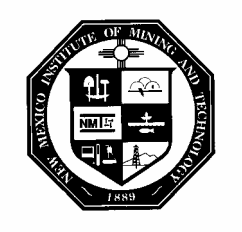
EEG-86



CONTACT HANDLED TRANSURANIC WASTE CHARACTERIZATION REQUIREMENTS AT THE WASTE ISOLATION PILOT PLANT

Matthew K. Silva
James K. Channell
Ben A. Walker
George Anastas

Environmental Evaluation Group
New Mexico

September 2003

EEG-86
DOE/AL58309-86

CONTACT HANDLED TRANSURANIC WASTE CHARACTERIZATION REQUIREMENTS AT THE WASTE ISOLATION PILOT PLANT

Matthew K. Silva
James K. Channell
Ben A. Walker
George Anastas

Environmental Evaluation Group
7007 Wyoming Boulevard NE, Suite F-2
Albuquerque, New Mexico 87109

and

505 North Main Street
Carlsbad, New Mexico 88220

September 2003

FOREWORD

The purpose of the New Mexico Environmental Evaluation Group (EEG) is to conduct an independent technical evaluation of the Waste Isolation Pilot Plant (WIPP) Project to ensure the protection of the public health and safety and the environment of New Mexico. The WIPP Project, located in southeastern New Mexico, became operational in March 1999 for the disposal of transuranic (TRU) radioactive wastes generated by the national defense programs. The EEG was established in 1978 with funds provided by the U.S. Department of Energy (DOE) to the State of New Mexico. Public Law 100-456, the National Defense Authorization Act, Fiscal Year 1989, Section 1433, assigned the EEG to the New Mexico Institute of Mining and Technology and continued the original contract DE-AC04-79AL10752 through DOE contract DE-AC29-89AL58309. The National Defense Authorization Act for Fiscal Year 1994, Public Law 103-160, and the National Defense Authorization Act for Fiscal Year 2000, Public Law 106-65, continued the authorization.

The EEG performs independent technical analyses on a variety of issues. Now that the WIPP is operational, these issues include facility modifications and waste characterization for future receipt and emplacement of remote-handled waste, generator site audits, contact-handled waste characterization issues, the suitability and safety of transportation systems, mining of new panels, and analysis of new information as part of the five year recertification cycles as mandated by the WIPP Land Withdrawal Act. Review and comment is provided on the annual Safety Analysis Report and Proposed Modifications to the Hazardous Waste Facility Permit. The EEG also conducts an independent radiation surveillance program which includes a radiochemical laboratory.

Matthew K. Silva
Director

EEG STAFF

Lawrence E. Allen, M.S., Geologic Engineer

George Anastas, M.S., CHP, PE, DEE, Health Physicist/Nuclear Engineer

Sally C. Ballard, B.S., Radiochemical Analyst

Radene Bradley, Secretary III

James K. Channell, Ph.D., CHP, Deputy Director

Patricia D. Fairchild, Secretary III

Donald H. Gray, M.A., Laboratory Manager

John C. Haschets, Assistant Environmental Technician

Linda P. Kennedy, M.L.S., Librarian

Lanny W. King, Environmental Technician

Thomas M. Klein, M.S. Environmental Scientist

Jill Shortencarier, Executive Assistant

Matthew K. Silva, Ph.D., Director

Susan Stokum, Administrative Secretary

Ben A. Walker, B.A., Quality Assurance Specialist

Scott B. Webb, Ph.D., Health Physicist

Judith F. Youngman, B.A., Administrative Officer

ACKNOWLEDGMENTS

The authors wish to thank Ms. Linda Kennedy and Ms. Judie Youngman for their editing and assistance in preparation of this report. Also thanks to Mr. Lawrence Allen for his editing and to Ms. Jill Shortencarier for final word processing and compilation of the report.

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS

AK	Acceptable Knowledge
ALARA	As Low As Reasonably Achievable
C of C	Certificate of Compliance
CBFO	Carlsbad Field Office
CCA	Compliance Certification Application
CFR	Code of Federal Regulations
CH	Contact Handled
CH WAC	Contact Handled Waste Acceptance Criteria for WIPP, rev 0; rev 0.1
CPR	Cellulose, Plastic and Rubber
DAC	Drum Age Criteria
DOE	Department of Energy
EEG	Environmental Evaluation Group
EPA	Environmental Protection Agency
FGE	Fissile Gram Equivalent
HSG	Headspace Gas
HWFP	Hazardous Waste Facility Permit
IDC	Item Description Code
INEEL (INEL)	Idaho National Engineering and Environmental Laboratory
LANL	Los Alamos National Laboratory
LWA	Land Withdrawal Act
NAS/NRC	National Academy of Sciences. National Research Committee
NDA	Non-Destructive Assay
NETL/CABE	National Energy Technology Laboratory/Center for Acquisitions and Business Excellence
NMAC	New Mexico Administrative Code
NMED	New Mexico environment Department
NRC	Nuclear Regulatory Commission
PCB	Polychlorinated Biphenyls

ACRONYMS (continued)

PE-Ci	Plutonium Equivalent Curies
PMR	Permit Modification Request
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPD	Quality Assurance Program Document
RCRA	Resource Conservation and Recovery Act
RFETS	Rocky Flats Environmental Technology Site
RH	Remote Handled
RIPB	Risk-Informed and performance-based
RTR	Real Time Radiography
SAR	Safety Analysis Report
SARP	Shipping Package Safety Analysis Report
SPM	Site Project Manager
SPQAO	Site Project QA Officer
SRS	Savannah River Site
SVOC	Semivolatile Organic Chemicals
TRAMPAC	TRUPACT-II Authorized Methods for Payload Control
TRU	Transuranic
TSCA	Toxic Substance Control Act
TSR	Technical Safety Requirements
VOC	Volatile Organic Chemicals
VE	Visual Examination
WAC	Waste Acceptance Criteria for WIPP, rev 0 through rev 7
WAP	Waste Analysis Plan
WIPP	Waste Isolation Pilot Plant
WSPF	Waste Stream Profile Forms
WWIS	WIPP Waste Information System

EXECUTIVE SUMMARY

Protection of the safety, health, and the environment at the Department of Energy (DOE) Waste Isolation Pilot Plant (WIPP) relies in part on the quality and completeness of the information about the waste that is shipped to the WIPP. This quality and completeness of the information is created through the waste characterization requirements identified in various regulatory documents. Waste characterization requirements are specified by the three WIPP regulatory agencies and the DOE: (1) the New Mexico Environment Department (NMED) through the Hazardous Waste Facility Permit (HWFP), (2) the U.S. Environmental Protection Agency (EPA) through the transuranic waste disposal Certification, (3) the U.S. Nuclear Regulatory Commission (NRC) through the TRUPACT II Authorized Methods for Payload Control (TRAMPAC), and (4) the Department of Energy through the Waste Acceptance Criteria (WAC). Of the four agencies, the requirements of the NMED for the Hazardous Waste Facility Permit tend to be the most prescriptive.

The Environmental Evaluation Group (EEG) has been evaluating the development of waste acceptance criteria since 1979. This report consolidates the findings and recommendations of the EEG's technical reviews and our current positions with respect to waste characterization requirements.

All waste characterization requirements were, at the time they were proposed and put in place, believed to be important for the protection of the worker safety, public health and the environment. The current waste characterization requirements were not developed ad hoc, but through much technical discussion, reference to accepted standards and codes, and considerable effort by DOE employees, DOE contractors, regulatory agency staff, regulatory agency contractors, the EEG staff, interested organizations, and/or members of the public.

The DOE has submitted several Class 2 and Class 3 Permit Modification Requests to NMED WIPP Hazardous Waste Facility Permit. Some have been accepted, some rejected, some withdrawn, and some are pending as tabulated in this report. EEG has provided a technical review of each. DOE has secured relief from a number of requirements. For example, by using

the permit modification process, the DOE has obtained a reduction of the headspace gas sampling requirement for thermally treated waste from Rocky Flats Environmental Technology Site (RFETS), a reduction in the visual examination requirement for waste from RFETS, and a reduction in headspace gas analysis for waste from the Idaho National Engineering and Environmental Laboratory (INEEL). These reductions in waste characterization requirements saved $30 million, saved $19 million, and allowed DOE to meet a deadline to remove 3100 m^3 from INEEL, respectively. From the time of application through the time of approval, these changes were each achieved in four months or less.

The waste characterization requirements from the various agencies contain many of the same requirements. Despite this overlap, the methods for meeting these requirements are somewhat different. The most complete methods of reaching compliance when requirements overlap, are usually found in the HWFP or the 40 CFR 194 compliance implementation found in Appendix A of the contact handled CH WAC. When considering a requirement change to either of these documents, the effect on all requirements, including those issued by other agencies, should be noted and evaluated for any potential impacts across agencies.

Based on our reviews, EEG offers the following observations and recommendations for waste characterization requirements:

Acceptable Knowledge: Acceptable Knowledge (AK) is the principle waste characterization technique for all of the regulatory agencies. AK is necessary and should be retained. At this time EEG supports the use of the HWFP AK requirements since they are the most explicit.

Headspace Gas Sampling and Analysis: It is desirable to maintain a comprehensive Headspace Gas (HSG) program for WIPP CH TRU waste. However, it should be possible to require less than 100% headspace gas sampling in some cases. Our primary concern is with organic sludges and older waste containers where knowledge of the waste is of lesser quality.

Drum Age Criteria: Drum Age Criteria (DAC) is necessary to ensure that Headspace Gas sampling of waste containers will measure gas concentrations that are at least 90% of

equilibrium. DAC values are required in both the HWFP and the TRAMPAC. The EEG supports this requirement.

Real Time Radiography: All WIPP waste containers are required to undergo either radiography or visual examination by the HWFP. Usually retrieved wastes undergo Real Time Radiography (RTR) and newly generated wastes are examined by visual examination. RTR has been a very effective means of verifying AK and discovering prohibited items in waste containers. It is also used to show compliance with several EPA and TRAMPAC requirements. The overall radiography program is an important part of the WIPP waste characterization program and should be retained. It may be possible to reduce some of the detailed procedural requirements in the HWFP.

Visual Examination for Retrievably Stored Waste: A small percentage (currently less than 2%) of retrievably stored waste is required by the HWFP to undergo visual examination for confirmation of RTR. The Visual Examination (VE) process has the potential for slightly greater radiation exposure than the other waste characterization requirements, although the EEG has seen no data to indicate that exposures are significant enough to justify reducing the requirement. The DOE has been successful in modifying the HWFP on retrievably stored visual examination and this would be the preferred process for seeking further reductions.

Visual Examination for Newly Generated Waste: VE is the method DOE usually prefers for newly generated waste because it can be done at the time the waste container is being filled. The EEG has not objected to any part of this requirement except to state that the requirement for two trained VE operators to perform the visual process "may be overkill" and that a single verification should be adequate.

Coring Sampling and Analysis: Currently the EEG continues to believe that the homogeneous sampling and analysis are unnecessary characterization requirements in the HWFP. Our principal reason for this position is that the data are not used for any additional regulatory control (metals releases from accidents or long-term processes would be controlled by radionuclide control requirements and VOCs and SVOC by HSG or the Confirmatory VOC Monitoring Plan).

Level II Management and Waste Certification HWFP Requirements: The DOE has listed these management and certification requirements as characterization activities in a recent cost analysis. EEG has not previously commented on these requirements. However, our current evaluation indicates that the required procedures are very detailed and somewhat redundant. This may be one of the areas to which the general EEG comment, "We believe waste characterization requirements are excessive," applies.

Characterization Support HWFP Requirements: EEG remains supportive of the WIPP audit and surveillance program. We have also said that we do not believe the relaxation of audit requirements and QA/QC is an appropriate way to reduce the regulatory burden.

EPA Non-Radiological Requirements: EPA's residual liquids, non-ferrous metal and cellulose, plastic and rubber requirements should remain and can continue to be determined as they are now, by the RTR and VE requirements of the HWFP. The ferrous metal requirement can continue to be met by counting waste containers emplaced in the repository.

EPA Radiological Requirements: The EEG agrees with the radioassay requirements for contact-handled transuranic waste specified in Appendix A of the CH WAC and the current procedures for modifying the document.

Current requirements for reporting the 10 required radionuclides should remain. ^{241}Pu should also be reported. The current requirement that all radioassay should be performed by WIPP-certified assay systems should be maintained.

Justification for less than 100% quantification and determination of isotopic ratios may be possible for some, but certainly not all, waste streams.

NRC Container Properties: The TRAMPAC requirements for residual liquids, filter vents and the sealed container prohibition should be retained. These are all verified by requirements in the current HWFP.

NRC Nuclear Properties: All nuclear property requirements should be retained and Appendix A of the CH WAC methodology should be used.

NRC Gas Generation Requirements: Requirements for measuring the chemical, payload classification, and radionuclide concentrations necessary to ensure hydrogen gas concentration criteria are met must be retained. There have been many changes, via the Certificate of Compliance (C of C) revision process, which have allowed additional containers to be shipped without changing the hydrogen gas criteria and additional changes may be justifiable in the future.

The flammable gas concentration limit of ≤ 500 ppm should be retained as described in the current revision of the TRAMPAC. Alternate methods (with appropriate QA) will be necessary if future changes to the HWFP affects the use of HSG sampling as the method for meeting this criteria.

WIPP Waste Acceptance Criteria: The WAC has served a useful historic purpose in developing initial criteria that have been adopted by the other three regulatory agencies. Currently it is a useful document for listing most of the requirements from all four sets of criteria. It would be more useful if the technical justification for each criteria or requirement were restored.

The unique role of the WAC in including any necessary operational safety and health requirements not included elsewhere is very important and must be constantly evaluated via the technical safety requirements (TSR) portion of the CH TRU Safety Analysis Report, and any necessary changes incorporated into the CH WAC.

Summary Observations and Recommendations

EEG's views on waste acceptance criteria and waste characterization continue to evolve. Shortly after the WIPP began receiving waste in 1999, the EEG published calculations comparing the risks from the hazardous constituents and the radioactive constituents in the WIPP inventory. The carcinogenic risks were quite low for both categories, with the expected carcinogenic risk

from the hazardous constituents four orders of magnitude less than the expected risk from the radiological constituents to workers from routine operations and operational accidents. Prudence suggests that mitigating the relatively small risk from the non-radiological constituents should not be the primary cost in waste characterization. Waste characterization efforts should focus on reducing the risk of release of radiological constituents.

Any proposed relaxation of waste characterization requirements needs to be evaluated in sufficient detail to convince the regulatory agencies, the EEG, and others that the modification is justified. Implicit in this approach is the understanding that any changes need to be made in a step-by-step transparent process and through existing regulatory procedures of the NMED, the EPA, and the NRC. This approach requires adequate justification and has worked effectively to obtain approval for a number of changes from all three non-DOE regulatory agencies. Moreover, as noted by the DOE, the regulatory agencies have indicated a preference for this approach.

1.0 PURPOSE AND SCOPE

Protection of the safety, health, and the environment at the Department of Energy (DOE) Waste Isolation Pilot Plant (WIPP) relies in part on the quality and completeness of the information about the waste that is shipped to the WIPP. This quality and completeness is created through the waste characterization requirements established in various regulatory documents.

This report is a compilation of The Environmental Evaluation Group's (EEG) comments since the operational phase of WIPP began and EEG's current positions on the existing waste characterization requirements by three regulatory agencies and the DOE. The report includes discussions about: (1) the process for changing requirements, (2) a comparison of risks due to various constituents in the waste, (3) whether current requirements are necessary, adequate or excessive, and (4) the continued need for the audit/QA process. The rationale for each conclusion and recommendation is also given.

The EEG has been evaluating the development of the WIPP waste characterization criteria since 1979. The WIPP began receiving contact handled (CH) transuranic (TRU) waste in March 1999. Later that same year, the project received its Hazardous Waste Facility Permit (HWFP) from the New Mexico Environment Department (NMED) and began receiving and emplacing mixed CH TRU waste.

The EEG has made several sets of comments since 1999 explaining our evaluations and evolving positions on waste characterization requirements. These were submitted as: (1) comments to the DOE in September 1999 concerning Waste Characterization Task Force recommendations, (2) comments to DOE in January 2002 on the proposed Appendix A changes to the WIPP CH Waste Acceptance Criteria (CH WAC), and (3) statements to the National Academy of Sciences/National Research Council (NAS/NRC) Committee on Optimizing the Characterization and Transportation of Transuranic Waste for the Waste Isolation Pilot Plant in October 2002, January 2003, and May 2003[1]. These comments and statements are included in Appendix A of

[1] EEG understands that the anticipated NAS/NRC committee report is under internal discussion.

this report. The EEG has also provided technical reviews on every Class 2 and Class 3 permit modification request submitted by DOE to the NMED, which is discussed in more detail in Chapter 4. All of these materials are available on EEG's web site (http://www.eeg.org).

This report references waste acceptance criteria, waste characterization requirements, and waste characterization methods cognizant of the DOE statement that, "in some cases the acceptance criteria and regulatory requirements are synonymous." (DOE 1999, p 3-8). The waste characterization methods are also specified in the permit and certificates, and arguably might be viewed as a requirement.

This report concentrates on EEG's position on the various waste characterization requirements, not the details of procedures required to show compliance. We recognize that the procedural requirements are a significant part of the waste characterization issue, but they are outside the scope of this report.

1.1 Overview of Waste Characterization Requirements

The U.S. Department of Energy (DOE), the U.S. Nuclear Regulatory Commission (NRC), the U.S. Environmental Protection Agency (EPA), and the New Mexico Environment Department (NMED) all have requirements for characterization of WIPP waste. A number of the waste characterization requirements are included in more than one set of requirements.

The DOE was self-regulating (except for the U.S. Department of Transportation shipping requirements) for all waste characterization criteria prior to 1989. The DOE, through its Orders and policies as far back as 1979 began to develop criteria protective of worker and public health and safety for anticipated operations. The criteria in the original WAC included limitations on: free liquids; pyrophoric, toxic and corrosive materials; explosive and compressed gas; gas generation and criticality. Container and certification requirements were also included (DOE 1980). Subsequent revisions of the WAC have consolidated into this one document requirements by each regulatory agency as these requirements became applicable. In April 2002, the WAC

was revised to contain only criteria for CH TRU waste. Up to this time, the WAC covered both CH TRU and remote-handled (RH) TRU waste.

The first set of requirements from a regulatory agency came from the NRC issuance of the Certificate of Compliance (C of C) of the TRUPACT-II Type B Package (NRC 71-9218) in 1989. These requirements included physical, nuclear and chemical properties and are included in a document called the TRUPACT-II Authorized Methods for Payload Control (TRAMPAC). Many of the properties were similar to those already in the WAC. In addition, there were extensive requirements dealing with control of the concentration of hydrogen, methane, and flammable volatile organic chemical (VOC) concentrations. Quality assurance (QA) requirements for packaging were also specified in the TRAMPAC.

The 1992 Land Withdrawal Act (LWA) specified that waste coming to WIPP must be transuranic waste (defined in the LWA as, "waste containing more than 100 nanocuries of alpha emitting transuranic isotopes per gram of waste with half-lives greater than 20 years."). Moreover, it was limited to waste generated by atomic energy defense activities of the United States. The LWA also specified a regulatory role for the EPA in ensuring long-term compliance of the WIPP repository. This role for EPA led to several additional waste characterization criteria.

EPA waste characterization requirements provide the most stringent requirements for quantification of radionuclides and also include several other requirements. The official methodology for radionuclide assay is primarily non-destructive assay (NDA) and is contained in Appendix A of the CH WAC (currently DOE 2002b). Modifications to Appendix A require EPA approval. The NDA methodology prescribed in Appendix A is also used in quantifying NRC and DOE radiological requirements.

The HWFP (NMED 1999) became effective in December 1999. The HWFP adds several waste characterization requirements and provides specific details of procedures that must be applied in meeting the requirements. Several NRC and EPA requirements are included in the HWFP and

1.0 PURPOSE AND SCOPE

Protection of the safety, health, and the environment at the Department of Energy (DOE) Waste Isolation Pilot Plant (WIPP) relies in part on the quality and completeness of the information about the waste that is shipped to the WIPP. This quality and completeness is created through the waste characterization requirements established in various regulatory documents.

This report is a compilation of the Environmental Evaluation Group's (EEG) comments since the operational phase of WIPP began and EEG's current positions on the existing waste characterization requirements by three regulatory agencies and the DOE. The report includes discussions about: (1) the process for changing requirements, (2) a comparison of risks due to various constituents in the waste, (3) whether current requirements are necessary, adequate or excessive, and (4) the continued need for the audit/QA process. The rationale for each conclusion and recommendation is also given.

The EEG has been evaluating the development of the WIPP waste characterization criteria since 1979. The WIPP began receiving contact handled (CH) transuranic (TRU) waste in March 1999. Later that same year, the project received its Hazardous Waste Facility Permit (HWFP) from the New Mexico Environment Department (NMED) and began receiving and emplacing mixed CH TRU waste.

The EEG has made several sets of comments since 1999 explaining our evaluations and evolving positions on waste characterization requirements. These were submitted as: (1) comments to the DOE in September 1999 concerning Waste Characterization Task Force recommendations, (2) comments to DOE in January 2002 on the proposed Appendix A changes to the WIPP CH Waste Acceptance Criteria (CH WAC), and (3) statements to the National Academy of Sciences/National Research Council (NAS/NRC) Committee on Optimizing the Characterization and Transportation of Transuranic Waste for the Waste Isolation Pilot Plant in October 2002, January 2003, and May 2003[1]. These comments and statements are included in Appendix A of

[1] EEG understands that the anticipated NAS/NRC committee report is under internal discussion.

incorporated into the HWFP or some other regulatory document with appropriate QA in order to sustain an adequate level of assurance.

