, filters, and glass) are contaminated with both radioactive constituents and hazardous constituents.

4) Several waste generating processes involve foundry operations where impurities are removed from plutonium. These impurities may result in the deposition of toxicity characteristic metals on the surfaces of objects such as firebrick, ceramic crucibles, pyrochemical salts and graphite which are contaminated with residual quantities of radioactivity.

5) In all of the process waste categories in the lower half of the attached table, the hazardous constituent and the radioactivity are physically mixed together as a result of the treatment process. In these wastes, the release of any portion of the waste matrix will involve both the hazardous waste and the radioactive waste components because the treatment process generates a relatively homogeneous waste form.

Some waste forms only contain radioactive contamination on the surface because they are not the result of a treatment process or because they are not porous in form. This includes the glass, leaded rubber, metals, graphite, ceramics, firebricks, and plastics. In theory, a hazardous waste release could occur if the interiors of these materials became exposed and were involved in a release or spill. Such an occurrence is not likely during the Test Phase, since no activities are planned or anticipated that would result in the breaking of these materials to expose fresh surfaces.

Based on the information in the attached table and the discussion above, hazardous constituent releases could potentially occur in only one of three forms: 1) VOC, 2) liquid from experiments in which brine is added to the waste, and 3) particulate due to the catastrophic failure of the test container. Mechanisms that can initiate releases in these forms are discussed subsequently. Regardless of how the release occurs, the nature of the waste and the processes that generated it is such that the radioactive and hazardous components are intimately mixed. A release of one without the other is not feasible.

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3.2 Nature of the TRU Mixed Waste

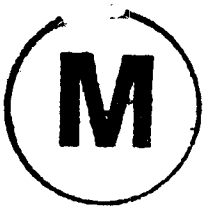
TRU mixed waste is defined as waste in which radioactive waste constituents and hazardous waste constituents exist as co-contaminants. The processes that placed the

radioactivity in the waste are, for the most part, the same process that placed the hazardous constituent in the waste. Therefore, the TRU mixed waste forms are described in terms of both classes of constituents. The WIPP Waste Acceptance Criteria (WAC) document places limits on the waste that can be shipped to the WIPP facility based on the characteristics of the waste form. According to the WAC, certain waste forms with specific characteristics are not allowed at the WIPP facility. Liquid waste is one waste form that is not allowed. Waste forms with greater that one percent respirable fines (particulates less than 10 microns in diameter) are not allowed. Other limitations include a prohibition on pyrophoric materials, corrosive materials, ignitable waste, and compressed gases. Furthermore, TRU waste must contain 100 nanocuries or more of transuranic elements per gram of waste which means that the radioactive component of the waste will always be present within the waste in significant concentrations. The limitations and restrictions are provided to ensure any waste form handled at the WIPP facility is stable and can be managed safely.

One benefit of waste form restrictions, such as no liquids or limited particulates, is that they limit the kinds of releases that could occur to those that would be readily detectable through visual inspection (large objects that fall out of ruptured containers) or through the use of radiation monitoring either locally or within the adjacent area to detect materials that have escaped from containers.

For several of the experiments to be conducted during the Test Phase, brine will be added to the waste in varying amounts to simulate repository conditions in which waste is in contact with naturally occurring brines. Because the brine will be in contact with the waste, it will become contaminated with radioactivity. It will also become contaminated with hazardous waste constituents. Therefore, a release or spill of contaminated brine could be detected using radiation detection methods.

In these experiments, the radiological control boundary provides a secondary container, should a leak develop in the test bin. In addition to the use of radiation detection for leaks or spills, another method of detection of leaks includes pressure loss within the bin. Regardless of whether or not a leak is suspected, the outside surfaces of the outer container will be visually inspected frequently to assure its integrity.



3.3 Nature of the Releases

The fundamental operating philosophy at the WIPP facility is to handle only sealed containers of waste. This practice minimizes the opportunity for releases or spills. For the purposes of safety analysis it was assumed that releases and spills during the Test Phase occur by either of two mechanisms: 1) surface contamination and 2) accidents.

Surface contamination is documented in WP02-9 which is the WIPP Final Safety Analysis Report (FSAR) to be the only credible source of contamination external to the containers during normal Test Phase operations. Surface contamination is assumed to be caused by

waste management activities at the generator site resulting in the contamination of the outside of waste containers. (Note: There are WAC limits on surface contamination; however, conservative assumptions were made regarding the occurrence of minor contamination.) Contamination would most likely be particulates (dirt or dust) that would be deposited during generator site handling/loading activities. This contamination would not be detected by visible inspections. Surface contamination is monitored upon arrival at the WIPP facility through the use of swipes and radiation monitoring equipment. DOE Orders require that off-site shipments of radioactive waste be checked to assure that the radioactive surface contamination is below very low levels. Consequently, any surface contamination that may be detected at the WIPP facility will be very minor. Since the hazardous constituents, if present, also occur in minor concentrations as residues and traces within the waste they represent very small health risks.