The overlap of requirements of each agency inherently complicates change. When considering a requirement change in either the HWFP or Appendix A of the CH WAC, the effect on all requirements, including those issued by other agencies, should be noted and evaluated for its impact on requirements across agencies.

1.3 EEG Waste Characterization Evaluations and Philosophy

1.3.1 Evaluation History

The EEG has reviewed waste characterization requirements as they were being developed and modified over the years. Our comments are contained primarily in letters or presentations rather than EEG reports. There are EEG reports on specific issues related to waste acceptance criteria (Little 1980), flammability of CH TRU waste drums (Neill and Channell 1983; Silva 1990; 1991), safety documents (primarily the WIPP Safety Analysis Report [SAR]; EEG 1989), and applications to regulatory agencies (the Compliance Certification Application [CCA] from DOE to EPA; Neill and others 1996; 1998) that led to the development or retention of some waste characterization requirements.

Our evaluations concentrated on the specific purpose of each of the criteria or regulatory documents. The initial WAC comments were primarily concerned with operational health and safety at WIPP. Reviews of NRC requirements concentrated on gas generation and adequacy of the TRUPACT-II package itself. These two issues were instrumental in adoption of the legal requirement that all waste shipments to WIPP be in NRC certified Type B packages. The EEG review (Neill and others 1996; 1998) of the DOE application and EPA proposed certification focused on requirements necessary to assure that the WIPP complied with 40 CFR 191 and 40 CFR 194.

EEG's reviews of the HWFP and proposed permit modification requests (PMRs) included detailed technical evaluations of whether the HWFP or a PMR would accomplish the required regulatory objectives. However, with our review of modification requests to the HWFP, we have also evaluated the effect that changes would have on existing requirements of the NRC, the EPA, and DOE (in the CH WAC). This is because the HWFP is usually the most prescriptive in specifying how the requirement will be met. The prescriptiveness of the HWFP increases the assurance that the requirements of the other regulatory agencies will be satisfactorily met.

1.3.2 EEG Philosophy on Waste Characterization Requirements

Much of EEG's overall philosophy on waste characterization requirements can be found in various statements and reports. These are summarized below.

(1) We believe overall waste characterization requirements are excessive. However, any proposed relaxation needs to be evaluated in sufficient detail to convince regulatory agencies, the EEG, and stakeholders that the modification is justified.

(2) Implicit in statement (1) is the belief that any changes need to be made in a transparent, step-by-step approach and through the existing regulatory procedures of NMED, EPA, and NRC. This approach requires adequate justification and has worked effectively to get approval for a number of changes from all three regulators.

(3) Our conclusions on individual waste characterization requirements are based on health and safety, and environmental considerations. The EEG does not speak for the regulatory agencies in offering opinions of legal and regulatory requirements. EEG's current positions on specific waste characterization issues are also subject to change if justified by new evaluations.

(4) Since EEG has concluded that the radiological risk is about 10,000 times that of the hazardous waste risk, we concentrate on those waste characterization requirements that affect the transuranic waste during our health and safety evaluations.

(5) It is important to recognize that a number of the requirements in the Hazardous Waste Facility Permit (HWFP) have a role in ensuring that radiological, transportation, and operational requirements are met.

(6) The relaxation of audit and Quality Assurance and Quality Control (QA/QC) requirements is not an appropriate way to reduce the regulatory burden.

(7) Another factor which EEG has never stated explicitly is our recognition that considerable uncertainty exists in the characteristics of wastes that may come to WIPP in the future. For this reason, our evaluations of waste characterization requirements attempt to also address the potential future characterization needs for presently uncharacterized waste streams.

(8) Claims have been made in the past (see Section 2.1) that removal of unnecessary waste characterization requirements can result in increased shipping rates to WIPP. EEG considers whether a requirement is necessary for health, safety, and environmental reasons and does not factor schedule implications into our conclusions.

Two other issues often discussed by the DOE when proposing reductions in waste characterization requirements are minimizing the risk and exposure to workers performing waste characterization and costs.

EEG has no reason to believe that radiation doses to waste characterization workers are significant and, in the absence of data indicating otherwise, should not be a justification for eliminating or reducing a waste characterization requirement (see Section 3.3).

Costs of waste characterization are significant and it would be desirable to continue to reduce or eliminate those requirements where it is prudent. However, significant non-waste characterization costs were also incorporated into the initial design and operation of the WIPP project; a prudent procedure for a first of a kind deep geologic repository. Few of the waste characterization requirements can be evaluated exclusively by a traditional cost/benefit

comparison. A rigorous evaluation via the regulatory process is the best way to decide on acceptable changes to any waste characterization requirements.

2.0 WASTE CHARACTERIZATION REQUIREMENTS CHANGE PROCESSES

Since the original receipt of waste at the WIPP in March of 1999, the DOE has successfully completed changes to waste characterization requirements specified by each of the different regulatory agencies. The process for creating these changes is significantly different for each of these regulatory agencies, as discussed in the following sections.

2.1 NMED: HWFP Waste Characterization Requirements Change Process

The non-radiological hazardous waste characterization requirements fall under the jurisdiction of the New Mexico Environment Department and are principally (and most completely) specified in Attachment B, including B-1 through B-6 of the HWFP, collectively known as the Waste Analysis Plan (WAP) (currently NMED 2003). Changes to the WAP are therefore subject to the same process as those for the entire HWFP. The New Mexico Administrative Code (20 NMAC 4.1) simply references the EPA-established requirements contained in the Code of Federal Regulations (CFR) for these changes. Either the regulatory agency (under 40 CFR 270.41) or the permittees (under 40 CFR 270.42) can initiate modifications of a permit. The regulatory agency's ability to modify a permit is much more limited than that of the permittee, the implication being that it is incumbent on the regulator to ensure that the initial permit is sufficient.

There are three classes of permit modification requests. The "Classification of Permit Modification" table (Appendix I to 40 CFR 270.42) identifies the process to be used for each class. For those modifications that do not match table entries, the permittees can request that the regulatory agencies make the designation, but the regulation also specifies the criteria under which the regulatory agencies are allowed to do so.

Class 1 modifications are to be used for minor upgrades. Examples include updating the administrative information in the permit (names, titles, etc.), replacement of equipment with functionally equivalent components, or correction of typographical errors. These modifications

keep the permit current with routine changes to the facility or its operation. These changes do not substantially alter the permit conditions (40 CFR 270.42(d)(i)). The Class 1 change process is very simple. The permittee can implement the modification immediately, with notification of the change provided to the regulator within seven days. Other organizations and individuals on the facility mailing list are to be notified within 90 days of the modification. One disadvantage of a Class 1 modification is that there is no requirement that the regulator formally accept the modification. Moreover, the regulator can reject a Class 1 modification at any time for cause. One way to avoid a belated Class 1 modification rejection is to use the Class 2 process.

Class 2 modifications enable a permittee to respond to common variations in the types and quantities of wastes managed, technological advances, and non-trivial changes associated with new regulations. The process to implement these requires a formal submittal of a PMR to the regulator and a subsequent 60-day public comment period. The public comment period must include a permittee-organized public meeting. Within 90 days of the initial submission the regulator must either: (1) approve the modification request (with or without changes), (2) deny the request, or (3) determine that the modification must follow the Class 3 process. Two other options are available. The modification can be temporarily approved for up to 180 days, or the regulator can simply notify the permittee that the decision will be forthcoming in the next 30 days (only one such extension is allowed).

The Class 3 process may be required to accommodate significant public concern or a complex change. Like the Class 2 process, the Class 3 process requires the 60-day public comment period and public meeting. After that the Class 3 can be considerably more complicated and lengthy. The decision making process allows the regulator to request additional information and file formal notices of deficiency on the application. Even after this portion of the process, it may be necessary to create a draft permit including the proposed modification, conduct a more formal public hearing by an independent hearing officer, reopen the public comment period, and produce a hearing officer's report. This would all need to be completed before the regulator makes a decision on the modification.

Class 1 modifications to the HWFP under these processes have usually been successful. However, Class 1 modifications related to waste characterization have suffered a relatively high rate of rejection, usually ascribed to misclassification under 40 CFR 270.42. All changes to the waste sampling and analysis methods should be designated as Class 2 (Appendix I to 40 CFR 270.42). These would be waste characterization changes that are not related to conformation with EPA guidance or regulations, multi-source leachates, or changes associated with underlying hazardous constituents in ignitable or corrosive wastes sampling. Thus, most common waste characterization changes would be Class 2 changes.

The EEG has commented on every Class 2 and Class 3 PMR during the public comment period. For the past two years, any Class 2 comments submitted by the EEG have been submitted to both the NMED and the DOE several days prior to the comment period deadline, so that the DOE could address the concern or respond to the comments in other ways during that same public comment period. EEG comments on PMRs may be viewed at http://www.eeg.org.

The bulk of Class 2 and Class 3 PMRs have been related to waste characterization. The EEG published an analysis of experience with the PMRs that were extant after 18 months experience, noting several areas of concern about the DOE's submissions and suggesting a possible solution (Walker and Silva 2002). Table 2-1 lists all of the HWFP modifications submitted by the DOE so far, and their current status. Despite the complexity of the process for HWFP changes, the DOE has obtained some relief in a timely manner using the modification process. According to the DOE, a Class 2 PMR to allow compositing of headspace gases greatly aided the completion of the Idaho National Engineering and Environmental Laboratory (INEEL) 3100 m^3 Project. Also, a Class 2 PMR allowing reduction in headspace gas measurements for thermally treated wastes saved over $30 million at the Rocky Flats Environmental Technology Site (RFETS). Finally, a Class 2 PMR reducing the number of drums requiring visual examination saved $19 million (DOE 2002c). From the time of application through the time of approval, these changes were each achieved in four months or less.

Table 2-1. WIPP HWFP Class 2 and 3 Modification Proposals

Proposal Date	Mod Class	Item #	Proposed Modification	Disposition	Action Date
03/30/00	2	1	Alter accuracy acceptance criteria for cresols and pyridines	Accepted	08/08/00
		2	Use hgas statistical sampling of homogeneous containers when AK does not indicate hazardous VOCs	Accepted	08/08/00
		3	Use hgas statistical sampling of containers when waste was thermally treated	Accepted	08/08/00
04/20/00	2	1	Add allowance for 3 sub-samples to be taken from solidified container cores	Accepted	08/08/00
		2	Change miscertification rate to SCG from waste stream	Accepted	08/08/00
		3	Use gross alpha/beta measurements for groundwater sampling	Accepted	08/08/00
07/21/00	2	1	Perform waste characterization at the WIPP	Withdrawn	09/29/00
		2	Combine data package reviews; eliminate off-site audits for SQS	Withdrawn	09/29/00
12/07/00	2	1	Change headspace has drum age criteria (DAC-1)	Rejected	03/26/01
01/22/01	2	1	Perform visual examination by tomography (DR/CT)	Withdrawn	03/23/01
03/06/01	2	1	Move inspection forms from the HWFP to the operating record	Accepted w/minor changes	07/06/01
		2	Change the frequency of firefighter I training	Accepted	07/06/01
		3	Eliminate portions of RCT training	Accepted	07/06/01
		4	Add new hazardous waste numbers to HWFP	Accepted all but U-134 (HF)	07/06/01
		5	Extend time for groundwater monitoring reports	Accepted	07/06/01
04/27/01	2	1	Allow additional storage space for TDOPs	Rejected	08/30/01
04/27/01	(2) 3	1	Change headspace gas drum age criteria (Revised; DAC-2)	Accepted w/modifications	12/31/02
06/06/01	3	1	Allow Central Characterization Facility (CCF) at the WIPP	Withdrawn	01/14/03
		2	Add storage capacity for the CCF	Withdrawn	01/14/03
		3	Increase allowed storage time at the WIPP to one year	Withdrawn	01/14/03
		4	Allow prohibited items to be received at the WIPP	Withdrawn	01/14/03
08/28/01	2	1	Allow compositing of headspace gas samples for analysis	Accepted	11/27/01
		2	Alter random sampling for visual examination to allow for site safety considerations	Rejected	11/27/01
		3	Allow hgas samples to be taken through existing filter openings	Accepted, but limited to POCs	11/27/01
06/27/02	2	1	Revised addition of HF hazardous waste number (U-134)	Accepted w/minor changes	11/25/02
		2	Elimination of control charting for repackaged solidified wastes	Accepted w/minor changes	11/25/02
		3	Record keeping and auditing of classified information	Accepted	11/25/02
		4	Add HalfPACT to shipping containers	Accepted	11/25/02
		5	Use of radiography instead of VE for newly generated wastes	Accepted w/minor changes	11/25/02
06/27/02	2	1	Add direct loaded 85-gal and 100-gal drums, and TDOPs	Accepted w/modification	11/25/02
06/27/02	(2)3	1	Data Management Update	Moved to Class 3 (in progress)	
06/28/02	3	1	Add RH-TRU	In process	
10/07/02	3	1	Change panel closures from Option D to WPC design	Proposed as Class 2, accepted as 3 (in progress)	

Table 2-1. WIPP HWFP Class 2 and 3 Modification Proposals (Continued)

Proposal Date	Mod Class	Item #	Proposed Modification	Disposition	Action Date
05/14/03	2	1	DAC for 85-gallon & 100 gallon drums, and TDOPs	Rejected (needs more data)	09/11/03
		2	Removal of booster fans in the underground	Accepted	09/11/03
		3	Eliminate LANL sealed sources waste streams hgas sampling and analysis	Rejected (suggested resubmittal with statistical sampling)	09/11/03
		4	Remove formaldehyde as a required analytical parameter for LANL	Accepted	09/11/03
		5	Add New HWNs (cyanides, DMS, Acetonitrile, 1,4Dioxane, hexaclorobutadiene)	Accepted	09/11/03
05/14/03	3	1	Add new hazardous waste disposal units (panels 4-8)	NMED review period	
05/21/03	2	1	Eliminate PCB prohibition from HWFP	Accepted	09/11/03

"AK" = acceptable knowledge
"DAC" = drum age criteria
"DR/CT" = digital radiography/computerized tomography
"HF" = hydrofluoric acid
"HWN" = hazardous waste number
"hgas" = headspace gas
"homogeneous containers" = containers of solidified or soil/gravel wastes
"POC" = pipe overpack container
"RCT" = radiation control technician
"RH-TRU" = remote-handled transuranic waste
"RTR" = real time radiography
"SCG" = summary category group (debris wastes, solidified wastes, and soil/gravel are the 3 SCGs)
"SQS" = small quantity sites
"TDOP" = ten-drum overpack containers
"U-134" = hazardous waste code, hydrofluoric acid, Chemical Abstract Number 7664-39-3
"VE" = visual examination
"VOC" = volatile organic compound
"WPC" = WIPP panel closure

2.2 EPA: 40 CFR 194 Waste Characterization Requirements Change Process

The most restrictive requirements for radionuclide waste characterization derive from the EPA decision (1998) to certify the WIPP to receive waste as required by the WIPP LWA. 40 CFR 194 contains the criteria the EPA established for the WIPP to be certified. 40 CFR 194.24 requires the DOE to have a system of controls to measure and track the waste components that affect the long-term performance of the repository. These components were identified as ten radionuclides (four plutonium isotopes, three uranium isotopes, americium-241, strontium-90, and cesium-137), cellulosic materials (cellulose, plastic, and rubber), free water, and as two

separate categories, ferrous and non-ferrous metals (DOE 1996; EPA 1998). The amount of the ferrous metal component is easily satisfied by counting waste drums. But the other components required waste characterization methods to measure them. The ten radionuclides are identified and their activity measured principally by NDA techniques. The other components are identified and measured by either radiography (x-ray imaging of container contents) or visual examination (VE) techniques.

Changes to the methods for identifying and measuring these components are relatively informal, except for severe changes to the requirements. The EPA established a rule-making process in 40 CFR 194.65, but has retained a fairly wide latitude in determining whether a change requires a rule-making. For changes that the EPA determines do not require rule-making, the process is informal. The DOE simply negotiates with the EPA on proposed changes, then submits the proposed change to the EPA for evaluation. The EPA sends a letter to the DOE announcing their approval of the elements of the change.

Since late 1999 the 40 CFR 194 radioassay waste characterization requirements have been placed in Appendix A of the CH WAC (currently DOE 2002b). The informal, non-rule system has been used to successfully modify the NDA requirements several times. While there is no formal comment process, the EEG has been notified by either the DOE or the EPA during the latter phase of these negotiations and has submitted technical comments for consideration. Thus far, the EEG has had no objections to the informal process used for modifying waste characterization requirements.

The DOE has initiated several informal changes to the 40 CFR 194 mandated requirements which have been approved by the EPA. These include changes to the NDA Performance Demonstration Program and two non-waste characterization items (a reduction in the requirements for backfill in the repository, and a change to the repository horizon). A more formal change to the implementation of 40 CFR 194, to allow both the EPA and the DOE additional flexibility in several areas, is currently in the final stages.

2.3 NRC: Transportation Waste Characterization Requirements Change Process

Transportation waste characterization requirements are established in the documentation supporting the NRC Certificate of Compliance (C of C) for the transportation package, as required by 10 CFR 71. Changes to any waste characterization requirements in this documentation are initiated by submitting the changed documentation to the NRC; 10 CFR 71.13(c) and 10 CFR 71.31(b) provide criteria by which the NRC evaluates these or any other proposed changes, and revised C of Cs are used to express the NRC's acceptance of these proposals.

The two criteria by which the changes are evaluated are not complex, even though the evaluation itself may be very complex. 10 CFR 71.13(c) states that modifications are not to significantly impact the design, operating characteristics, or fissile material package with respect to criticality, in relation to the stringent testing requirements of the shipping package. 10 CFR 71.31(b) simply requires that modification of the authorized contents of the packaging provide sufficient information to demonstrate that the package will remain in conformance with the package standards in effect at the time the modification is requested.

WIPP CH TRU waste is transported in the Transuranic Package Transporter-II (TRUPACT-II), for which the C of C's principal supporting documentation concerning waste characterization is the *TRUPACT-II Authorized Methods for Payload Control* (TRAMPAC) (DOE 2003a), currently issued as a separate document, but still a part of the *TRUPACT-II Contact Handled Transuranic Waste Shipping Package Safety Analysis Report* (SARP) (DOE 2003b). The SARP specifies the waste characterization methods that will be used to meet the criteria established or referenced in the C of C is in Revision 16 (NRC 2003); while all of these revisions were not necessarily concerned with waste characterization requirements, most of the recent ones (C of C revisions 13 through 16) have adjusted waste characterization criteria.

2.4 DOE: CH WAC Characterization Requirements Change Process

The CH WAC (currently DOE 2002a) contains statements of waste characterization requirements that originate from operational activities at the WIPP. These requirements are

derived from the *Waste Isolation Pilot Plant Contact-Handled (CH) Safety Analysis Report* (CH SAR) (DOE 2003c), and are listed in the Technical Safety Requirements (TSR) attachment 1 (DOE 2003d) to the CH SAR. 10 CFR 830 requires nuclear facilities to establish and maintain a documented safety analysis. The published CH SAR has been updated annually since 1992 and any modifications to waste characterization requirements take place as a part of the ongoing review of this document. EEG is responsible for the review of the CH SAR on behalf of the State of New Mexico. The process for modification is simply to include the changes in the annual CH SAR, a process not necessarily simple in itself. Initiation of the change, review, comment resolution, and signature release are all necessary. These changes are then reflected in the next revision of the CH WAC, except for Appendix A which must be approved by EPA. For example, this process was used in 1999 to change the maximum radiotoxicity limit for 55-gallon drums (from 1000 PE-Ci to 1100 PE-Ci; see Chapter 7 for a discussion of PE-Ci).

The CH WAC also lists the DOE's interpretation of the regulatory criteria for the HWFP, NRC, and EPA. In the past the WAC contained not only the waste acceptance criteria—that is, the data that waste characterization would need to supply, but also a discussion of the source of each criterion from each regulatory organization. In promulgating the immediate predecessor of the current CH WAC, the information presented was changed so that it only reflected the most restrictive criteria in each area. The WAC no longer cites either the source for that most restrictive criterion or the various regulatory sources that place restrictions on that area. Moreover, the CH WAC no longer contains a discussion of the technical justification for each criteria as it once did in the earlier versions. EEG has gone on record urging DOE to restore that discussion into the document (EEG 2002a).

3.0 RISK PERSPECTIVES

When designing and operating a nuclear waste repository, it is necessary to evaluate the risks associated with the wastes being disposed and to use this information to minimize operational and long-term risks to workers, the public, and the environment. Waste characterization should be sufficient to provide the information necessary to ensure that the "mixed" (radiological and hazardous wastes) wastes being shipped and emplaced, meet these operational and long-term safety requirements.

3.1 EEG Evaluations and Statements

The EEG published EEG-72, *A Comparison of the Risks from the Hazardous Waste and Radioactive Waste Portions of the WIPP Inventory*, (Channell and Neill 1999). The six major conclusions from this study were:

1. Risks are low in all cases. Lifetime carcinogenic risks are expected to be about 1×10^{-3} for workers and about 1×10^{-8} for members of the public.

2. The expected radiological carcinogenic risks to workers from routine operations and from operational accidents were at least four orders of magnitude greater than the carcinogenic risk from the hazardous waste constituents. Under maximum conditions, the radiological risks are more than two orders of magnitude greater than the hazardous waste risks.

3. During routine operations, a member of the public residing at the WIPP Site Boundary would receive a very low carcinogenic risk (less than 10^{-8} lifetime) from Volatile Organic Compounds (VOCs) and no radiological risk. The radiological risk to a member of the public from average operational accidents is over five orders of magnitude greater than the hazardous waste risk.

4. Radionuclide annual risks to a resident farmer from average releases to the surface following human intrusion 1000 years after WIPP closure are one order of magnitude greater than total risks from VOCs. These long-term risks are two orders of magnitude lower than risks during the operational period and are less likely to occur.

5. Non-carcinogenic risks from VOCs during operation are less than 2% of the Hazard Index and are not important relative to the carcinogenic risks.

6. The evaluations confirmed the intuitive assumption that radiological risk from WIPP wastes are much greater than the risks from hazardous wastes.

In May 2000 EEG published EEG-75, *Evaluation of Risks and Waste Characterization Requirements for the Transuranic Waste Emplaced in WIPP during 1999*, (Channell and Walker 2000). The waste emplaced during the first year of WIPP operation was non-mixed (did not meet the regulatory definition of hazardous wastes although low concentrations of VOC's were present in headspace gas samples) and with low radionuclide concentrations. The EEG found that risks from VOCs were extremely low (lifetime cancer fatality risks of 10^{-11} to 10^{-14}).

The EEG-72 and EEG-75 conclusions have several implications for waste characterization requirements and priorities. These conclusions have been pointed out by EEG subsequent to July 1999. While many of these comments are quoted elsewhere in this report, the more relevant EEG statements have been:

1. We see no scientific reason why it is necessary to analyze for hazardous metals in waste solids (see discussion in Section 4.7).

2. VOC releases will occur routinely and have a quantifiable, albeit low, risk. Thus, there is a logical reason to quantify VOC releases.

3. In EEG-75, EEG concluded that the Confirmatory VOC Monitoring Plan in the WIPP underground would detect concentrations that are three orders of magnitude below allowable Permit limits.

4. EEG stated in an April 2001 paper at the 9th International High-Level Radioactive Waste Management Conference (Neill and Silva 2001):

> The cost of complying with non-radioactive hazards (Resource Conservation and Recovery Act [RCRA] regulations) may be much more than complying with the radiological hazards, which are about 10,000 times greater. Predicting releases over 100 years for the non-radiological constituents should not be the primary cost in comparison to limiting radiological releases over 10,000 years.

5. In an October 4, 2001 statement to the National Academy of Science/National Research Council Committee on the Characterization of Remote-Handled Transuranic Wastes we said, "… The fact that radiological risks are much greater than hazardous risks needs to be kept in mind by DOE, regulatory agencies, peer review groups, this Committee and oversight agencies when addressing possible changes to waste characterization requirements." (EEG 2001).

3.2 Risk-Based Approach to Characterization

The DOE has proposed at various times since 2000 that a "risk-based" or "performance based" system should be used to determine waste characterization requirements (Moody 2002). These two terms have not been precisely defined by DOE, but presumably refer to only those waste characterization requirements believed to serve a useful purpose in controlling risks.

The NRC has attempted to include the use of probabilistic risk assessment in a Risk-Informed and Performance-Based (RIPB) system since 1995. RIPB analyses are to be used along with traditional deterministic approaches in setting priorities for regulations. The NRC and others

believe this process will encourage more transparent regulatory approaches and focus on requirements that lead to actual reduction in risk. This is apparently the general intent of the DOE thrust in reduction of CH TRU waste characterization requirements.

EEG believes that an RIPB assessment should be included in developing CH TRU waste characterization requirements. A requirement that does not have a health or safety basis should be reevaluated. These considerations have been the general philosophy in EEG's recommendations to date, which have usually been limited to health and safety issues. However, this concept is more easily stated than implemented because the risk being addressed is often not quantifiable. The evaluation of individual CH TRU waste characterization requirements should consider two questions: (1) are the data collected used for any purpose (for example, elimination of waste containers for shipment to WIPP; or controlling quantitative limits for transportation, operations, or long-term performance), and (2) is the particular test being used or it's frequency (for example, 100%) the most cost-effective approach.

3.3 Hazards to Waste Characterization Workers

References have been made to the extra radiation doses incurred by workers performing "unnecessary" waste characterization activities (NAS/NRC 2001, p 33). The DOE was asked to address questions relating personnel radiation exposure (dose) to various characterization activities at the generator sites. The DOE acknowledged that it does not have, "information relative to dose from TRU waste characterization activities… Dosimetry groups at the various DOE sites differentiate dose by individual rather than by tasks." At best, the DOE was only able to address the questions with a qualitative answer and the promise to provide the information if and when it became available (DOE 2002d, p 23).

The EEG has not received any data that the DOE may have on actual doses received by workers characterizing CH TRU wastes. The EEG's present belief is that these doses are very low and cannot be used as a justification for reducing waste characterization requirements. Another reason for this preliminary conclusion is that (even though it is not waste characterization) the external collective radiation doses received by waste handlers and radiation control technicians

handling and emplacing drums at WIPP are so low (0.06 mrem per container from 3/99 through 12/31/02).

This conclusion is consistent with the DOE response in which the DOE noted that the risk for radiological exposure is very low for NDA, RTR, and HSG sampling and analysis during normal operations. VE is considered to be a moderate risk. As noted by DOE, the impact of VE/repackaging is controlled by ALARA (as low as reasonably achievable) principles, which normally result in very low exposures to workers. Personal protective equipment and procedures are used to prevent inhalation of airborne contamination. DOE does caution that repackaging campaigns for special cases such as ^{238}Pu and high-wattage ^{239}Pu require extra measures to avoid significant doses (DOE 2002d, p 4-7).

4.0 HWFP WASTE CHARACTERIZATION REQUIREMENTS AND EEG COMMENTS

The DOE/CBFO requested that the DOE National Energy Technology Laboratory's Center for Acquisition and Business Excellence (NETL-CABE) prepare an analysis on the cost of waste characterization (NETL/CABE 2003) that estimates the CH TRU waste characterization costs per container. Table 4-3 from this study, *Average Cost of Characterization Activities*, is reproduced here as Table 4-1. Table 4-1 is being used in the report for two reasons: (1) it gives a relative idea of the costs for each "characterization activity" (which are significant), and (2) the "characterization activity" breakdown is a convenient one to use in addressing our waste characterization conclusions and recommendations. A review of the cost study is outside the scope of this report and EEG uses the cost figures as provided, without offering an opinion of their accuracy.

Table 4-2 is an EEG-developed table that shows how the overlap of the waste characterization requirements analyzed in Table 4-1 is used to meet the requirements. The table shows which of these methods are required or used by each agency. A "required" characterization method ***must*** be used either 100% of the time or part of the time to meet the indicated requirement. The term "used" is for a waste characterization method that, in some cases, ***may*** be used to meet a requirement, but the method is not specifically mandated. For example, the HWFP requires HSG sampling and analysis, whereas, to satisfy the TRAMPAC limits on flammability, HSG sampling and analysis is not specifically required but may be, and has been used. The associated average cost of characterization per container from the DOE cost study is also included. The EEG notes that some of the categories are not regulatory requirements. For example, the "Segregation/Rework" must be performed in some cases even though it is not required by any regulatory agency. These categories have been included to retain consistency with the DOE cost study.

It is clear from these tables that nearly all of these requirements and a major part of waste characterization costs can be attributed to meeting the requirements of the HWFP. The following sections describe these requirements.

Table 4-1 Average Cost of Characterization Activities.

Characterization Activity	Percentage of Containers Requiring Activity	Average Unit Cost to Characterize	Average Cost of Characterization per Container
Non-Destructive Assay	100%	$840	$840
Headspace Gas Sampling	100%	$620	$620
Real-Time Radiography	32.8%	$730	$240
Visual Examination/ Retrievably Stored	1.2%	$22,500	$270
Visual Examination/ Newly Generated	67.2%	$540	$360
Solids Coring and Sampling	0.5%	$24,000	$120
Solids Analysis	0.5%	$63,000	$310
Acceptable Knowledge	100%	$87	$87
Drum Venting	1.8%	$120	$2
Level II Management	100%	$160	$160
Gas Generation	9%	$670	$60
Drum Age Criterion	68.7%	$46	$32
Segregation/Rework	30%	$1,400	$420
Waste Certification	100%	$330	$330
Characterization Support Activities	8%	$648	$52
Average Cost of Characterization per Container			**$3,900**

Source: NETL/CABE 2003

Table 4.2. Overlap of Regulatory Agencies and DOE Waste Characterization Requirements and Associated Cost Per Container.

	NMED		EPA		NRC		DOE		
Characterization Requirement	Used by HWFP	Req. by HWFP	Used by §194.24	Req. by §194.24	Used by TRU-PACT-II	Req. by TRU-PACT-II	Used by WIPP CH WAC	Req. by WIPP CH WAC	Average Cost of Characterization per Container [b]
Non-Destructive Assay	No	No	Yes[a]	Yes	Yes	Yes	Yes	No	$840
Headspace Gas Sampling	Yes	Yes	Yes	No	Yes	No	No	No	$620
Real-Time Radiography	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	$240
Visual Examination/ Retrievably Stored	Yes	Yes	Yes	No	Yes	No	No	No	$270
Visual Examination/ Newly Generated	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	$360
Solids Coring and Sampling	Yes	Yes	No	No	No	No	No	No	$120
Solids Analysis	Yes	Yes	No	No	No	No	No	No	$310
Acceptable Knowledge	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	$87
Drum Venting	Yes	Yes	No	No	Yes	Yes	Yes	Yes	$2
Level II Management	Yes	Yes	No	No	No	No	No	No	$160
Gas Generation	No	No	No	No	Yes	Yes	No	No	$60
Drum Age Criteria	Yes	Yes	No	No	Yes	Yes	No	No	$32
Segregation/ Rework	No	No	No	No	No	No	No	No	$420
Waste Certification	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	$330
Characterization Support Activities	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	$52
							TOTAL		**$3,900**

[a] In the required (req) column, "yes" means the method ***must*** be performed 100% of the time or part of the time. In the used column, "yes" means the method ***may*** be performed to meet a requirement, but the specific method is not mandated by that requirement.

[b] The cost of activity spread over all the containers shipped to WIPP.

4.1 HWFP: Acceptable Knowledge (AK) Requirements

AK is the principal waste characterization requirement for all of the regulatory agencies. As shown in Table 4-1, the DOE cost study indicates AK to be one of the least costly of the waste characterization techniques at $87/container. However, the AK package is developed on a waste stream basis rather than on individual containers.

Several slightly differing definitions of the term are in use on the WIPP project; the HWFP states:

> Acceptable knowledge includes a number of techniques used to characterize transuranic (TRU) mixed waste, such as process knowledge, records of analysis acquired prior to RCRA, and other supplemental sampling and analysis data (EPA 1994). (NMED 2003, Attachment B4-1).

Process knowledge" is the knowledge of the waste based on the materials and processes used to generate the waste, and "EPA 1994" is an EPA guidance document on waste characterization for facilities that treat, store, or dispose of hazardous wastes (the WIPP is a storage and disposal facility). Thus, acceptable knowledge is effectively the compilation of all useful knowledge about the waste. Container analyses by other waste characterization methods become a part of the AK for the waste stream, as does any other information related to the waste that is discovered. The HWFP requires AK to be organized in a report on each waste stream, from general facility information (areas and facilities) to specific information for the waste stream (description of the generating process to include buildings, process flow diagrams, material inputs, types and quantities generated, and storage locations). An overall AK summary report is generated after records are found, documents are indexed, and applicable waste and facility information has been organized.

The EEG has not commented specifically on the need for AK as a waste characterization requirement. There has never, to the EEG's knowledge, been any question of the need for an AK-like data accumulation. The HWFP's AK requirements are the most prescriptive of any of

the regulatory agencies. At this time the EEG supports the continued use of the HWFP AK requirements.

4.2 HWFP: Headspace Gas Sampling and Analysis Requirements

The AK requirements section of the HWFP also states:

> Radiography and/or visual examination, headspace gas sampling and analysis, and homogeneous waste sampling and analysis ...are used to acquire supplemental sampling and analysis data to meet the requirements of the Waste Analysis Plan (WAP) specified in Permit Attachment B. (NMED 2003, Attachment B4-1).

More often, the HWFP addresses these techniques as "confirmation of AK"; the EEG views these techniques more as a process for discovering deviations from the currently known AK.

At $620/container, headspace gas sampling and analysis is one of the more expensive costs-per-container waste characterization techniques listed in Table 4-1. According to DOE:

> Headspace gas is measured both to meet transportation requirements and to meet NMED requirements. Several methods are used to collect a sample of gas from inside the top of the container. One method involves drawing a sample of gas through the existing filter by inserting a needle through the filter core. The punctured filter is then removed and a new filter installed. A second method involves using a self-tapping replacement filter that first taps a hole in the waste container. Next the samples are drawn through the self-tapping filter assembly. A third method uses a self-tapping sampling port through which a sample is drawn, and then the port is sealed.
>
> Headspace gas sampling is done in a structure that prevents radioactive particulate from the waste container from escaping into the atmosphere. Precautions are taken around the puncture area to prevent releases of radioactive particulate to the

> atmosphere and to prevent drawing outside air into the container during sampling (DOE 2002d, p 5).

Analysis is targeted to determine the presence and concentrations of about 30 different hazardous chemicals within each headspace gas sample, and the HWFP also requires analysts to look for, and identify, other chemicals in the sample from each container. If these other chemicals are on the hazardous waste list, and appear in 25% or more of the individual containers analyzed in each waste stream, then they are added to the target list for that waste stream also. The analysis is performed according to procedures modified from the EPA's *Test Methods for Evaluating Solid Wastes* (EPA 1996) and *Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Specially Prepared Canisters With Subsequent Analysis by Gas Chromatography* (EPA 1999). Included in the HWFP requirements are the many sample control methods for quality assurance and quality control. Those also contribute to the cost of headspace gas sampling and analysis.

The EEG has commented on HWFP headspace gas requirements, stating to the NAS/NRC WIPP CH Waste Characterization Committee in 2002 that though headspace gas sampling and analysis helps meet the 40 CFR 264.13(a)(1) requirement for a detailed chemical analysis of a representative sample of the waste, "...we do not see why 100% headspace gas sampling at the sites should be necessary to ensure compliance with Room Based Concentration Limits" (EEG 2002c). The HWFP establishes concentration limits for VOCs in the underground rooms, primarily as a protection for underground and above ground workers and members of the public. The headspace gas analysis results are one of two checks to ensure that these concentrations are not exceeded; the other check is by sampling of the air from these underground rooms (confirmatory VOC monitoring). The EEG went on to state the following:

> The Code of Federal Regulations requirement for a detailed chemical analysis of a representative sample of waste is addressed only by headspace gas analysis for most of the debris waste. These analyses do provide additional information on the contents of waste containers. Additional waste streams have been defined because of the results of these analyses, and on occasion additional RCRA

> hazardous waste numbers have been added to waste streams. The importance of these functions has occasionally been denigrated, primarily because this additional information is not used to control quantities of VOCs coming to WIPP other than to show compliance with the room based concentration limits (EEG 2002c).

In more recent comments to the same NAS/NRC committee, the EEG again noted that room-based concentration limits can be met by confirmatory VOC monitoring at the WIPP, that "A comprehensive HSG [headspace gas] sampling program is also the most direct means of ensuring compliance with the flammable gas concentration limits for transportation that are included in the TRAMPAC", and that:

> HSG sampling is the primary way DOE has chosen to meet the "detailed chemical analysis...of a representative sample of the waste" that is specified in the New Mexico Administrative Code. This information is used (in conjunction with acceptable knowledge) to assign hazardous waste numbers to each container. However, EEG is not aware that these hazardous waste numbers are used to exclude waste from the WIPP or to otherwise control the hazardous waste. These data probably provide the incidental benefit of confirming AK and ensuring the various Waste Acceptance Criteria (WAC) requirements for stability of waste are met.
>
> EEG believes that it is desirable to maintain a comprehensive HSG program for WIPP CH-TRU wastes. However, it should be possible to require less than 100% sampling in some cases. This determination needs to be made on small batches or waste streams where there is reason to believe that relative uniformity exists. Also, the detailed approach necessary to ensure that representative data is still obtained needs to be justified by a proposed modification request (PMR) to the HWFP in the same manner that existing PMRs are justified (EEG 2003b).

One of EEG's concerns about the complete elimination of HSG sampling is that knowledge of the waste may be much less certain on retrievably stored waste which has not yet been characterized.

As noted above, the quality control and quality assurance (QA/QC) requirements for headspace gas sampling and analysis processes would appear to contribute to the DOE's estimated cost for headspace gas activity. The EEG has stated several times a variant of the following:

> The relaxation of audit requirements and QA/QC is not an appropriate way to reduce the waste characterization burden. These requirements should maintain the current level of stringency. The appropriate way to reduce the waste characterization burden is to eliminate unnecessary requirements, not to reduce the degree of compliance. (EEG 2002c).

Other EEG comments have noted that headspace gas analysis is often used to ensure that flammable gas limits for transportation are met, and the HWFP itself notes that headspace gas is useful for determining potential flammability.

As noted in Section 2.1, the DOE has successfully pursued modifications related to headspace gas requirements in the HWFP that the DOE believes will result in savings of tens of millions of dollars. It should also be noted that the DOE has itself endorsed continuation of some headspace gas analysis (DOE 2002d, p 17-18).

Reduction in the HSG requirement should be possible if the DOE submits detailed PMRs on specific waste streams.

4.3 HWFP: Drum Age Criteria (DAC) Requirements

The DAC is the time after the closing of a container necessary to ensure that VOC and flammable gas concentrations in the headspace of the container have achieved at least 90% of equilibrium concentration. The times vary widely, currently from four days to 283 days,

depending on the waste type, packaging configuration, and the container filters. The DOE cost study (NETL/CABE 2003) considered the DAC as a separate requirement with a cost of $32/container, but the DAC is solely for purposes of establishing the representativeness of the headspace gas in a container, and is really a part of the sampling process for headspace gases. The DAC is also used as a part of the TRUPACT-II requirements when flammable gases are to be actually measured.

The DOE eventually succeeded in obtaining changes to the initial DAC values in the HWFP, but three modifications were submitted before this success was obtained. In a paper (Walker and Silva 2002) presented at the conference Waste Management '02 conference midway through these attempts, the EEG used the DAC modifications as the principal example to point out four observed difficulties in the DOE's approach to the permit change process. Three of these difficulties delayed the DAC permit modification request.

First, the modification was not properly classified. The DOE submitted the revised DAC as a Class 1. This was immediately rejected by the NMED. Second, when submitted as a Class 2 proposal, the DOE did not provide sufficient data and information. Third, the DOE failed to meet the expectations of the regulator. In rejecting the first PMR, the NMED cautioned DOE to submit the request as a Class 3. Nonetheless, DOE submitted the request as a Class 2. NMED was forced into the process for changing the request to Class 3. The action by DOE contributed to further delay.

The DAC modification was an important change to the HWFP and TRAMPAC. It decreased the storage times on many waste containers by several months. The modification process for the eventual Class 3 request to the HWFP also underscored the value of public involvement as specified in the process. The EEG requested that the DOE provide the input and output files for the DAC computer model. These were later provided to the EEG by the DOE at the insistence of the NMED. The public review process identified six discrepancies between the output files and the DAC tables that until then had not been identified.

4.4 HWFP: Real-Time Radiography (RTR) Requirements

All WIPP waste containers are required by the HWFP to undergo either radiography or VE. RTR is a non-destructive examination technique that utilizes x-ray technology to create images of the interior of waste containers. The "real-time" component is important. It allows the radiography technician to increase and decrease the energy of the x-rays so as to create images of different density materials within the container. Thus, lower energy x-rays can produce an image of loose plastic material in the containers, and adjustments can also be made to observe the interior of metal cans or bottles or other denser material that may be in the container.

With some training, an operator can distinguish between different kinds of metals (lead, steel, aluminum, by their different densities), determine the number of layers of plastic packaging around waste, and detect any free liquid in bottles or cans that are in the waste. Thus, radiography can be used to create a record of the physical contents of the container. The HWFP requires that operators of radiography equipment be trained both formally and by on-the-job techniques. The operator must successfully demonstrate an ability to identify a specific list of objects in the waste prior to performing official scans. Operators must then be further trained to the waste streams they are reviewing, an audio-visual recording of the examination of each container must be made. A similarly-trained independent reviewer must confirm the information in the records created by the operator. Once each day, or once each testing batch, (20 or fewer containers) a replicate analysis must be performed by an independent operator. Operators are required to determine the Waste Matrix Code for the waste, estimate material parameter weights, and look for prohibited items in the waste.

It is worth noting that the 40 CFR 194.24 waste characterization requirements to quantify non-ferrous metals and cellulosic materials are met primarily through radiography. These are some of the material parameters that the HWFP requires radiography operators to estimate. In the absence of HWFP requirements, a comparable program would either be needed to address the 40 CFR 194.24 waste characterization criteria or alternate methods (visual examination) would be necessary.

As with AK, few substantive concerns have been raised about radiography requirements and the EEG's comments on radiography have been brief. In 1999, as part of a broader statement, an EEG comment was that:

> EEG agrees with the generic policy that data that is not going to be used should not be collected. This includes data for all requirements, not just VE. However, it is necessary to do thorough evaluations to show that RTR and/or VE are not providing useful data in a waste stream. At the recent SRS audit, 15% of the first batch of drums was rejected by RTR. (EEG 1999).