It should be that, with respect to surface contamination, detection using radioactivity is very sensitive and allows for the detection of contamination that may not be visible on the surface of the container. This exceeds the capability required by RCRA which is generally limited to inspections that detect only visible evidence of spills or leaks.

Releases due to accidents are modeled in the WIPP FSAR. Significant accidents within the waste handling process are assumed to result in the release and dispersion of particulate radioactive contaminants and of VOCs. Radioactive releases of particulates are detectable using surface sampling (swipe) techniques and the extensive network of radiation sensors located throughout the facility. An accidental release would be detected immediately by the operator or the health physics technician. The impact of VOC releases is discussed below.

In summary, releases that are most likely at the WIPP facility involve the dispersion of particulates containing radioactivity. This radioactivity is readily detectable. On the other hand, the presence of hazardous constituents in these releases would likely go undetected due to their extremely low concentrations without the conservative co-detection practices.

4.0 APPLICATION OF CO-DETECTION

The use of co-detection applies to any situation calling for sampling or monitoring for non-volatile releases. This includes initial sampling for surface radiological contamination upon receipt, sampling for contamination during waste handling activities, monitoring for releases of particulates or liquids during testing, sampling for contamination during decommissioning, sampling for contamination during packaging for off-site shipment, and sampling to demonstrate the effectiveness of decontamination activities that follow a release or spill and retrieval. Radiation monitoring and sampling is mandated by DOE orders and provides an immediate indication of a release or spill, even when they are not visibly detectable. The basis for accepting co-detection is that the radioactivity is intimately mixed with the hazardous constituents to the extent that both are present in the waste. It can be assumed that a release or spill involving hazardous constituents (except

VOCs) will also involve a release or spill of radioactivity. This assurance that hazardous and radioactive contaminants are mixed is based on the processes that generated the waste and the physical form of the waste. These processes mixed the hazardous and radioactive components, as described in Section 3.1, to the extent that detection of the radioactive component can lead to the conclusion that the hazardous component is also present. Conversely, the absence of the radioactive component indicates that no release or spill has occurred. The assumption that hazardous and radioactive materials are released together is appropriate in that no reasonable release mechanisms which can be postulated that would separate the different types of contamination.

5.0 MONITORING OF VOLATILE ORGANIC COMPOUNDS

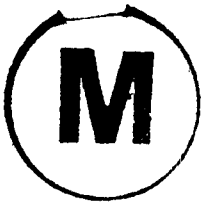
During the process of managing TRU mixed waste at the WIPP facility, VOCs will likely off-gas from the waste. Prior to emplacement and hookup of the waste containers into the experimental apparatus, these VOCs will be allowed to vent into the Waste Handling Building (WHB) atmosphere. All containers will have either carbon composite or Kevlar® filters installed to capture any radioactive particulate that might otherwise be released from the container with the vented gases. Consequently, the release of VOCs through container filters will occur without an accompanying release of radioactivity. Because of this, radiation detection equipment cannot be used to detect these releases. In the WHB, the inability to detect VOCs is of no concern because VOCs in containers are limited by the conditions placed on the waste by the Environmental Protection Agency (EPA) when they issued the WIPP No-Migration Determination (NMD). The limits are specified in the NMD. Calculations in the NMD, the DOE's No-Migration Variance Petition and the FSAR demonstrate that these limits are well below health based standards for the VOCs involved. Consequently, any such releases from containers in the WHB are of little concern.

In the underground, the EPA requires that all VOCs from the bin-scale tests be captured in a carbon sorption system with a 95 percent efficiency. Such a system has been installed for the Test Phase. To verify the effectiveness of the VOC collection system, one source and four ambient air monitors have been installed that detect the VOCs of interest.

6.0 SUMMARY

The use of co-detection at the WIPP facility as a means of detecting both radioactive and hazardous waste constituents can be summarized as follows:

1) The two waste components are intimately mixed such that a release of one will be accompanied by a release of the other (except for gaseous releases of regulated VOCs).



2) Without the ability for co-detection using radiological sampling and monitoring, the hazardous constituents would likely go undetected because of their extremely low concentrations unless visible evidence of a spill or release is present.

3) Radiation detection is sensitive enough to detect hazardous contamination, even in cases where the contamination is not visible.

4) Radiation sampling and monitoring provides easy and immediate detection of contamination.

5) The use of radiation for detection and the assumption that the hazardous constituents are also present leads to a conservative RCRA classification of spills and releases.

6) The use of radiation detection can be used to detect releases and contamination during all phases of the Test Phase, including retrieval and decontamination.

7) Even with the use of radiation detection to identify spills and releases, required RCRA inspections activities will be performed to assure that containers are not deteriorating.