Radiography was introduced in lieu of visual examination of waste, so that the DOE's HWFP application expected that only visual examination would be used for newly generated waste. The HWFP initially followed this track, but at least one waste characterization program found radiography to be so useful, the DOE submitted a PMR to allow radiography as well as VE to be used for newly generated waste. The PMR was quickly approved, and either method may now be used for newly generated wastes.

The overall radiography program is an important part of the WIPP waste characterization program and should be retained. It may be possible to reduce some of the detailed procedural requirements in the HWFP.

4.5 HWFP: Visual Examination for Retrievably Stored Waste Requirements

VE may be used as an alternative to RTR for retrievably stored wastes, but this alternative may not have been used yet. However, because RTR is merely an imaging technique, a radiography operator cannot, for instance, read the label on a bottle, or estimate a weight by lifting the object. The HWFP also requires that a statistically determined sample of radiographed containers undergo confirmatory VE. The size of the statistical sample is based on the number of mis-certifications found from the previous year at that site, from each of the three summary category groups (debris, solidified wastes, and soil/gravel wastes). Thus far, less than 2% of retrievably

stored containers undergo VE. Nonetheless, the process is an expensive component of the waste characterization program. The DOE estimates the cost to be $22,500 per container examined, or $270 per container over the entire population sent to the WIPP.

The HWFP requirements for VE include those for RTR (determine Waste Matrix Code, measurement, rather than estimation, of material parameter weights), but also requires that "all discernable waste items" are to be identified, as well as residual and packaging materials. A VE expert is required to be present. This individual's discretion determines whether bags or cans inside the container must also be opened (weights of the contents are to be estimated if it is not opened). The packaging configuration, type and number of filters, and other information necessary for determining the DAC are also to be recorded. Audio-visual recordings of the process are to be made, and operators (as well as the much more thoroughly trained VE expert) must undergo formal and on-the-job training.

The EEG has stated that:

> Claims are often made that VE is dangerous because of additional radiation exposures and possibility of contamination. EEG has discussed this issue with persons doing VE at INEEL, RFETS, and LANL and found they don't feel VE is dangerous and do not have data on incremental radiation exposures. More specific data and evaluations are needed if danger is to be used as an argument against VE. Also, plans to use 100% VE for newly generated wastes appear to be inconsistent with expressed safety concerns. (EEG 1999, p 8).

The DOE has been successful in modifying the HWFP on retrievably stored VE, producing great cost savings, as noted in Section 2.1.

4.6 HWFP: Visual Examination/Newly Generated Requirements

For newly generated wastes, the original HWFP (based on the DOE's application) specified only VE as a method for determining the required detailed physical analysis of a representative

sample of the waste. The process actually specified in the HWFP has the advantage of allowing verification at the time the container is being filled and is somewhat different from retrievably stored VE, and has often been referred to as "visual verification" (V-squared) to distinguish it from the retrievably stored process. No audio/video recording is required, but two visual examination operators are required to observe the loading of waste into containers and record the data. The same data is to be recorded as for retrievably stored VE.

The EEG has not commented specifically on the visual verification process, except when commenting on the PMR to allow radiography as well as visual verification. In those comments the EEG noted that visual verification is a much higher quality process than radiography, and that the requirement for two trained visual examination operators to perform the visual process:

> ...may be overkill; the HWFP could be modified to require generator site procedures be developed and implemented that would require, for each waste container, that a data form be used to document the contents of the container, and then require a single verification of the information on the data form (EEG 2002b).

As noted previously, the PMR submitted by the DOE was successfully integrated into the HWFP.

4.7 HWFP: Solids Coring and Sampling, and Solids Analysis (Homogeneous) Requirements

The DOE's waste characterization cost analysis in Table 4-1 shows solids (solidified wastes and soil/gravel) coring and sampling costs separate from the chemical analysis of these solids. For the 0.5% of drums that will be cored, sampled and analyzed, the estimated cost per drum is $24,000 for coring and sampling and $63,000 for analysis. When spread over all containers shipped to WIPP, for sampling, the cost per drum shipped is estimated at $120; for the analysis, the cost is $310. The overall estimate of $430 per container shipped is among the highest waste characterization method costs.

"Coring" is a process wherein a container of solids is opened, and a hollow drill bit is inserted near the bottom of the container. The core is taken from the bit and "sampled" by removing either one or three thin sections from along its length. These sections become the sample.

For retrievably stored wastes, the HWFP states that homogeneous sampling and analysis is used to determine the toxicity "characteristic" in the waste; that is, the hazardous compounds that are considered toxic only if present above the threshold concentrations listed in 40 CFR 261.24, or if the "listed" wastes under Subpart D of 40 CFR 261 are present. Sampling of these waste streams is statistical, rather than each of the containers; five randomly selected containers must be sampled initially, then chemically analyzed. The average concentration and standard deviation of each hazardous compound is then computed and used, along with the threshold concentrations (or program required quantification limit, if it is a "listed" waste in Subpart D) to calculate the total number of containers from the waste stream that must be sampled. For most (perhaps all) of the homogeneous waste streams analyzed so far, the initial five samples suffice.

The HWFP requires analysis of homogeneous samples for total VOCs, semivolatile organic compounds (SVOCs), and analysis for metals. Tables in the HWFP list over 30 chemicals for the VOC analysis, 11 for the SVOC analysis, and 14 metals that are the primary targets, but other hazardous constituents may be added to the list for a waste stream if they are found in more than 25% of the samples from that waste stream. A test for Polychlorinated Biphenyls (PCBs) is also currently required, but a PMR is currently in process to eliminate those requirements now that the DOE has obtained an approval from the EPA under the Toxic Substances Control Act (TSCA) to dispose of PCB-contaminated wastes at the WIPP. A full panoply of QA/QC requirements are also established for homogenous sample analysis, and radiation protection activities associated with opening of containers and processing the samples also contribute to the homogeneous sampling and analysis program.

The EEG has commented several times on homogeneous waste sampling and analysis, eventually concluding that these requirements are not needed. In 1999, comments on two DOE documents, in a section entitled, "Homogeneous Waste Sampling and Analysis", the EEG first

stated that metals analysis was not needed, and deferred an opinion on the homogeneous VOC and SVOC requirements:

> For the following reasons, EEG sees no scientific reason why it is necessary to analyze for metals at all:
>
> $ DOE apparently did not feel that metals concentration data were important enough to include in the RCRA application. The State apparently concurred since they did not request that the data be include[d].
>
> $ The required hazardous metals data are not to be used for any regulatory control under the Draft Permit.
>
> $ Evaluations in EEG-72 concluded that human exposures to hazardous metals at WIPP would only occur from the types of operational and human intrusion accidents that released radioactive materials. The calculated radionuclide risks (Excess Cancer Fatalities) were $2x10^6$ times the hazardous metals release for operational accidents and $5x10^5$ times for long term releases. Furthermore, methods used to clean up radionuclide contamination would also be effective in cleaning up hazardous materials.
>
> $ EEG has no opinion at this time on sampling for VOCs and SVOCs in homogeneous wastes. The decision should be based on whether any useful information will be obtained for VOC control under the RCRA permit... (EEG 1999).

In 2002, in comments for the NAS/NRC CH waste characterization committee, the EEG added the homogeneous VOC and SVOC analyses to metals:

> The HWFP requires a fraction of homogeneous waste containers to be analyzed for toxic metals, other hazardous chemicals, volatile VOCs [sic], and semi-volatile VOCs [sic] (SVOCs). The EEG has stated that we see no technical reason why it is necessary to analyze for metals and chemicals at all. Our reasons are...[Followed by the information in the first three bullets of the previous quote] (EEG 2002c, p 8).

Currently, the EEG continues to believe that the homogeneous sampling and analysis are unnecessary characterization requirements in the HWFP.

The DOE has successfully pursued changes to the HWFP on homogeneous sampling and analysis issues, the major change being to add to the statistical quality control method initially required for newly generated homogenous wastes so that the retrievably stored process could also be used. Quality control requirements for SVOC specific analytes (pyridines and cresols) were changed in another PMR, and one of the first HWFP PMRs successfully altered the requirement for core sampling to allow one sample to be taken from the core rather than the three samples from each core that was previously required.

4.8 HWFP: Level II Management (Project Level) and Waste Certification Requirements

This is the first time EEG has commented on these Level II and Waste Certification Requirements. "Level II Management" requirements are estimated to cost $160 per container by the DOE. "Level II Management" requirements are apparently those activities addressed in the HWFP as "Project Level" requirements. These are solely HWFP requirements, though they appear to be closely intertwined to the "Waste Certification" requirements (at $330 per container) also shown in Table 4-1. Further, the quality assurance provided by these checks supports non-HWFP requirements as well. The two activities, Level II Management and Waste Certification, from Table 4-1 will be covered as a single topic in this section. It should be noted that the 40 CFR 194 waste certification process does not specify these activities, but a

comparable program would likely need to be developed specifically for the 40 CFR 194 required program were it not specified in the HWFP.

Project level activities are principally performed on data packages developed at the "data generation level" (radiography or visual examination test batch data reports, headspace gas and homogeneous waste sampling batch data reports, and headspace gas and homogeneous analytical data reports). These data packages are compilations of the data specified to be collected during the activity (including quality control information such as independent technical review forms, supervisor review forms, quality assurance review forms, reports on non-conforming items or processes during the activity, chain-of-custody forms, evidence of sample preservation, quality control sample results, etc.). Although radioactive materials are not a part of the HWFP function, data packages for the radioactive component waste characterization are also developed and processed based on the requirements specified in the HWFP.

At the project level, the Site Project QA Officer (SPQAO) is then required to review and sign all batch data reports supplied from the data generation level for completeness. This includes verification that quality control checks were properly performed, and that the quality assurance objectives specified in the HWFP were properly met. The Site Project Manager (SPM) also must sign off on the package; the SPM must ensure that the DAC is valid, that the necessary generation level reviews were performed and ensure that the checklists are complete, and that the data meet the required quality assurance objectives. Both the SPQAO and the SPM must prepare summary reports that include validation checklists, discussion of any nonconformances within the data package, signatures of the individuals. When a new waste stream is proposed, the Site Project Office must determine that sufficient information is available in the preliminary data packages to establish the waste stream. Site project offices are responsible for preparing the Waste Stream Profile Forms (WSPF) that officially document the new waste stream, and a characterization information summary from the preliminary data packages that is required along with the WSPF.

Other project level activities include performing the statistical calculations for random sampling. The site project offices also calculate the confidence levels from analyses, and document that

these are within the quality assurance objectives established in the HWFP. The site project office also is responsible for putting waste characterization and transportation information into the WIPP Waste Information System (WWIS), and negotiating with the WIPP site reviewers of this information.

The EEG has not commented on the project level HWFP requirements, but the data package review and approval process may be one of the areas to which the general EEG comment that, "We believe waste characterization requirements are excessive" applies. We suspect that many of these requirements were provided from a legal perspective, rather than a technical one, and therefore may be useful on that level. However, from a technical perspective, the data package review-and-approval process invoked by the HWFP appears excessive.

The DOE submitted a Class 2 PMR which would have virtually eliminated project level waste characterization activities, among other changes. This modification was later withdrawn by the DOE.

4.9 HWFP: Characterization Support Requirements

The HWFP requires the DOE to conduct an audit and surveillance program to ensure that waste characterization sites conduct waste characterization activities in accordance with the HWFP Waste Analysis Plan, and that the information supplied by each site is managed properly (records management). The HWFP also requires specific training for all areas discussed above. The 40 CFR 194 criteria also require these activities, as does the DOE itself.

The EEG has commented several times on the WIPP audit and surveillance program over the years. These comments have generally been supportive of the program and we have observed it to be a very good QA program. The basic EEG comment has been that waste characterization requirements may be changed, but not the auditing/surveillance program. For example, in a comment to the NAS/NRC committee, the EEG stated:

> Quality assurance requirements in the CBFO Quality Assurance Program Document (QAPD) are applied to waste characterization activities; while

> the EPA has mandated those in use for those processes related to 40 CFR 191/194, the HWFP only requires that the quality assurance practices in the CBFO QAPD be followed, and there may be a way of altering the requirements for non-radioactive waste characterization. However, for a variety of reasons, the EEG believes that a change in the QA requirements would not substantially decrease waste characterization requirements and would likely result in less assurance that the program was in compliance. (EEG 2003a).

Requirements for training are included in the CBFO QAPD, so that this EEG comment would appear to cover training, also. The EEG has not commented on TRUPACT-II loading, equipment and facilities, waste storage, or records maintenance in terms of their importance to the WIPP project.

5.0 40 CFR 194 (EPA) REQUIREMENTS

Title 40 CFR 194.24(c) requires the DOE to specify limiting values for waste components that are to be emplaced at WIPP. The primary analyses are quantification of radionuclides. However, there are three non-radiological waste materials that need to be quantified.

(1) free water (other regulatory agencies use the term free liquids or residual liquids)
(2) ferrous and non-ferrous metals
(3) cellulose, plastic, and rubber (CPR)

These materials are currently quantified principally by use of radiography and visual examination methods, except for the ferrous metal requirement. Chapter 4 provides the discussion of radiography and visual examination waste characterization methods. Both the radiological and non-radiological quantification is to include measurement error statistics (EPA 1998).

Under 40 CFR 194 criteria, radionuclide quantification requirements can be met by either destructive (radiochemical analysis) methods or NDA methods. Nearly all (if not all) radionuclide quantities reported to date have been by NDA. The DOE estimated that the average cost per container for NDA measurements was $840, thus making NDA the single most expensive waste characterization method (see Table 4-1).

5.1 EPA's Non-Radiological Waste Criteria

5.1.1 EPA: Free Water Requirements

EPA's Compliance Certification Decision (EPA 1998) limits the total amount of free water in the repository to 1685m^3, which is equivalent to an average of 1% of the volume of a waste container. This limitation is required because of the assumptions DOE used for waste room modeling in the Compliance Certification Application (DOE 1996). This requirement could be satisfied by a repository (or waste panel) average rather than on each waste container. However,

transportation, HWFP, and WIPP Operations and Safety requirements all limit free water to 1% on each container.

EEG believes the free water limit of 1% on each container should not be changed since it is required for the transportation, HWFP, and WIPP criteria, and is probably the most cost-effective way to ensure the EPA's requirement is met.

5.1.2 EPA: Metals Requirements

The EPA has a minimum requirement for the quantity of ferrous metals in the repository, to maintain a reducing chemical environment in the repository in order to minimize radionuclide mobility. Waste drums and other containers provide more than the minimum ferrous metals requirement. The method of compliance is to simply count the containers in the repository and multiply the number of containers by the amount of iron in each container. The DOE has stated that enough containers have already been placed in the repository to meet the ferrous metal requirement.

EEG has stated that this requirement should be tracked at a waste panel (rather than entire repository) level. However, we have also said "there may be an argument for eliminating further tracking of this parameter" (EEG 2002c). This is really a non-problem and will continue to be unless there are future changes that allow non-ferrous waste containers to be emplaced.

Non-ferrous metals are included in the EPA's requirements because it was argued that these materials will reduce or eliminate the possibility that the radioactive components would attach to organic ligands (EPA 1998). The non-ferrous metals will attach to the binding sites on these ligands (EPA 1998). The amount of non-ferrous metals in each waste container is estimated by radiography or measured (weighed) during visual examination; a discussion of these methods can be found in Chapter 4.

5.1.3 EPA: Cellulose, Plastic and Rubber (CPR) Requirements

The presence of cellulose, plastic, and rubber could cause generation of gas in sealed repository rooms which could affect the release of radionuclides from the repository. Because of this

potential, the EPA has set a maximum repository limit on the kilograms of CPR. At present the mass of CPR is estimated or measured in each container during either radiography or visual examination.

This quantification continues to be necessary because the limit is important to assumptions used in the performance assessment for the repository. However, it does not seem to be difficult to stay below the limit. EEG has stated, "…, quantification on a waste stream (rather than individual container) basis should be acceptable if properly estimated." (EEG 2002c).

5.2 EPA's Radiological Waste Characterization Requirements

The principal EPA radiological waste characterization requirements are for the purpose of tracking the quantities of ten radionuclides emplaced in the repository to ensure that the radiological limits established for the repository are met. This continuously updated radionuclide inventory is also important for evaluation of long-term compliance during the performance assessments required at each five-year recertification. Radionuclide quantification is required on each waste container.

There are additional radiological waste characterization requirements for transportation and for the WIPP repository. These requirements will be discussed in Chapters 6 and 7. However, it is important to recognize that these transportation and WIPP requirements also require determination of some individual radionuclides which would have to be obtained even in the absence of EPA requirements.

Appendix A of the CH WAC of the Waste Isolation Pilot Plan (DOE 2002a) specifies the Radioassay Requirements for CH TRU in considerable detail. The EEG commented on the Draft Appendix A during its development (EEG 2002a).

5.2.1 EPA: The Ten Required Radionuclides

The ten required radionuclides are ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{241}Am, ^{233}U, ^{234}U, ^{238}U, ^{90}Sr and ^{137}Cs. Some of the radionuclides are more important for long-term compliance. The most

significant are ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{241}Am. Since their half-lives and specific activities vary considerably, each of the four present a different hazard and their activities should be separately determined. The other tracked radionuclides (^{233}U, ^{234}U, ^{238}U, ^{242}Pu, ^{137}Cs, and ^{90}Sr) have less effect on repository performance but could affect certain scenarios either because of the possibility of "early" human intrusions (that is, within hundreds of years of closure) or non-random emplacement of waste in the repository.

There are other reasons for tracking several of these radionuclides. Uranium-233 must be determined because of the NRC FGE requirement. Uranium-235 is not one of the ten EPA tracked radionuclides, but it is required to be tracked by the NRC FGE requirements. Also, if minor radionuclides in an assay are recognized, there is more assurance that the major contributors are correctly identified.

One important radionuclide not included in the 10 required radionuclides is ^{241}Pu. It is the primary contributor to total WIPP activity (60% of the activity emplaced to date) and it decays with a 14.4 year half-life to ^{241}Am, which is an important radionuclide. The sites are reporting ^{241}Pu now, although not required to do so, and this reporting should continue.

The EEG believes that all ten of the radionuclides should be tracked and reported. Also, ^{241}Pu tracking should be required.

5.2.2 EPA: Other Non-Destructive Assay Issues

EEG has provided opinions on two issues concerning NDA requirements. These are: (1) the EPA requirement that determination of isotopic ratios be on each waste container (rather than on a waste stream); and (2) use of non-WIPP certified instruments to perform waste characterization.

EEG believes justification for less than 100% quantification and determination of isotopic ratios may be possible for some, but certainly not all, waste streams (EEG 2002c).

The DOE has proposed to use non-WIPP certified assay systems used for Safeguards measurements for NDA analysis of WIPP waste. EPA has rejected this DOE proposal. EEG currently agrees with the EPA position. We do not believe that quality control of NDA measurements should be relaxed. Also, it has not been shown that radionuclides other than ^{239}Pu and ^{240}Pu can be reliably determined with these instruments. The EEG has stated:

> EEG believes that quantification of radionuclides and confirmation of isotopic ratios should continue to be obtained as they are now, i.e., by using WIPP-certified NDA systems. These determinations, unlike some other required waste characteristics that cannot be directly measured, can be obtained directly by measurement. Any additional efforts to produce more accurate AK in order to reduce the NDA burden will inevitably result in less accurate radionuclide values (EEG 2002a).

6.0 NRC (TRUPACT-II) TRANSPORTATION REQUIREMENTS

The NRC has extensive payload requirements for shipment of wastes in the TRUPACT-II package. These requirements include:

(1) container and physical properties
(2) nuclear properties
(3) chemical properties
(4) gas generation
(5) payload assembly
(6) quality assurance.

These requirements are specified in detail in the TRUPACT-II TRAMPAC (DOE 2003a). Compliance is through generator or storage site programmatic or waste-specific TRAMPACs. The DOE Carlsbad Field Office (CBFO) is responsible for approving these site-specific TRAMPACs and verifying compliance. The NRC does not become directly involved with this characterization process.

Payload requirements 1 through 4 above include waste characterization requirements. These waste characterization requirements are similar to those required in either the HWFP or in EPA's NDA requirements and are incorporated in these two waste characterization programs.

6.1 TRUPACT-II Container Properties

Most container properties involve weights and listing of acceptable containers. However, there are three container properties that are obtained from waste characterization requirements of the HWFP. These are:

(1) Filter vents are required in each waste container.

(2) Residual liquids shall not be more than 1% of the volume in any payload container. This is verified by RTR, VE, or AK.

(3) Sealed containers greater than four liters (nominal) are prohibited unless in waste material Type II.2 packaged in a metal container. Compliance is determined by RTR, VE, or AK.

6.2 TRUPACT-II Nuclear Properties Characterization

6.2.1 Nuclear Criticality

In order to ensure that nuclear criticality will not occur during shipments it is necessary to limit the FGE in individual waste containers. Requirements in Appendix A of the CH WAC are currently used to satisfy all NRC radioassay requirements even though this is not mandated by the TRAMPAC. This requires quantification of all fissile radionuclides. Although a number of transuranic radionuclides can be fissionable, the most important ones at WIPP are ^{239}Pu, ^{235}U, and ^{233}U. Therefore, it is necessary to determine the quantity of these three radionuclides through the NDA process discussed in Chapter 5. As mentioned in Chapter 5, ^{235}U quantification is not required by the EPA. In many cases the FGE value will be well below allowable container and TRUPACT-II limits and this requirement can be satisfied by AK.

6.2.2. Radiation Dose Rates

External radiation dose rates are limited to 200 millirem per hour at the surface of waste containers. This is a mandatory measurement, but is not a waste characterization requirement.

6.2.3 Decay Heat Limits

Ionization caused by radioactive decay can generate hydrogen gas which must be controlled in the TRUPACT-II. The decay heat value, which is a gas generation requirement, is used in determining the payload shipping category. Decay heat values are calculated from the

radioactivity of each radionuclide in the container. Therefore, it is necessary for the NDA to quantify all significant radionuclides in the waste. The EPA requirements for NDA provide adequate information to determine decay heat values.

6.3 TRUPACT-II Chemical Properties Characterization

Pyrophoric materials are limited to small residual amounts (< 1% by weight). Explosives, corrosives, and compressed gases are prohibited. Chemical composition is required to be known in order to determine gas generating properties. Chemical compatibility is also required by complying with, *A Method for Determining the Compatibility of Hazardous Waste*, (Hatayama and others 1980).

Compliance with the requirements is demonstrated via AK, VE, or RTR. These same criteria are also required under the HWFP, which as noted, requires more robust waste characterization methods (see Chapter 4).

6.4 Gas Generation Requirements

6.4.1 Payload Shipping Category

The payload shipping category determines the decay heat limit that is necessary to ensure that hydrogen gas concentrations will be no more than 5% by volume in the innermost bags within the waste container. In addition to the decay heat value determined from NDA, it is necessary to determine the waste type from the chemical properties and tables of allowed materials. Chemical properties are determined from AK, VE, or RTR. The number of layers of bags in a container, as well as the presence of a rigid liner is both necessary to determine the payload shipping category and these are confirmed by RTR or VE.

6.4.2 Flammable (Gases and VOCs) Concentration Limits

The TRAMPAC also limits the presence of methane and flammable VOCs as well as hydrogen, to ensure the absence of flammable mixtures in TRU waste payloads. The limit of flammable VOCs in the headspace of a waste container is ≤ 500 parts per million.

Procedures for showing compliance with the Gas Generation Requirements can become very complex. If the decay heat limit requirement is met and AK is adequate to verify that the ≤ 500 parts per million flammable VOC requirement can be met, the container falls into the Analytical Category and the requirement can be satisfied by analysis. Otherwise, containers fall into the Test Category.

Test Category containers may be able to show compliance either by measurement of the headspace of payload containers or by Full-Drum Testing. Headspace gas analysis, required in the HWFP, can be used to satisfy the flammable VOC limit requirement.

6.5 EEG Positions on NRC Requirements

The three waste characterization requirements in the Container Properties should be retained. Other changes in Container Properties (primarily specifying appropriate waste containers) would be acceptable if approved by the NRC's Revision Process.

There should not be any changes made in Nuclear Property requirements.

The basic gas generation requirements (hydrogen gas concentrations of < 5% by volume in the innermost bag and flammable VOC concentrations ≤ 500 ppm in the headspace of waste containers) should remain as described in the current version of the TRAMPAC (DOE 2003a). The procedures for showing compliance with the gas generation requirements were quite conservative in the original Certificate of Compliance in 1989. This was because of the lack of sufficient data or demonstration of alternative analytical procedures. There have been many changes in these procedures over the years and it is now possible to show compliance for many waste containers that would not have originally been shippable. EEG has considered this revision process and NRC's evaluations to be an acceptable process. We believe it is appropriate for DOE to continue to propose procedure modifications and that NRC should critically evaluate these before approval.

7.0 THE WIPP CH WAC AND WIPP OPERATIONAL WASTE REQUIREMENTS

7.1 History of the WIPP WAC and Waste Characterization

Waste characterization has been an important consideration for the WIPP since its earliest days. As early as 1976 the WIPP scientific advisor, Sandia National Laboratories, began, "...to gather the diverse input required to establish appropriate criteria," for waste characterization. These were later published in the1980 *Report of the Steering Committee on TRU Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, which was the first of a series of documents referred to as the "WIPP WAC" (DOE 1980). This first WAC contained similar or identical criteria to many of the waste acceptance criteria in the most recent version (DOE 2002a), including elements that are now considered to be HWFP, 40 CFR 194, and TRAMPAC requirements. These include requirements for residual liquids, free water, and free liquids respectively (HWFP, 40 CFR 194, and TRAMPAC), pyrophoric, corrosive, and explosive materials (HWFP, TRAMPAC), compressed gases (HWFP, TRAMPAC), toxic materials (HWFP), waste certification requirements (HWFP, TRAMPAC), physical description of the waste (HWFP, TRAMPAC), combustibility (HWFP TRAMPAC), surface dose rates (TRAMPAC), thermal power (TRAMPAC), container requirements (TRAMPAC, HWFP), and hazardous materials (HWFP). These and other criteria were all included based on internal DOE Order and policy requirements current at that time.

Earlier versions of the WAC contained a discussion of the technical rationale for each criteria and justification to the criteria. The CH WAC no longer includes such rationale or justification. EEG has stated:

> EEG objects to the continued practice of deleting the history and technical justification of criteria when the CH-WAC is revised. Our concern is that a contractor or review group might propose to revise or delete a criteria because they were unaware of the technical basis and that CBFO would too quickly adopt those recommendations. Also, we

> have a concern that future revisions to the CH-WAC may not critically evaluate the need for revised or new requirements that would improve safety at WIPP. EEG, in its role of representing the State of New Mexico in review of the Safety Analysis Report (SAR), will keep this concern in mind during future WAC and SAR reviews (EEG 2002a).

In 1984 DOE Order 5820.2 changed the definition of transuranic from >10 nCi/g of long-lived alpha-emitting waste to >100 nCi/g. Revision 2 of the WAC (DOE 1985) included that definition, but it was not until Revision 3 (DOE 1989) that the definition became a WAC criterion. In 1992, the WIPP Land Withdrawal Act (LWA) included and extended this definition, making it federal law as well as a DOE requirement.

In 1989 the TRAMPAC added criteria and requirements (see previous Chapter), and the NRC became a second regulator of the WIPP waste characterization. To this time the WAC had been the single most important WIPP waste characterization document extant. With first the TRAMPAC, then the applications to the NMED and EPA, and finally the resultant 40 CFR 194 Certification by the EPA (1998) and promulgation of the HWFP (1999), the criteria in the WAC also became less authoritative. The WAC became more the DOE's working version of the criteria included in these other documents.

At the waste characterization level, other more specific requirement documents began at least as early as 1991, implementing the methods used to meet the criteria from these upper-tier documents. In 1979 the INEEL (then INEL) had set up a program to, "...confirm that drums shipped from Rocky Flats contained the assigned item description code (IDC), and to determine the possible hazardous constituents in the waste." (Haily1995). The waste characterization methods of visual examination and gas sampling were used. A 1983-1985 program at the INEL pioneered real-time radiography, headspace gas sampling, solids sampling and analysis, and radioassay (gamma only) in the first attempt to examine waste for compliance with the WAC (Clements and others 1985). Extensive visual examination was also performed. In 1985 neutron NDA—the basic component of current NDA systems–was used in still another INEL program (Hailey 1995).

By 1991 intermediate-level requirements documents were developed by the WIPP. These documents translated the WAC criteria into waste characterization methods and requirements for the transuranic waste generating and storage sites in the DOE complex. The 1995 *Transuranic Waste Characterization Quality Assurance Program Plan* (DOE 1995) included the TRAMPAC waste characterization requirements and also established the waste characterization requirements that the EPA accepted as a part of the 40 CFR 194 certification of the WIPP. This document also contained equivalent methods and requirements to those later promulgated in the WIPP HWFP in 1999 (Channell and Walker 2000).

7.2 Current DOE Waste Acceptance Criteria

The current WAC is for CH TRU waste only (a draft WAC for RH is a part of a DOE submittal currently under evaluation by the EPA for approval of RH TRU waste characterization). Most of the waste characterization criteria found in the CH WAC has been addressed in earlier chapters of this document in one form or another; the remaining area are primarily those self-required by the DOE. As is noted in Section 2.4 of this report, these are primarily from the WIPP site Safety Analysis Report (SAR) (currently DOE 2003c), and more specifically are collected in the Technical Safety Requirements (TSRs) (currently DOE 2003d) which is an attachment to the SAR.

Statements in the TSRs clearly indicate that the WIPP Waste Acceptance Criteria, which drive the waste characterization program, is very important for the safety, health, and environment of the WIPP. The quality and completeness of the waste characterization effort is critically important to WIPP operational activities and some of the requirements are only covered in the CH WAC. It is very important that operational health and safety requirements are constantly evaluated via the TSR portion of the CH TRU SAR and any necessary changes be incorporated in the CH WAC.

The SAR and TSR waste characterization criteria are developed by applying DOE Orders and other DOE internal regulatory documents to the WIPP site. The WIPP TSR criteria include many prohibited wastes that are also prohibited by other WIPP waste characterization

regulations, including the less-than-1% liquids prohibition described in Chapters 4, 5, and 6; the prohibition against pyrophoric materials; prohibition of explosive and compressed gases (Chapters 4 and 6); and the prohibition of RCRA characteristic wastes considered ignitable, corrosive , and reactive (Chapter 4). These criteria can be characterized in the waste by AK, chemical tests (headspace gas or homogeneous analysis) and radiography or visual examination.

The WIPP TSRs add one additional radiological requirement, limiting the plutonium-equivalent activity (PE-Ci) in the waste. The PE-Ci represents a normalization of the radiotoxicity of prominent radionuclides expected to be in the waste to equivalency with ^{239}Pu. To characterize this component of the waste the amounts of these prominent individual radionuclides are necessary. While PE-Ci can be calculated from AK information if the AK contains radioassay values for the radionuclides; these values are currently obtained from the EPA-required assay of each container.

The CH WAC still contains the >100 nCi/g of alpha-emitting transuranic isotopes with half-lives of 20 years criterion, which is also met through the NDA program established to meet the 40 CFR 194 radioassay requirements.

The CH WAC combines the TSR criteria for acceptable waste with those from the HWFP, the TRUPACT-II criteria in the TRAMPAC, and the 40 CFR 194 waste characterization criteria. The waste characterization methods discussed in Chapters 4-6 of this report are used to ensure that these criteria are met.

8. CONCLUSIONS

Waste characterization criteria, requirements/methods, and procedures for WIPP are specified in the DOE Waste Acceptance Criteria, the NRC Certificate for transportation, the EPA Certificate for disposal, and the NMED Hazardous Waste Facility Permit for disposal. EEG has provided a technical review of these measures over many years. Our reviews have considered the need for a requirement as well as whether a proposed change is justified.

The summary below presents EEG's current assessment of the key components of the waste characterization requirements for the more significant requirements/methods. Our views continue to evolve to reflect new information and analyses.

8.1 Overlap of Requirements

Between the four entities, there is considerable overlap in waste characterization requirements. The HWFP and Appendix A of the CH WAC are the more prescriptive for specifying compliance. When considering a requirement change to either of these documents, the effect of the change on all requirements, including those issued by other agencies, should be noted and evaluated for its potential impact across agencies.

8.2 The Change Processes

The DOE, NMED, EPA, and NRC each have different processes for changing the requirements and these vary considerably in the degree of formality and participation by outside organizations. All processes have proved to be workable and effective. The proposed modifications are implemented more effectively and expeditiously if they are considering smaller, less comprehensive changes. The EEG believes that in the future, proposed changes to the waste characterization requirements should continue to use the existing processes.

8.3 Risk Considerations

The radiological risk from routine operations, operational accidents, and long-term releases is orders of magnitude greater than the risk from hazardous waste. Therefore, a risk based approach to waste characterization should concentrate on those requirements that affect the radiological risk.

No data have been provided by the DOE to indicate that exposures to workers performing CH TRU waste characterization are large enough to be a significant reason for reducing waste characterization requirements.

8.4 Acceptable Knowledge Requirement

Acceptable Knowledge is a principal waste characterization technique for all the regulatory agencies. AK is necessary and should be retained. At this time the EEG supports the use of the HWFP AK requirements since they are the most prescriptive.

8.5 Headspace Gas Sampling and Analysis

DOE has indicated that HSG sampling and analysis is one of the most expensive waste characterization requirements and the HWFP requires this be conducted in 100% of all non-thermally treated waste containers. HSG sampling is the primary way DOE has chosen to meet the "detailed chemical analysis…" specified in the New Mexico Administrative Code. Data from HSG sampling is used to verify that VOC concentrations in waste storage rooms meet the Room Based Concentration limits in the HWFP. However, these limits can also be verified by data obtained from the Confirmatory VOC Monitoring Plan in the WIPP underground. Since HSG is required by the HWFP, it is a convenient (but not the only) way of assuring that flammable gas concentration limits in the TRAMPAC are met.

EEG believes it is desirable to maintain a comprehensive HSG program for WIPP CH TRU wastes. However, it should be possible to require less than 100% sampling in some cases. Our primary concerns are with organic sludges and older waste containers where information may be less reliable.

8.6 Drum Age Criteria Requirements

Drum Age Criteria is necessary to ensure that HSG sampling of waste containers will measure gas concentrations that are at least 90% of equilibrium. DAC values are required in both the HWFP and the TRAMPAC. The EEG supports this requirement.

8.7 Real Time Radiography

All WIPP waste containers are required to undergo either radiography or visual examination by the HWFP. Usually retrieved wastes undergo RTR and newly generated wastes are examined by visual examination. RTR has been a very effective means of verifying AK and discovering prohibited items in waste containers. It is also used to show compliance with several EPA and TRAMPAC requirements.

The overall radiography program is an important part of the WIPP waste characterization program and should be retained. It may be possible to reduce some of the detailed procedural requirements in the HWFP.

8.8 Visual Examination/Retrievably Stored Waste

A small fraction (currently less than 2%) of retrievably stored waste is required by the HWFP to undergo visual examination for confirmation of RTR. The VE process has the potential for slightly greater radiation exposure than the other waste characterization requirements, although the EEG has not been provided any data from the DOE to indicate that exposures are significant enough to justify reducing the requirement.

The DOE has been successful in modifying the HWFP on retrievably stored visual examination and this would be the preferred process for seeking further reductions.

8.9 Visual Examination/Newly Generated Waste

VE is the method DOE prefers for newly generated waste because it can be done at the time the waste container is being filled. The EEG has not objected to any part of this requirement except to state that the requirement for two trained VE operators to perform the visual process “may be overkill” and that a single verification should be adequate.

8.10 Solids Coring and Sampling and Solids Analysis

The EEG continues to believe that the homogeneous sampling and analysis are unnecessary waste characterization requirements in the HWFP. Our principal reason for this position is that the data are not used for any additional regulatory control (metals releases from accidents or long-term processes would be controlled by radionuclide control requirements and VOCs and SVOCs by HSG or the Confirmatory VOC Monitoring Plan).

8.11 Level II Management and Waste Certification HWFP Requirements

The DOE has listed these management and certification requirements as characterization activities in a recent cost analysis. EEG has not previously commented on these requirements. However, our current evaluation indicates that the required procedures are very detailed and somewhat redundant. This may be one of the areas to which the general EEG comment, "We believe waste characterization requirements are excessive," applies.

8.12 Characterization Support HWFP Requirements

EEG has been supportive of the WIPP audit and surveillance program and has observed it to be a very good QA program. The EEG does not believe the relaxation of audit requirements and QA/QC is an appropriate way to reduce the regulatory burden.

8.13 EPA Non-Radiological Requirements

EPA's free water, non-ferrous metal and cellulose, plastic and rubber requirements should remain and can continue to be determined as they are now, by the RTR/VE requirements of the HWFP. However, the required CPR data could be provided to EPA on a waste stream rather than individual container basis. The ferrous metal requirement can continue to be met by counting waste containers emplaced in the repository.

8.14 EPA Radiological Requirements

The EEG agrees with the radioassay requirements for contact-handled transuranic waste specified in Appendix A of the CH WAC and the current procedures for modifying the document.

Current requirements for reporting the 10 required radionuclides should remain. The EEG recommends that ^{241}Pu be added to the list of EPA tracked radionuclides. The current requirement that all radioassay should be performed by WIPP-certified assay systems should be maintained.

Justification for less than 100% quantification and determination of isotopic ratios may be possible for some, but certainly not all, waste streams.

8.15 NRC Container Properties

The TRAMPAC requirements for residual liquids, filter vents, and the sealed container prohibition should be retained. These are all verified by requirements in the HWFP.

8.16 NRC Nuclear Properties

All nuclear property requirements should be retained and the methodology in Appendix A of the CH WAC should be used.

8.17 NRC Gas Generation Requirements

Requirements for measuring the chemical, payload classification, and radionuclide concentrations necessary to ensure hydrogen gas concentration criteria are met must be retained. There have been many changes, via the revision process, which have allowed additional containers to be shipped without changing the hydrogen gas criteria and additional changes may be justifiable in the future.

The flammable gas concentration limit of ≤ 500 ppm should be retained as described in the current revision of the TRAMPAC. Alternate methods (with appropriate QA) will be necessary if future changes to the HWFP affects the use of HSG sampling as the method for meeting this criteria.

8.18 WIPP Waste Acceptance Criteria

The WAC has served a useful historic purpose in developing initial criteria that have been adopted by the three regulatory agencies. Currently it is a useful document for listing most of the characterization requirements. It would be more useful if the technical justification for each criteria or requirement were restored.

The unique role of the CH WAC in including any necessary operational safety and health requirements not included elsewhere is very important and must be constantly evaluated via the TSR portion of the CH TRU SAR, and any necessary changes incorporated into the CH WAC.

9.0 REFERENCES

10 CFR 71. Packaging and transportation of radioactive material. Title 10, Energy; Chapter I, Nuclear Regulatory Commission; Code of Federal Regulations.
[§71.13 Previously approved package]
[§71.31 Contents of application]

10 CFR 830. Nuclear safety management. Title 10, Energy; Chapter I, Nuclear Regulatory Commission; Code of Federal Regulations.

20 NMAC 4.1. Hazardous Waste Management. Title 20, Environmental Protection; Chapter 4, Hazardous Waste. New Mexico Administrative Code.

40 CFR 194. Criteria for the certification and re-certification of the Waste Isolation Pilot Plant's compliance with the 40 CFR part 191 disposal regulations. Title 40, Protection of the environment; Chapter I, Environmental Protection Agency; Code of Federal Regulations.
[§194.24 Waste characterization]
[§194.65 Notice of proposed rulemaking for modification or revocation]

40 CFR 261. Identification and listing of hazardous waste. Title 40, Protection of the environment; Chapter I, Environmental Protection Agency; Code of Federal Regulations.
[§261.24 Toxicity characteristic]

40 CFR 264. Standards for owners and operators of hazardous waste treatment, storage, and disposal facilities. Title 40, Protection of the environment; Chapter I, Environmental Protection Agency; Code of Federal Regulations.
[§264.13 General waste analysis.

40 CFR 270. EPA administered permit programs: The Hazardous Waste Permit Program. Title 40, Protection of the environment; Chapter I, Environmental Protection Agency; Code of Federal Regulations.
[§270.41 Modification or revocation and reissuance of permits]
[§270.42 Permit modification at the request of the permittee]

Channell, James K; Neill, Robert H. 1999 Jul. A Comparison of the risks from the hazardous waste and radioactive waste portions of the WIPP inventory. Albuquerque (NM): Environmental Evaluation Group. EEG-72.

Channell, James K; Walker, Ben A. 2000 May. Evaluation of risk and waste characterization requirements for the transuranic waste emplaced in WIPP during 1999. Albuquerque (NM): Environmental Evaluation Group. EEG-75.

Clements, Thomas L, Jr; Kudera, DE (EG&G Idaho, Inc). 1985 Sep. TRU waste sampling program: Volume I-Waste characterization. Idaho Falls (ID): OE/IDO. EGG-WM-6503.

[DOE] US Department of Energy. 1980 May. Report of the Steering Committee on TRU waste acceptance criteria for the Waste Isolation Pilot Plant, rev 0. Westinghouse Electric Corporation. WIPP-DOE-069, rev 0.

[DOE] US Department of Energy. 1984. Radioactive Waste Management. DOE Order 5820.2.

[DOE] US Department of Energy. 1985 Sep. TRU waste acceptance criteria for the Waste Isolation Pilot Plant. Carlsbad (NM): Carlsbad Area Office. DOE/WIPP-069, rev 2.

[DOE] US Department of Energy. 1989 Jan. TRU waste acceptance criteria for the Waste Isolation Pilot Plant. Carlsbad (NM): Carlsbad Area Office. DOE/WIPP-069, rev 3.

[DOE] US Department of Energy. 1995. TRU Waste Characterization Quality Assurance Program Plan. Carlsbad (NM): Carlsbad Area Office. DOE/WIPP/CAO-94-1010, rev 0.

[DOE] US Department of Energy. 1996a Jun. Transuranic waste baseline inventory report, rev 3. Carlsbad (NM): Carlsbad Area Office. DOE/CAO-95-1121, rev 3.

[DOE] Department of Energy. 1996b Oct. Title 40 CFR 191 compliance certification application. Carlsbad (NM): Carlsbad Area Office. DOE/CAO-1996-2184. (Chapter 4 addresses waste characterization).

[DOE] Department of Energy. 1999 Nov. Waste acceptance criteria for the Waste Isolation Pilot Plant. Carlsbad (NM): Carlsbad Area Office. DOE/WIPP-069, rev 7.

[DOE] Department of Energy. 2002a Jul 25. Contact handled transuranic waste acceptance criteria for the Waste Isolation Pilot Plant. Carlsbad (NM): Carlsbad Field Office. DOE/WIPP-02-3122, rev 0.1.

[DOE]. Department of Energy. 2002b Jul 25. Radioassay requirements for contact-handled transuranic waste. In: Contact-Handled Transuranic waste acceptance criteria for the Waste Isolation Pilot Plant. Carlsbad (NM): Carlsbad Field Office. DOE/WIPP-02-3122, rev 0.1; Appendix A.

[DOE] Department of Energy. 2002c Oct 28. NMED permit modification and EPA change notification: Three years of operating experience at WIPP. Presentation by Robert F. Kehrman to the National Academy of Sciences/National Research Council. Optimizing the characterization and transportation of transuranic waste destined for the Waste Isolation Pilot Plant: first committee meeting, October 28-29, 2002; Carlsbad (NM).

[DOE] Department of Energy. 2002d Dec 16. National Research Council Committee's questions on transuranic waste characterization, December 16, 2002.

[DOE] Department of Energy. 2003a Apr. TRUPACT-II authorized methods for payload control (TRAMPAC), rev 19c. Carlsbad (NM): Westinghouse TRU Solutions.

[DOE] Department of Energy. 2003b Apr. Safety analysis report for the TRUPACT-II shipping package, rev 19c. Carlsbad (NM): Westinghouse TRU Solutions.

[DOE] Department of Energy. 2003c Jun. Waste Isolation Pilot Plant contact handled (CH) safety analysis report, rev 7. Carlsbad (NM): Carlsbad Field Office. DOE/WIPP-95-2065, rev 7.

[DOE] Department of Energy. 2003d Jun. Waste Isolation Pilot Plant Contact Handled (CH) technical safety requirements, rev 7. In: Waste Isolation Pilot Plant contact handled (CH) safety analysis report, rev 7, Attachment 1. Carlsbad (NM): Carlsbad Field Office. DOE/WIPP-95-2125, rev 7.

[EEG] Environmental Evaluation Group. 1989 May. Review of the final safety analysis report (Draft), DOE Waste Isolation Pilot Plant, December 1988. Albuquerque (NM): Environmental Evaluation Group. EEG-40.

[EEG] Environmental Evaluation Group. 1999 Sep 17. EEG preliminary comments on the two reports of the Transuranic Waste Characterization Task Force (TWCTF). [Letter from Robert H. Neill, EEG, to Ines Triay, DOE/Carlsbad Area Office].

[EEG] Environmental Evaluation Group. 2001b Oct 4. Some issues identified by EEG regarding the characterization of RH TRU waste: Statement by Matthew K. Silva before the NAS WIPP Committee. EEG/S-2001-10-04.

[EEG] Environmental Evaluation Group. 2002a Jan 30. EEG Comments on DOE/WIPP-Draft G-3122 (Contact-handled transuranic waste acceptance criteria for the Waste Isolation Pilot Plant). [Letter from Matthew K. Silva, EEG, to Ines Triay, DOE/CBFO] EEG/C-2002-01-30.

[EEG] Environmental Evaluation Group. 2002b Sep 18. Waste characterization updates and other process improvements class 2 permit modification request (PMR) submitted June 27, 2002. [Letter from Matthew K. Silva, EEG, to Steve Zappe, NMED]. EEG/C-2002-09-18.

[EEG] Environmental Evaluation Group. 2002c Oct. EEG Views on WIPP characterization and transportation requirements. Statement by Matthew K Silva to the NAS/WIPP Committee, October 29, 2002. EEG/S-2002-10-29-02.

[EEG] Environmental Evaluation Group. 2003a Jan. EEG response to National Research Council Committee's questions on transuranic waste characterization December 6, 2002. EEG/C-2003-01-13.

[EEG] Environmental Evaluation Group. 2003b May. EEG response to NAS WIPP Committee questions for May 19, 2003 meeting. EEG/S-2003-05-19.

[EPA] Environmental Protection Agency. 1994 Apr. Waste analysis at facilities that generate, treat, store, and dispose of hazardous waste. EPA 530-R-94-024 [OWSER Directive no 9938.4-03].

[EPA] Environmental Protection Agency. 1996 Dec. Test methods for evaluating solid wastes, physical/chemical methods. 3rd ed. EPA/SW-846. (Current updates are available at http://www.epa.gov/hazwaste/test/main.htm.)

[EPA] US Environmental Protection Agency. 1998 May. Criteria for the certification and recertification of the Waste Isolation Pilot Plant's compliance with the 40 CFR part 191 disposal regulations: Certification decision: Final Rule. 63 Fed Reg 27254-27406 (May 18, 1998).

[EPA] US Environmental Protection Agency. 1999 Jan. Compendium of methods for the determination of toxic organic compounds in ambient air. Compendium Method TO-15: Determination of volatile organic compounds (VOCs) in air collected in specially-prepared canisters and analyzed by gas chromatography mass spectrometry (GC/MS). 2nd ed. Cincinnati (OH): Center for Environmental Research Information. EPA/625/R-96/010b.

Hailey, Sheila. 1995 Sep. Summary of transuranic waste characterization programs at the INEL (1979-present). Idaho Falls (ID): Idaho National Engineering Laboratory. INEL-95/0397.

Hatayama HK, Chen JJ, de Vera ER, Stephens RD, Storm DL (California Department of Health Systems). 1980 Apr. A method for determining the compatibility of hazardous wastes. Cincinnati (OH): EPA. EPA-600/2-80-076.

Little, Marshall S. 1980 Feb. Review comments on the report of the steering committee on waste acceptance criteria for the Waste Isolation pilot Plant. Albuquerque (NM): Environmental Evaluation Group. EEG-4.

[LWA] Waste Isolation Pilot Plant Land Withdrawal Act. Public Law 102-579, 105 Stat, 4777 as amended by Public Law 104-201, section 2.18 (October 1992).

Moody, David C. 2002. Opportunities for improving characterization efficiencies. Presented to the National Academy of Sciences/National Research Council. Optimizing the characterization and transportation of transuranic waste destined for the Waste Isolation Pilot Plant: first committee meeting, October 28-29, 2002; Carlsbad (NM).

[NAS/NRC] National Academy of Sciences. National Research Council. 2001. Improving operation and long-term safety of the Waste Isolation Pilot Plant: Final Report. Washington (DC): National Academy Press.

Neill, Robert H; Channell, James K. 1983 Aug. Potential problems from shipment of high-curie content contact-handled transuranic (CH-TRU) waste to WIPP. Albuquerque (NM): Environmental Evaluation Group. EEG-24.

Neill, Robert; Chaturvedi, Lokesh; Lee, William, W -L; Clemo, Thomas M; Silva, Matthew K; Kenney, Jim; Bartlett, William T; Walker, Ben A. 1996 Mar. Review of the WIPP draft application to show compliance with EPA transuranic waste disposal standards. Albuquerque (NM): Environmental Evaluation Group. EEG-61.

Neill, Robert H; Chaturvedi, Lokesh; Rucker, Dale F; Silva, Matthew K; Walker, Ben A; Channell, James K; Clemo, Thomas M. 1998 Mar. Evaluation of the WIPP Project's compliance with the EPA radiation protection standards for disposal of transuranic waste. Albuquerque (NM): Environmental Evaluation Group. EEG-68.

Neill, Robert H; Silva, Matthew K. 2001. EEG's independent technical oversight on WIPP, a TRU waste geologic repository. In: Proceedings of the 9th International High-Level Radioactive Waste Management Conference, April 29-May 3, Las Vegas, NV. EEG/P-2001-04-29.

[NETL/CABE]. National Energy Technology Laboratory. Center for Acquisition & Business Excellence. 2003 Jun. WIPP TRU characterization cost analysis: final. Carlsbad (NM). DOE/CBFO. NETL/CABE-575.

[NMED] New Mexico Environment Department. 1999 Oct 27. Hazardous Waste Facility Permit issued to Waste Isolation Pilot Plant. EPA No. NM4890139088.

[NMED] New Mexico Environment Department. 2003 Jan. Waste Analysis Plan. In: Hazardous Waste Facility Permit issued to Waste Isolation Pilot Plant. EPA No. NM4890139088, Attachment B.

[NRC] US Nuclear Regulatory Commission. 2003 Jul 3. Certificate of Compliance for radioactive materials packages, No. 9218, rev 16. Washington (DC): US GPO. NRC 71-9218.

[RCRA] Resource Conservation and Recovery Act. 42 USC §6901 et seq (1976).

Silva, Matthew K. 1990 Jun. Preliminary investigation into the explosion potential of volatile organic compounds in WIPP CH-TRU waste. Albuquerque (NM): Environmental Evaluation Group. EEG-45.

Silva, Matthew K. 1991 Jun. An assessment of the flammability and explosion potential of transuranic waste. Albuquerque (NM): Environmental Evaluation Group. EEG-48.

[TSCA] Toxic control Substance Act. 15 USC §2601 et seq (1976).

Walker, Ben A; Silva, Matthew K. 2002. EEG's views on the proposed modifications to the WIPP Hazardous Waste Facility Permit. Presented at WM'02, February 27-28, 2002; Tucson, AZ. EEG/P-2002-02-26.

APPENDIX A

1. 9/17/99 letter, Neill to Triay (comments on Waste Characterization Task Force Final Report)

2. 1/30/02 letter, Silva to Triay (comments on Draft CH WAC, Revision 0)

3. 10/29/02 statement (Silva) to NAS/NRC WIPP Committee

4. 1/13/03 EEG response to NAS/NRC WIPP Committee 12/6/02 questions

5. 5/19/03 EEG response to NAS/NRC WIPP Committee meeting questions

JKC

ENVIRONMENTAL EVALUATION GROUP

AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER

7007 WYOMING BOULEVARD, N.E.
SUITE F-2
ALBUQUERQUE, NEW MEXICO 87109
(505) 828-1003
FAX (505) 828-1062

September 17, 1999

Dr. Inés Triay, Manager
Carlsbad Area Office
U.S. Department of Energy
P.O. Box 3090
Carlsbad, NM 88221-3090

Dear Dr. Triay:

EEG's preliminary comments on the *Fundamental Bases of the Characterization Requirements for Disposal of Transuranic Waste at the Waste Isolation Pilot Plant* and *Findings and Recommendations of the Transuranic Waste Characterization Task Force Final Report* (August 9, 1999) are attached.

Our comments are not a critique of the two reports but are limited to those recommendations where we have preliminary opinions. Silence on some recommendations does not imply either agreement or disagreement.

We believe that overall waste characterization requirements are excessive and the Task Force reports are a worthwhile effort at beginning to evaluate individual requirements. However, any proposed relaxation needs to be evaluated in sufficient detail to convince regulators, EEG, and stakeholders that the modification is justified.

Please call Dr. Jim Channell if there are questions.

Sincerely,

for Robert H. Neill
Director

RHN:JKC:js
Enclosure

EEG Preliminary Comments on the Two Reports of the Transuranic Waste Characterization Task Force (TWCTF)

General Comments

There is a great deal of useful information as well as preliminary decisions in the two reports of the TWCTF: (1) Fundamental Bases of the Characterization Requirements for Disposal of Transuranic Waste at the Waste Isolation Pilot Plant, August 9, 1999; and (2) Findings and Recommendations of the Transuranic Waste Characterization Task Force, Final Report, August 9, 1999.

We are sympathetic to the purpose of the TWCTF ("...to focus on increasing the efficiency, effectiveness, and regulatory confidence of characterization operations while reducing costs."). In general we consider the overall waste characterization requirements to be excessive and believe it should be possible to increase efficiency without any decrease in health and safety. But each proposed relaxation needs to be evaluated in enough detail to convince regulators, EEG, and stakeholders that the modification is justified.

EEG may undertake a review of the existing waste characterization requirements where we independently evaluate some waste characterization elements that appear excessive or without basis. We will also rigorously evaluate any DOE evaluations. The outcome of our individual evaluations cannot be predetermined; we could end up recommending that a requirement be increased, relaxed, deleted, or unchanged.

These comments on some of the recommendations in the second TWCTF report should be considered preliminary. They represent our current thinking on some of the recommendations but have not received enough evaluation to be considered final opinions. Our comments are not a critique of the reports themselves, but only of those recommendations where we have preliminary opinions. No assumptions should be made of implied agreement on discussions or recommendations we do not address. We believe it will be more useful to give you preliminary comments in a timely manner rather than delay until more thorough analyses can be made.

Fundamental Bases Report

This document was a useful resource to EEG and the effort required to produce it is appreciated. However, the compilation is not rigorous enough (we noted several errors) or detailed enough (it often references requirements rather than states them) to be a stand alone reference.

Findings and Recommendations Final Report

Chapter 1 describes the problem and approach used. The discussion recognizes that those requirements that have a legal or regulatory basis will be more difficult to change than one that

comes from only the WAC or QAPP. We agree but believe that any non legal or regulatory related changes should receive just as thorough a technical evaluation and justification.

Chapter 2

The use of only variable costs in the cost model appears reasonable as a way of comparing savings from reducing the frequency of the individual characterization activities in Table 3. If it were possible to completely eliminate one of the activities, fixed costs could be a factor. The assumption of 500 containers per waste stream is important because of the very expensive visual examination, coring, and solids analyses cost. We agree that (using the assumptions on pages 10-12) current variable cost of WIPP waste characterization would be about $1.8 billion. It is noted that the 1997 WIPP Supplemental EIS (SEIS-II) estimated total (including facility and overhead) waste retrieval and characterization costs of $3.9 billion.

Chapter 3

This chapter contains the activity by activity discussion and justification for the recommendation. We will respond individually to those items where we have preliminary opinions.

Chemical Compatibility

EEG agrees that this requirement should not be changed and has no recommendations at this time concerning the compliance method.

Explosive, Corrosives, Compressed Gases, and Pyrophorics

EEG agrees that these requirements should not be changed. We have no recommendations at this time concerning the compliance method.

External Dose Rate

The 200 mrem/hr contact dose rate limit is consistent with DOT regulations. Experience at DOE facilities indicates that occupational doses of persons handling these wastes are well below one rem/year. Therefore, we believe this is an appropriate limit and should not be changed.

Fissile Gram Equivalent

A limit of 200 Fissile Gram Equivalents for a drum and 325 FGE/for a standard waste box is specified in the TRUPACT-II Certificate of Compliance. We believe it is a reasonable limit and should not be changed.

Flammable Volatile Organic Compounds

The document states that no technical basis has been found for the specific limit of 500 ppm for VOCs. The history of the use of this limit in WIPP documents is summarized below. Use of the 500 ppm limit for flammable VOCs to mitigate flammability or explosion concerns is documented in the No Migration Variance Petition (U.S. Federal Register, vol. 55, no. 220, pp. 47709 and 47717). In addressing the issue of WIPP waste flammability, the DOE prepared a position paper that identifies how the 500 ppm VOC limit will mitigate flammability events. The DOE position states:

> The safety concerns associated with the flammability of the waste seem to be well addressed by regulations from agencies such as the EPA and the NRC, by the waste acceptance criteria formulated by the DOE for both transportation and disposal, and by the operational procedures at individual sites. The regulations and the waste acceptance criteria are based on conservative analysis, and thus involve a margin of safety for preventing any potential flammability-related incidents. As an example, the total quantity of flammable VOCs in the headspace of a TRU waste drum is limited to 500 ppm. The fact that this imposed limit is extremely conservative, is clearly evident upon comparison with the lower explosive limits for some typical flammable VOCs. One such flammable VOC, xylene, which was actually involved in one of the incidents summarized in Section 4.0, has a lower explosive limit in air of 1.1 % (NFPA, 1986). Upon conversion of units, this value is equivalent to 11,000 ppm. Therefore a minimum of 11,000 ppm of xylene must be present in order to form a flammable mixture with air. By comparison, this is 22 times larger than the existing limit of 500 ppm of total amount of all flammable VOCs allowed per drum. (U.S. DOE, 1991).

The DOE is referring to the NRC requirements for transportation in the TRUPACT-II and the EPA No-Migration Determination for the WIPP.[1] In 1991, the DOE maintains that the 500 ppm limit on flammable VOCs was based on "conservative analysis." Unlike the NRC transportation limits, the EPA conditional determination did not restrict the concentration of flammable VOCs to 500 ppm. Rather, EPA used the 500 ppm to define a significant level of VOCs for the purpose of requiring DOE to "perform an explicit flame test to determine if a flammable mixture can be formed with air" (U.S. EPA, 1990, Section IV.B.7.a, p. 47709). EPA was concerned that the presence of significant levels of flammable VOCs would affect the LEL results calculated by the Le Chatelier formula for mixtures of hydrogen and methane.

The EPA technical justification for the 500 ppm level for flammable VOCs has merit. It inherently recognizes that the waste in a drum or standard waste box can be a complex mixture in

---

[1] The 1996 amendment to the WIPP Land Withdrawal Act deleted the need for EPA regulation on the migration of RCRA constituents.

which the flammability limits of hydrogen or methane can be lowered by the presence of a small amount of a flammable VOC.

Any proposal to change the VOC limit based on technical considerations must consider the potential need for a non-flammable VOC limit as well. For example, at least one non-flammable VOC found in the waste, trichloroethylene, is known to lower the flammability limits for methane and hydrogen. Jorissen and Meuwissen (1925) determined for "pure methane the explosion limits, which without addition of trichloroethylene vapor were 4.9% and 12.6%, were lowered to 3.3% and 9.6% by 5.8 percent of trichloroethylene vapor." In a study of hydrogen flammability, Jorissen and Ongkiehong (1925) showed the presence of trichloroethylene vapor also lowered the upper and lower explosive limits for mixtures of hydrogen and air.

The DOE recommended the 500 ppm VOC limit to the NRC ten years ago and again in August 1998 (see below). In addressing other issues, the DOE assured the NRC that the concentration of flammable VOC would be in the low ppm range. These other issues included pressure buildup and the impact of organic vapors on the efficacy of the O-rings for the certified TRUPACT-II and the proposed RH-TRU shipping cask. The TRUPACT-II SARP states that very few waste streams use flammable organic solvents at the sites, the permeabilities of the aromatic hydrocarbons through the plastic bags used as confinement layers are extremely high allowing these compounds to escape before being emplaced in the shipping container, analysis of the solidified aqueous inorganic materials with ppm levels of aromatic hydrocarbons in the waste did not have any detectable levels in the headspace above the waste (TRUPACT-II SARP, 2.10.10-3). These statements of low concentrations are not consistent with the Table C2-4 data mentioned below.

The flammable VOC requirement is a significant one. It is an expensive characterization cost. Also, some containers will not be shippable with the 500 ppmv limit or even a 5,000 ppmv limit. For example, the headspace gas data on 930 drums that is in Table C2-4 of DOE's RCRA application had over 11% of the drums with greater than 500 ppmv volatile VOCs and over 5% have greater than 5,000 ppmv volatile VOCs. Furthermore, six of the 11 Waste Matrix Code Groups (WMCGs) sampled had at least one drum with a total VOC headspace gas concentration greater than 10,000 ppmv (1%). DOE has ignored the 1995 data from Table C2-4 in their latest submittal to NRC for the CH-TRAMPAC (8/98) and references 1989 or earlier data which concludes that only the solidified organic WMCG can have VOC concentrations greater than 1%.

The comment is made in Section 3.2.1 that a gross screening to determine if flammable VOCs total <500 ppm would be appropriate. We believe that a gross screening for total VOCs of <500 ppm would be appropriate because of the possible synergistic effect of nonflammable VOCs on the flammability limits. This <500 ppm total VOCs screening limit should also be acceptable for the VOCs that have room based concentration limits in the RCRA Permit. None of the 9 VOCs have room based concentration limits below 2400 ppmv and 7 of them are ≥ 5490 ppmv. Those containers with <500 ppmv total VOCs will have no effect on showing compliance with the

room based limits. Any evaluation of raising the 500 ppm limit needs to consider the above history and also the effect on butyl O-rings in CH-TRU and RH-TRU shipping packages.

Free Liquids

We believe the free liquid requirement should remain unchanged. There are no recommendations at this time concerning the compliance method.

Decay Heat

EEG has been concerned about hydrogen gas generation of waste during shipment since 1983 when we published EEG-24. NRC had similar concerns that resulted in the limits specified in the TRUPACT-II Certificate of Compliance. We are also aware of the ongoing CAO effort to expand the envelope of gas generating wastes that can be shipped in TRUPACT-II (our most recent information came from Phil Gregory's July 26, 1999 presentation to the NAS WIPP Committee in Albuquerque).

We have the following comments on the gas generation issue:

- The safety issue is real and the current requirements have significant characterization and shipping impacts.
- An effort to try and justify some relaxation in the requirements is worthwhile if it does not adversely affect transportation safety.
- It is unfortunate that so little progress has been made on this issue since the original TRUPACT-II Certificate of Compliance in 1989.
- The CAO effort has the potential to significantly increase the number of containers that will be shippable but the problem is not likely to be completely solved without either treatment or repackaging of some containers.
- EEG intends to closely follow the CAO effort and may perform an analysis of its own.

Waste Packaging - Confinement Layers

The number of confinement layers obviously affects hydrogen gas concentrations in the innermost bags and has an impact on the ability of a container to meet decay heat criteria and be shippable. Possibilities of reducing the number of layers in newly generated waste should be studied.

We offer one caveat. Layers of plastic bags have advantages in preventing contamination of workers that are removing wastes from glove boxes. Any evaluation aimed at minimizing the layers of bags used should have an overriding objective of minimizing possible contamination.

Plutonium Equivalent Curies

EEG was involved in the development of the PE-Ci concept back in 1982. We have reviewed and commented on a number of issues involving appropriate limits since that time. We have no additional comments at this time.

Waste Classification

This issue will be discussed further under the topic of radioassay. One observation is that a relaxation of the 95% confidence limit would reduce the amount of low level waste that would be acceptable at WIPP (wastes with mean concentrations greater than 60-80 nCi/g would usually be called TRU when 1.645σ is added). Also, see our comments under the 10-100 nCi/g low-level waste issue.

Matrix Parameter Category

EEG reached two conclusions in its review of the CCA that are relevant to the requirement for weights of cellulosics, plastics, and rubber: (1) the determination of average concentration should be on a sub-repository basis (such as a panel) rather than on the full repository basis that is acceptable to EPA (see EEG-68, page 164); and (2) the calculation of Wang is not appropriate because it ignored density data that are reported in the Baseline Inventory Report which is the basis of the CCA inventory. Use of BIR data show that it is possible to exceed 2 times the inventory average concentration in a waste panel; and (3) neither DOE or EPA have responded to EEG's question about the accuracy of the cellulosic, plastic, and rubber determination which is important because of conclusion (2). EEG's justification for conclusions (2) and (3) are in an April 10, 1998 letter from R.H. Neill to Mary Kruger at EPA. EEG also expressed concern about the cellulosic content of the dunnage in drums containing RFETS pipe containers (in EEG's report of the September 1998 Salt Residues Audit).

Another consideration is that Sandia is evaluating the possibility of removing MgO backfill from the repository. So, the Task Force should be careful about assuming the existence of MgO backfill when justifying long-term recommendations.

We have no objection to estimating the quantities of cellulose, rubber, and plastic on a waste stream basis (as long as the waste stream is appropriately defined) because average concentrations for a panel appear to be adequate. However, the amount of uncertainty in the estimate is important in the present performance assessment models and we are not certain that the present system is accurate enough. Any proposal to decrease the amount of sampling (and thus increase uncertainty) needs to be carefully studied and justified.

Defense Waste

There would not be a technical basis for excluding non-defense waste from WIPP provided the amounts were small and there were not significant differences in waste streams. This is a public policy issue. It is spelled out in Public Law 96-164 (December 29, 1979), the Consultation and Cooperation Agreement between the State of New Mexico and DOE (June 30, 1981), and the WIPP Land Withdrawal Act of 1992 (PL 102-579). Because of this history, relief from this restriction should be sought from the Congress and the State of New Mexico.

Acceptable Knowledge

The desire to rely more on AK and back off from 100% head space gas sampling and analysis is understandable. It is true that approximate means and standard deviations of a waste group can be obtained by sampling less than 50% of containers. An examination of the Table C2-4 headspace gas data shows that only 2 minor waste matrix code groups (salt waste and soils) out of 11 have no containers with >500 ppm flammable VOCs and only 5 of 11 WMCGs have no containers over 5,000 ppm. Therefore in order to justify much sampling reduction it will be necessary to either get some relief from the NRC on the 500 ppm flammable VOC level and/or an understanding from NRC on the percentage of containers that are allowed to exceed the target level. Also, it will be necessary to do quite a bit of sampling within a waste stream to be sure of the distribution and thereby determine the sampling requirements.

Homogeneous Waste Sampling and Analysis

For the following reasons, EEG sees no scientific reason why it is necessary to analyze for metals at all:

- DOE apparently did not feel that metals concentration data were important enough to include in the RCRA application. The State apparently concurred since they did not request that the data be include.

- The required hazardous metals data are not to be used for any regulatory control under the Draft Permit.

- Evaluations in EEG-72 concluded that human exposures to hazardous metals at WIPP would only occur from the same types of operational and human intrusion accidents that released radioactive materials. The calculated radionuclide risks (Excess Cancer Fatalities) were $2x10^6$ times the hazardous metals release for operational accidents and $5x10^5$ times for long term releases. Furthermore, methods used to clean up radionuclide contamination would also be effective in cleaning up hazardous metals.

- EEG has no opinion at this time on sampling for VOCs and SVOCs in homogeneous wastes. The decision should be based on whether any useful information will be obtained

for VOC control under the RCRA Permit. We have no opinion at this time about use of the Toxicity Characteristic Leaching Procedure rather than total analysis.

Radioassay

The reason for removing NDA requirements from the QAPP and placing them in the WACC Revision 6 is not clear. Please explain.

For the four recommendations under Section 3.2.3 we have the following comments:

- No comment on QAO's at this time.
- Uneasy about removing limits on total bias. This needs to be explained and justified.
- It has to be shown that the FGE limits and determination of >100 nCi/g TRU concentrations can be met on all containers with 90% sampling.
- Clearly large container assay systems need to be developed. Progress has been slow and unless expedited will be a detriment to shipping flexibility.

Radiography and Visual Examination

These two requirements are combined here since they are inter-related and discussed together in Section 3.2.4.

The findings and recommendations address only the existing procedures for stored waste. It is unclear whether the Task Force has any reservations about plans to do 100% VE and 0% RTR for newly generated waste.

Claims are often made that VE is dangerous because of additional radiation exposures and possibility of contamination. EEG has discussed this issue with persons doing VE at INEEL, RFETS, and LANL and found they don't feel VE is dangerous and do not have data on incremental radiation exposures. More specific data and evaluations are needed if danger is to be used as an argument against VE. Also, the plan to use 100% VE for newly generated wastes appears to be inconsistent with expressed safety concerns.

EEG agrees with the generic policy that data that is not going to be used should not be collected. This includes data for all requirements, not just VE. However, it is necessary to do thorough evaluations to show that RTR and/or VE are not providing useful data in a waste stream. At the recent SRS audit, 15% of the first batch of drums were rejected by RTR.

Requirements - Minimizing, Making Consistent, Minimizing Changes

Minimizing Requirements. As mentioned throughout these comments we agree that waste characterization that is not used in some decision making process should be evaluated for elimination. This was our argument against metals analyses. The requirements dealing with operational and transportation safety (FGE, liquid, flammability, etc.) are related to decision making and obviously should not be eliminated.

The removal of WIPP from RCRA regulation is a political issue and we have no position on it. Our recent report (EEG-72) did conclude that the radiological risks from routine operations, operational accidents, and long-term releases were several orders of magnitudes greater than the risks from hazardous wastes.

Making Requirements Consistent. Some inconsistency in requirements is inevitable until the final RCRA Permit is issued. It seems to us that the timing of QAPP Revision 1 exacerbated this problem.

Minimizing Changes to Requirements. Coordination between CAO and the Sites is a common sense approach to minimizing the effect of changing requirements. Constant change is inevitable and we believe that any changes resulting from Task Force recommendations will occur over a period of several years rather than at one discrete time. An obsession with minimizing change would favor retention of the status quo which the Task Force believes is undesirable.

Data Management

We are not familiar with the RCRA/CERCLA system and cannot comment on it. Much of the criticism of redundancy is related to the QAPP and the stringency of the CAO audit process. We believe the audit process itself should not be relaxed because this would encourage sloppiness. It is preferable to try to reduce requirements that need to be audited while maintaining the current level of audit stringency.

Hanford stated that the number of data validations seemed excessive. Yet in the recent Hanford audit an EEG observer found numerical and calculation errors in one QAO document and one procedure. So, for whatever reason, the Hanford system is not effective enough to eliminate errors.

Performance Based Programs

We have concerns about the increased burden on the sites and CAO of implementing performance based programs and whether results would actually be as accurate. Would such programs put a greater (perhaps unrealistic) responsibility on the Performance Demonstration Program?

Pu-238 Transportation

Most of our thoughts on this issue are expressed under the decay heat requirement. One additional comment is relevant. We oppose use of the argument that only explosions that damage the transport container should be considered. This is a reduction in the factor of safety that would allow contamination of drums, boxes, and the interior of the TRUPACT-II.

Ten to 100 nCi/g Low-Level Waste

LANL suggested that the definition of TRU waste be lowered, perhaps all the way to 10 nCi/g. The motivation would be to help solve a mixed low-level waste problem, not a TRU waste problem. The claim under discussion of issues ("Reduced radioassay characterization costs would result from less effort expended to determine with existing uncertainties that the waste contains TRU nuclides in quantities greater than 100 nCi/g") makes sense only if there is to be no attempt to determine the lower value. We believe that the paper by Holman and Altomare (Assessing the Impacts of Lowering the Radioactivity Limit Definition of TRU waste from 100 nCi/g to 10 nCi/g, WM '99 conference) is a much better argument for not lowering the limit than any arguments in this report.

References

Jorissen, W.P., and Meuwissen, J.C., 1925. The influence of some noninflammable vapors of organic liquids on the limits of inflammability of mixtures of inflammable gases and air III. Rec. travaux chim. Pays Bas 44:132-140.

Jorissen, W.P. and Ongkiehong, B.L., 1925. Influence of trichloroethylene on the limits of inflammability of hydrogen-air mixtures. Rec. travaux chim. Pays Bas 44:814-817.

U.S. Department of Energy, 1991. WIPP final safety analysis report addendum: Dry bin-scale test. WP-02-9, Rev. 0, January.

U.S. Environmental Protection Agency, 1990. Conditional no-migration determination for the U.S. Department of Energy Waste Isolation Pilot Plant. Federal Register, November 14, 1990, vol. 55, No. 220, p. 47700.

ENVIRONMENTAL EVALUATION GROUP

AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER

7007 WYOMING BOULEVARD, N.E.
SUITE F-2
ALBUQUERQUE, NEW MEXICO 87109
(505) 828-1003
FAX (505) 828-1062

January 30, 2002

Dr. Inés Triay, Manager
Carlsbad Field Office
U.S. Dept. of Energy
P.O. Box 3090
Carlsbad, NM 88221

Dear Dr. Triay:

Attached are EEGs comments on the Draft G of "Contact-Handled Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant, Revision 0, (DOE/WIPP-Draft G-3122)." Our comments cover all portions of the WAC, not just Appendix A.

EEG objects to the continued practice of deleting the history and technical justification of criteria when the CH-WAC is revised. Our concern is that a contractor or review group might propose to revise or delete a criteria because they were unaware of the technical basis and that CBFO would too quickly adopt those recommendations. Also, we have a concern that future revisions to the CH-WAC may not critically evaluate the need for revised or new requirements that would improve safety at WIPP. EEG, in its role of representing the State of New Mexico in review of the Safety Analysis Report (SAR), will keep this concern in mind during future WAC and SAR reviews.

The text of Draft G has been improved in several instances since Revision 7. Our comments recommend several additions which can easily be made and will clarify or strengthen Draft G. We urge that they be incorporated.

Appendix A has been drastically revised. Although Draft G does not allow the use of less-than-100% NDA for quantification or determination of isotopic ratios, the text provides a justification for the future use of Acceptable Knowledge in lieu of current NDA requirements with WIPP certified systems. EEG believes that much more justification is needed before a future reduction in NDA requirements should be allowed.

Overall, EEG believes that Draft G of Appendix A is workable provided that the audit procedures remain as strict as they are at present. However, there are a number of places where modifications would clarify or strengthen the requirements. EEG recommends that our comments (which are not an exhaustive list) be incorporated into Appendix A.

Minor changes are also recommended in Appendices C and D. The addition of Appendix D is one of the major improvements since Revision 7.

Thank you for the opportunity to comment on Draft G. Please contact Dr. Jim Channell if there are questions.

Sincerely,

Matthew K. Silva
Director

MKS:JKC:BW:pf

cc: Frank Marcinowski, EPA
Rajani Joglekar, EPA
Scott Monroe, EPA
WilliamWeston, WTS
Reinhard Knerr, CBFO

EEG Comments on DOE/WIPP - Draft G - 3122
(Contact-Handled Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant)

COMMENTS ON SECTIONS 1-5

Change History

Sixth bullet "Verbatim traceability of waste acceptance criteria to WIPP authorization basis documents has been deleted." In Draft G only the most controlling criteria is cited and referenced for each parameter, whereas in Revision 7 the requirements (or non-requirements) in each of 5 areas (Operations & Safety, Transportation, Hazardous Waste Facility Permit, Compliance Certification Decision, and Land Withdrawal Act) are given. This continues a trend that began in recent WAC revisions of providing less information and justification on the criteria in each successive revision. For example, in Revision 4 and prior revisions the technical justification for a criterion was given.

EEG is bothered by the continued practice of deleting the history and technical justification of criteria when the WAC is revised. We can understand why DOE might want a smaller "working document" for those needing to use it for compliance. However, the history and technical rational should be made available in appendices or in a single separate document. The main reason that history and justification should be clearly transparent is because DOE's current strategy appears to be to require only what regulations mandate. In the future as DOE obtains changes in the regulations (usually by eliminating or relaxing current regulations), there should be a place in the WAC or a companion document where changes are explained (rather than simply changed or eliminated).

Another troubling aspect of this trend is the implication that the WIPP Project may no longer be doing any safety analyses not required by regulators to determine if additional or more stringent criteria may be appropriate.

Sections 2.2 & 2.4. Several additions (since Revision 7) are noted in these sections. These all add clarity or specificity and are improvements.

Sections 3.0, 3.3.4, 3.3.6 Thermal Limits. Two sentences are added in Section 3.0 since Revision 7. The first is "The acceptance criteria of this CH-WAC describes the controlling (i.e. the most restrictive) requirements to be used by the sites in preparing their waste for transportation to and disposal at the WIPP." We do not believe the WAC provides adequate guidance in complying with the TRUPACT-II thermal limit of 40 watts. The PE-Ci limits listed in Table 3.3.4 contain a number of values where single containers are allowed to have greater than 40 watts. Forty watts is equivalent to 1098 PE-Ci of ^{238}Pu or 1196 PE-Ci of ^{241}Am and neither of these radionuclides are FGE limited. Table 5.5-1 of Appendix 5.5 of the TRAMPAC allows up to 40 watts per container and contains no warning about the total limit of 40 watts for a TRUPACT-II.

DOE should not assume the users of the WAC know about this limit. We believe the WAC should explicitly describe this requirement in Table 3.3.4 and in the text of Section 3.3.6.

Section 3.1 Summary of Authorization Basis. The 3½ page summary Table 3.1 in Revision 7 has been deleted. We have found this table to be useful and would prefer it be retained.

Section 3.1.1 DOE Operations and Safety Requirements. The last sentence in this section in Revision 7 has been deleted. It read "In addition to the requirements found in the WIPP SAR, requirements from best practices and operational experience are also listed in this section."

This deletion suggests that the current DOE philosophy is to no longer look for better and safer ways for waste handling at the WIPP Site where they are self-regulating. Further, that ALARA will not be incorporated unless forced to by SAR revisions. EEG objects to this approach and hopes that this is not DOE's intent.

Section 3.1.4 EPA Requirements. The second sentence in the last paragraph ("The presence or absence of these specific radionuclides is determined from AK, radioassay, or both in accordance with Appendix A of this CH-WAC") has been changed. Revision 7 said "....using AK documentation and radioassay...." This change would allow use of AK in place of radioassay. EEG objects to this relaxation of NDA requirements.

Section 3.1.5 LWA Requirements. The Section 3.1.5 adds a final paragraph (that is not in Revision 7) stating that no high-level waste or spent fuel can be transported to WIPP and that all TRU waste must be in NRC certified packages that meet NRC QA requirements. Putting these requirements in the WAC is an improvement and EEG supports it.

Section 3.1.6. Section 3.1.6 in Revision 7 ("The acceptance criteria of this CH-WAC describes the controlling (i.e. the most restrictive) requirements to be used by the sites. In some cases the acceptance criteria and regulatory requirements.") have been deleted. This attempt to delete all non-regulatory requirements is consistent with the changes in Section 3.1.1 and EEG objects to it.

Section 3.2.1 Container Properties. The addition of a payload container integrity checklist requirement here and in Appendix D is an improvement. There are no particular comments on the text in this section except the editorial comment that some of the detail could be deleted and referred to Appendix D.

Section 3.2.4 Removal of Surface Contamination. Draft G explicitly adds that WIPP is not allowed to fix surface contamination to meet criteria and this is a good addition. However, the requirement in Revision 7 that sites must measure removable surface contamination before shipment to WIPP has been deleted. We recommend that it be re-inserted.

Section 3.2.7 Filter Vents. The referencing of acceptable filter vents to the TRAMPAC and CBFO Web page is an improvement since it will not be necessary to change the WAC whenever there is a change in acceptable filters.

Section 3.3.1 Radionuclide Composition. The proposed method of reporting <LLD or zero for the ten radionuclides is acceptable to EEG. Also, the reporting of all radionuclides that contribute to 95% of the radioactive hazard is consistent with 49CFR173.433(f). Revision 7 had,

incorrectly, stated 95% of the activity.

Section 3.3.3 TRU Alpha Concentrations. Draft G adds more detail to how to determine the TRU alpha activity concentration and this is an improvement. There is one question. Does the sentence "Loading a 55-gallon pipe overpack with cans is considered to be direct loading-not overpacking for the purposes of calculating the weight of the container"refer to placing cans in the pipe component (rather than the 55-gallon drum)? Is the statement "the weight of cans that are placed in a pipe component is considered to be part of the waste weight" the point that is being made?

Section 3.3.5 Radiation Dose Equivalent Rate. The term dose equivalent rate is correct and preferable to merely calling it dose rate(as was done in Revision 7).

Section 3.3.6 Decay Heat. The change in this criterion (now allowed because of changes in Revision 19 of the TRUPACT-II TRAMPAC) which allows shipment of containers that comply with the unified flammable (gas /VOC)concentration limit is a significant advantage to the Project since it will significantly increase the number of waste containers that can be shipped without repackaging.

Section 3.5.5 Headspace Gas Concentrations. Changes in this section appropriately incorporate the unified flammable (gas/VOC) concentration determination now allowed by Revision 19 of the TRAMPAC.

Section 3.6.1 Characterization Data. Draft G adds a requirement, "Sites are required to estimate the CPR weights and report these estimates in the WWIS on a payload container basis." This has always been a requirement at WIPP and it's good that this is now explicitly stated.

APPENDIX A

General Comment

There are a modest amount of significant changes in Appendix A, Draft G as compared to Appendix A in Revision 7. Some of these would affect operations if approved for use in Revision 0. These will be discussed in the page-by-page comments.

One change that would have minimal initial effect would be the changes in definition, importance, and use of Acceptable knowledge (AK) for NDA because 100% NDA for both quantification and confirmation of isotopic ratios is still required. However, the proposed use of AK would permit significantly reduced use of NDA for both quantification and confirmation of isotopic ratios in the future. The proposed Appendix A would also elevate the status of non-WIPP certified NDA instruments.

EEG believes that quantification of radionuclides and confirmation of isotopic ratios should continue to be obtained as they are now; i.e. by using WIPP-certified NDA systems. These determinations, unlike some other required waste characteristics that cannot be directly measured, can be obtained directly by measurement. Any additional efforts to produce more accurate AK in order to reduce the NDA burden will inevitably result in less accurate radionuclide values. Additional comments on AK are made below in the page-by-page comments. See also our comments on the definition of AK in Appendix C.

If it has not already done so, CBFO may wish to pursue a retrospective study of wastes that have already come to WIPP that compares AK predictions of radionuclide concentrations and isotopic ratios with those measured by WIPP-certified NDA systems. The outcome of this study would provide CBFO with insight into the accuracy of AK and might lend support to a future proposal.

Specific Comments

1. Section A.1 Appendix A indicates (p. A-2) that only those radionuclides "listed in section 3.3.1" need to be tracked. Section 3.3.1 addresses only the 10 radionuclides considered in the CCA as important to the WIPP Performance Assessment (CCA Table 4-10), and additional ones that would be needed to be reported to meet the transportation requirement of reporting 95% of the hazard in a payload container. The CCA also lists radionuclides that contribute to the waste unit factor used to determine compliance with 40 CFR 191 in Table 4-8. These radionuclides should continue to be measured and reported when present in the waste.

2. Section A.1 page A-2 allows AK qualification of isotopic ratios on a waste stream basis. The WWIS data indicates significant differences in isotopic ratios within waste streams. EEG believes the ratios should continue to be determined on a container basis.

3. Section A.1 of Appendix A states (p. A-2):

> Each site must technically justify that the AK and/or radioassay

> techniques, instruments, and procedures used...will result in unbiased values for the cumulative activity and mass of the WIPP radionuclide inventory.

The "and/or" is inappropriate, and should be replaced by the word "and". The WIPP was allowed to open in part due to a commitment to accurately measure the radionuclides in each waste container prior to shipment. The principal waste characterization document used to obtain EPA's certification of the WIPP states (TRU Waste QAPP, CAO-94-1010) states in Section 9.1 (p. 7):

> Acceptable RA [radioassay] data shall be obtained for 100 percent of the waste containers characterized for disposal. Acceptable radioassay data shall consist of data on the radioactivity content of the waste package obtained from measurement systems which have been demonstrated to have met all the relevant QAOs for radioassay.

The DOE should adhere to this requirement until a process is developed and completed to explain the rationale for substituting a less comprehensive waste characterization than was expected for WIPP wastes. Also, EEG recommends that the phrase "accurate and unbiased" be substituted for the single word "unbiased".

4. Section A.1 of Appendix A states (p. A-2):

> Existing radioassay data collected prior to the implementation of a quality assurance program pursuant to 40 CFR §194.22(a)(1) may only be qualified in accordance with an alternate methodology that is approved by CBFO...

This allowance is not one that reflects the wording or intent of 40 CFR 194.22(b), on which it is apparently meant to be based. §194.22(b) requires that qualification of such data be by a methodology approved by the EPA, not the CBFO.

It is also important to note that 40 CFR §194.22(a)(1) requires the DOE to implement the 1989 NQA standards "As soon as practicable after April 9, 1996...". The EPA certified that the DOE met all the 40 CFR 194 criteria, including §194.22(a)(1), in March of 1998, so it would appear that the necessary QA program was in effect prior to that date. Any data produced after that time would not appear to be qualifiable under §194.22(b). This date, or an appropriate earlier time at which the DOE's QA program met the criterion, should be described in this Appendix.

Section A.2 of Appendix A states (p. A-3):

> Sites may opt to qualify AK as permitted by 40 CFR §194.22(b) by performing confirmatory testing using WIPP-certified radioassay systems.

The date of compliance with 40 CFR 194.22(a)(1) as described above should be associated with this statement also.

The structure and wording of 40 CFR 194.22 make it clear that the qualification of existing data process (QED) in §194.22(b) was intended to be used only for data that was collected prior to establishment of the mandatory QA program implementing the NQA requirements. There was clearly no intent to allow development of the QA program to continue *ad infinitum*. There is no acceptable reason for not conducting WIPP waste characterization activities under a QA system that meets the WIPP quality assurance program at this time. There should be less use of the QED process as time goes on, not more.

5. Sections A.2 of Appendix A lists acceptable knowledge (AK) requirements for isotopic ratios in the waste. As mentioned above, EEG does not believe that AK should be used in the future to reduce present NDA measurements. However, if the role of AK is expanded there are several cases where the requirements need to be more specific. These cases are included in all our following comments. Appendix A does not describe other AK requirements that should be in effect for radionuclide characterization, and the Sections in A.2 could easily be broadened to include the other information. Particularly useful would be AK describing radionuclide quantities in each container especially if, as is stated in the January 9, 2001 Triay-to-EPA's Marcinowski letter, the CBFO intends to pursue statistical sampling rather than 100% radioassay in the future. Also, it would be very useful to be able to present a comparison of AK information to WIPP-certified measurements at the time statistical sampling is formally proposed.

   The Appendix should also require controls on the AK process. The radiological AK should be required to be gathered and assembled under procedural control, and procedures for collecting AK, for developing and identifying waste streams, and for resolving discrepancies between different components of the AK data. It may be sufficient to simply reference the appropriate sections in the WIPP Hazardous Waste Facility Permit (HWFP) for these requirements, or the CBFO QAPD requirements for procedure development and control.

6. Section A.2 of Appendix A indicates that when isotopic ratios are established by measurement and valid data "...may not be obtainable for given containers for technical reasons..." then those containers must be "...appropriately dispositioned by the measurement facility." The parameters for what constitutes "appropriate disposition" should be clearly described.

   Also, the following sentence should read:

   > "For those few waste containers for which direct measurement does not yield useable isotopic ratio information, <u>values from NDA of other containers and</u> AK shall be used."

7. Section A.2.1 of Appendix A states (p. A-3):

   > "Measured isotopic ratios for ^{241}Am may confirm existing AK by waste stream. However, due to the fluctuation of ^{241}Am in certain waste streams, it may become necessary to measure ^{239}Pu to ^{241}Am isotopic ratios

on all containers in that waste stream."

This section should also note that prior to using $^{241}Am/^{239}Pu$ ratios sites must determine that the only ^{241}Am in the waste stream is from the decay of ^{241}Pu native to the waste stream. A cursory examination of wastes coming to WIPP at this time suggests that significant variation in $^{241}Am/^{239}Pu$ ratios is common.

8. Section A.2.1 of Appendix A indicates that measurement of uranium isotopes, ^{137}Cs, and ^{90}Sr would not be necessary. For the uranium isotopes, the section states:

> For some of the generator sites that were involved primarily in weapons production, the fissile isotopes ^{235}U and ^{233}U and the fissionable isotope ^{238}U may not have been measured when the transuranic waste was originally assayed (i.e., using non-WIPP-certified systems), primarily because the plutonium isotopes were the radionuclides of interest to the generator site. However, other forms of AK may be available. If so, then the AK can be confirmed by data generated on a WIPP-certified system. If valid AK does not exist, then the data generated on a WIPP-certified system can only be used to detect or calculate ^{238}U, ^{235}U, and ^{233}U or to confirm their absence.

We believe this statement places an unwarranted importance on the concept of confirming AK. The purpose of NDA measurements should be to measure the radionuclides in a container (which will be more accurate than AK) and report those values. As noted in a previous comment the opening of the WIPP was based in part on a requirement for waste to be assayed with WIPP-certified systems. The intent expressed to the EPA, the EEG, and the public was that WIPP-qualified measurements of waste containers would be made. WIPP-certified measurement of the amount of radionuclides present should be considered a requirement. The quantities of uranium radioisotopes in the waste should be measured, not confirmed.

9. Section A.2.2 of Appendix A states (p. A-4):

> The use of AK information concerning the radiological composition of a waste stream will be documented either in the AK summary report for the waste characterization of the waste stream or in another controlled document approved by the Site Project Manager. Should this information be contained in AK package(s) prepared to meet other general waste characterization requirements, it need not be duplicated in other controlled documents that address the radiological properties of the waste stream.

These statements should be amended to require the AK summary report to clearly reference the location of the radiological composition data when it is not directly included in the AK summary report.

Reference to the AK summary report should likely indicate that it is the report required

by the WIPP HWFP that is meant.

10. Section A.2.2.1 also includes a list of bulleted items, but all these relate only to isotopic distributions, not to the amounts of the various radionuclides that documents in the AK may provide. Note that the TRU Waste QAPP required "types and quantities of TRU waste" (Section 4, p. 10). The AK for a waste stream should include all of the available information concerning radionuclides in the waste.

11. The final bullet in Section A.2.2.1 again lists only the 10 radionuclides in the CCA Table 4-10, and those that would be necessary to encompass 95% of the radiological hazard for the container. The waste unit factor radionuclides from CCA Table 4-8 should also be included. This should also be specified in Section A.3.

12. Additions to the bulleted list in Section A.2.2.1 of Appendix A should be made. The required AK elements should also include that the AK written record must contain waste stream volume and time period of generation for each waste stream; process flow diagrams for each waste stream; and material inputs or other information that can be used to identify radionuclide content of each waste stream, and a description of the correlation between waste streams that originate from the same process (such as combustible and metal waste streams that came from the same building and process). While some of these additional items are required by the WIPP HWFP, they should also be included as a part of the documentation of radionuclide content.

13. Section A.2.2.3. The first sentence states:

> If there is a discrepancy between AK information related to isotopic ratios or composition, the site will evaluate the sources of the discrepance to determine if the discrepant information is credible.

EEG believes that the assayed values are what should be reported because they are the best indication of what is actually in the waste container and not what is supposed to be present.

14. Section A.2.2.3 of Appendix A, Discrepancy Resolution, states (p. A-6):

> If discrepancies result in change to the original determinations, the AK summary will be updated.

Previous portions of the Appendix have indicated that radiological AK need not be reported in the AK summary report. This sentence should be revised to indicate that the radiological AK summary document used by the site should be updated.

15. Section A.3 of Appendix A states that "There are no stipulated data quality objective for PE-Ci or individual isotope activities." For those cases where other than $^{239}Pu + ^{240}Pu$ dominate the PE-Ci calculations, the PE-Ci could vary widely. Table 3.3.4 prescribes PE-Ci limits for containers received at WIPP. The two most important limits are the 80 PE-Ci for direct loaded drums and 130 PE-Ci for direct-loaded boxes. If there is not a

DQO requirement for isotopic ratios (especially ^{238}Pu and ^{241}Am which have negligible effect on FGE) there is no assurance that the limits in Table 3.3.4 can be met. This is one of the main reasons why EEG believes it is important to obtain accurate values for isotopic ratios by NDA.

Sections A.3 & A.4 Data Quality Objectives and Quality Control.

The Sections A.3 and A.4 are considered together in our comments because the items are interrelated. Also, since several of the topics (DQOs, calibration, permission checks) have been rearranged since Appendix A, Revision 7, it is necessary to study both sections in their entirety to determine what has been changed, added, or deleted.

Our general conclusion is that the requirements specified in Draft G, Appendix A are adequate. However, the text could be much improved to more explicitly state some requirements. As written, these Sections place a significant burden on the audit process to insure that the intent of the requirements are satisfied. If the audit process remains as strict as it has in the past it should be possible to obtain acceptable NDA results. A few of the areas where editing would improve Sections A.3 and A.4 are mentioned below as examples. This is by no means as exhaustive list.

16. **Data Quality Objectives**. The DQOs for precision and accuracy in Table A-1 of Revision 7 are presented in a much different manner in Draft G. However, the accuracy range of 70%-130% on a non-interfering matrix is still the same. Precision QAOs are the same for all radionuclide concentration ranges for both 6 replicates and 15 replicates.

    These values are the same as for # 0.02Ci in Rev 7. However, Revision 7 requires greater precision for higher radionuclide concentrations. Although Draft G allows a relaxation in precision for higher concentration containers we consider this acceptable.

17. **Calibration.** Revision 7 requires an initial calibration and re-calibration after major repairs. Calibration verification on an interfering matrix are required annually. Draft G would change calibration requirements to initial calibration with interfering matrix, calibration verification after major changes, and re-calibration only if a calibration verification fails. Draft G does not, but should, specify that calibration verification be with an interfering matrix.

    The calibration criteria in Draft G are clearly less stringent than in Revision 7. There is one offsetting addition in Draft G; the requirement that there must be a weekly check with an interfering matrix of the waste type being assayed. This weekly check is required to cover the operating range of the instrument over a six-month period. EEG believes this weekly check is an adequate off-set to the lessened calibration requirements.

    Examples of where the text could be improved to either clarify or prevent abuse are:

    (1) defining the terms % R and %RSD;

    (2) be more specific about how non-primary standards must be “correlated” with

primary standards;

(3) specify the conditions under which "measurement facilities may develop alternate limits for accuracy and precision subject to approval by CBFO...."

18. **Performance Checks**. The daily background measurement and instrument performance measurements are effectively the same as in Revision 7. The text in Draft G is more specific and is an improvement. Also, new requirements for the weekly check with an interfering matrix and the specific requirement (in Table A-4.2) for a weekly evaluation of the daily measurements are definite improvements.

The Revision 7 requirements for replicate assays and for control charts have been dropped. Replicate assays were a usefully practice for assessing precision. However, since Revision 7 did not specify any criteria for agreement between measurements there was no requirement to deal with discrepant results.

The control chart requirement in Revision 7 did specify that action be taken if results were outside an acceptable range but did not define acceptable range. EEG would prefer for the control chart requirement to be maintained because it is easy to verify compliance during an audit. However, the data check requirement and Table A-4.2 provide an alternate mechanism for fulfilling the same purpose.

Items that could be improved to clarify or prevent abuse are:

(1) the criteria by which CBFO could grant other-than-daily background measurements should be specified

(2) a RC batch should be defined

(3) more detail should be provided on sampling procedures, including representativeness, for RC analyses

(4) an external comparison program, such as PDP, should be required for radiochemical assay.

19. **Section A.4.1 Comparison Programs.** The requirement that sites participate in a relevant comparison program, such as PDP, is retained in Draft G. However, there should be a requirement that participation be successful and occur annually.

APPENDIX B

No Comments

APPENDIX C

There have been slight changes in the Glossary since Revision 7 and we have several comments about changes and omissions. Our general comment is that acronyms are used extensively in the

definitions and this requires constant reference to the Lists of Acronyms and Abbreviations in the front of the document. Our specific comments are:

(1) Appendix A's consideration of acceptable knowledge is tainted by the inclusion of a new definition of AK used in this draft version of the WAC (p. C-2):

> **Acceptable Knowledge** (AK)- Knowledge used for waste characterization, which is based on the materials and processes used to generate a waste. Acceptable knowledge includes information about the physical form of the waste, the base materials composing the waste (especially hazardous and radioactive materials), and the process that generated the waste. Acceptable knowledge is used to define waste streams, assign summary categories, assign EPA hazardous waste numbers, estimate the weight fraction of CPR, and estimate isotopic ratios.

The definition of AK that was presented to the EPA in the WIPP *Title 40 CFR 191 Compliance Certification Application* (CCA; DOE/CAO 1996-2184) is somewhat

different. From the Transuranic Waste Characterization Quality Assurance Program Plan, CAO-94-1010, Rev 0, Section 4, page 1:

> Acceptable knowledge refers to applying knowledge of the waste based on the materials or processes used to generate the waste. Acceptable knowledge includes information regarding the physical form of the waste, the base materials composing the waste, the nature of the radioactivity present, and process generating the waste.

The differences are minimal, but the practice of changing definitions from those that form the basis of the WIPP certification might be one that could result in failures to meet regulatory requirements.

(2) Contact-Handled Transuranic Waste. It would be more specific to define this as "transuranic waste with radiation dose equivalent rate that is less than 200 mrem/hr on the surface of the waste container."

(3) Fissile Material. The current definition in Draft G is an improvement.

(4) G-value. This has been deleted since Draft E. However, the term is not referred to in the document so this deletion is satisfactory.

(5) Mixed Waste. Was defined in Revision 7 but has been deleted. It is mentioned in Section 3.5.2. We recommend that it be included.

(6) The current definitions of Packaging, Payload Container, and Pipe Overpack are all improvements.

(7) Suggest that the following sentence be added to Plutonium Equivalent Activity. "The

value is expressed as plutonium equivalent curies (PE-Ci)."

APPENDIX D

The new Payload Container Integrity Checklist is a useful addition in that it adds specificity to the evaluation of the requirement that payload container integrity be acceptable. We are generally satisfied with the degree of specificity provided. There are only two minor comments:

(1) Items 1. and 2. lack specificity but apparently are meant to apply to those containers that are so obviously compromised that specific criteria are not necessary. This vagueness is acceptable only because specificity is provided in the other 8 items.

(2) In item 9, "vents" should be described as "filter vents."

EEG VIEWS ON WIPP CHARACTERIZATION AND TRANSPORTATION REQUIREMENTS

A Statement Provided to

NAS/NRC WIPP COMMITTEE
October 29, 2002
Carlsbad, NM

By

Matthew Silva

EEG Views on WIPP Waste Characterization and Transportation Requirements

The Environmental Evaluation Group (EEG) has been reviewing waste characterization and transportation aspects of the WIPP Project since 1979. In both areas, the Project has developed and circumstances and requirements have changed. Our views have also evolved over the years and we reevaluate our position in response to current information and conditions.

Waste characterization and transportation are discussed separately below.

WASTE CHARACTERIZATION

Basic Philosophy

These previous EEG statements reflect our basic criteria regarding waste characterization:

1. "We believe overall waste characterization requirements are excessive ... . However, any proposed relaxation needs to be evaluated in sufficient detail to convince regulators, EEG, and stakeholders that the modification is justified." [1]

2. In our October 4, 2001 Statement to the NAS Committee on the Characterization of Remote-Handled Transuranic Wastes for the Waste Isolation Pilot Plant we said, "The conclusions from EEG-72 were that for routine operations the radiological risk was on the order of 10,000 times the hazardous waste risks, all from Volatile Organic Compounds (VOCs)... . The fact that radiological risks are much greater than hazardous waste risks needs to be kept in mind by DOE, regulatory agencies, peer review groups, this Committee,

[1]September 17, 1999 letter from Robert H. Neill to Inés Triay transmitting EEG comments on the August 9, 1999 Recommendations of the Transuranic Waste Characterization Task Force Final Report.

and oversight agencies when addressing possible changes to waste characterization requirements."

3. The relaxation of audit requirements and QA/QC is not an appropriate way to reduce the waste characterization burden. These requirements should maintain the current level of stringency. The appropriate way to reduce the waste characterization burden is to eliminate unnecessary requirements, not to reduce the degree of compliance.

In light of these basic criteria, EEG has made some preliminary findings in the past on some of the waste characterization requirements that are listed in Revision 0 of the CH TRU Waste Acceptance Criteria for the WIPP (CH WAC, DOE/WIPP-02-3122) and in the WIPP Hazardous Waste Facility Permit. These are discussed separately below. Our comments address the waste characterization needs for short-term and long-term health and safety. We recognize that there may be additional waste characterization necessary to satisfy legal or regulatory requirements but we are not addressing these in this statement. Ultimately, the requirements need to be decided by the regulator.

Stability of Wastes

There are several of the physical and chemical properties in the CH WAC that have the intent of providing a stable waste form that will minimize any short-term problems in handling containers at the generator/storage sites, during transportation to the WIPP, in handling/emplacing containers at the WIPP, and during storage in open waste disposal rooms. These same requirements are also present in the TRUPACT-II Authorized Methods for Payload Control (TRAMPAC) and the Hazardous Waste Facility Permit. These requirements include: (1) residual liquids (less than 1% for the payload containers and less than 1 inch in the bottom of internal containers), (2) sealed containers (no sealed internal containers greater than 4 liters), (3) pyrophoric radioactive materials (less than 1% by weight), (4) incompatible chemical materials (not allowed), and (5) explosives, corrosives, and compressed gases (not allowed). There are clearly qualitative benefits to the above criteria, although they are difficult to quantify.

The EEG does not believe that any of the above criteria should be relaxed. They each have a purpose in minimizing problems of container integrity, leakage, and corrosion. Container problems have the potential to contaminate workers, facilities, and Inner Containment Vessels of TRUPACT-IIs and result in economic penalties due to decontamination and overpacking.

Container Properties

Container Properties listed in the CH-WAC (weight limits and center of gravity, assembly configurations, dunnage, removable surface contamination, identification/labeling, and filter vents) are necessary requirements but not waste characterization requirements per se. These should all be retained.

Radiological Requirements

The radiological properties in the CH WAC (radionuclide composition, ^{239}/Pu Fissile Gram Equivalent {FGE}, TRU alpha activity ^{239}/Pu Equivalent Activity {Pe-Ci}, radiation dose equivalent rate, and decay heat) require a considerable waste characterization effort through radioassay (primarily nondestructive assay) and appropriate use of acceptable knowledge. The EEG is aware that the DOE would prefer that the required methods of meeting these criteria be relaxed.

The EEG is not, at this time, in favor of any significant change in the radiological requirements or in the acceptable procedures for showing compliance. Essentially all of the long-term and short-term risk in the repository is due to the radiological properties and each of the requirements serves a useful purpose in defining and controlling those risks. The properties are discussed separately below.

Radionuclide Composition. The EPA requires that 10 radionuclides be tracked on a payload container basis for purposes of tracking the total WIPP radionuclide inventory for long-term disposal. The inventory, regularly updated during the emplacement of wastes in WIPP, is

important to reevaluations of long-term compliance during the performance assessments required at each 5-year recertification.

Some of the radionuclides are more important for long-term compliance. The most significant are ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{241}Am. Since their half-lives and specific activities vary considerably, each of the four present a different hazard and their activities should be separately determined. The other tracked radionuclides (^{233}U, ^{233}U, ^{238}U, ^{242}Pu, ^{137}Cs, and ^{90}Sr) have less effect on repository performance but could affect certain scenarios either because of early human intrusions or non-homogeneous emplacement in the repository.

There are other reasons for tracking several of these radionuclides. Uranium-233 must be determined because of the FGE (this is also necessary for ^{235}U which is not one of the 10 tracked radionuclides). One of the methods being considered for determination of TRU concentrations in Remote Handled TRU waste is by a ^{137}Cs to TRU ratio. Also, if minor radionuclides in an assay are recognized there is more assurance that the major contributors are correctly identified.

One important radionuclide not on the list is ^{241}Pu. It is the primary contributor to total WIPP activity (60% of the activity emplaced to date) and it decays to ^{241}Am, which is an important radionuclide. The sites are reporting ^{241}Pu now, although not required to do so, and this reporting should continue. The Committee may wish to explore a recommendation to require reporting of ^{241}Pu be added to the WAC.

Fissile Gram Equivalent. In order to ensure that nuclear criticality does not occur, each waste container has a FGE limit (200 FGE for 55-gallon drums, and 325 FGE for Standard Waste Boxes) and the TRUPACT-II also has a limit. Three radionuclides are important; ^{239}Pu, ^{235}U, and ^{233}U. There must be sufficient radioassay to assure that each container is below the FGE limit.

TRU Alpha Activity. This is required to determine whether each waste container meets the definition of TRU waste (i.e. more than 100 nanocuries per gram of waste) and is therefore eligible for disposal at WIPP.

^{239}Pu Equivalent Activity (PE-Ci). The PE-Ci normalizes all radionuclides to a common radiotoxic hazard index. Each type of waste container has a Pe-Ci limit established to meet the WIPP Safety Analysis Report envelope. All transuranic radionuclides (including beta emitters and ^{233}U are included in the calculation.

Radiation Dose Equivalent Rate. All containers must have an external radiation dose equivalent rate of $\leq$ 200 mrem/hr at the surface. Any neutron dose needs to be determined and included in the dose rates.

Decay Heat. The decay heat limit is used to limit the gas generating potential of the waste as required in the TRAMPAC.

General Comment on Determination of Radiological Properties. In order to comply with all of the radiological property criteria it is necessary to quantify all significant radionuclides in a container not just ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu and ^{241}Am (or the sum of these four radionuclides). In many cases there are no other significant radionuclides but this needs to be determined by an appropriate combination of radioassay and acceptable knowledge.

In most cases it should be easy to show compliance with the FGE, PE-Ci and TRU Alpha Activity limits without a rigorous radioassay. However, the radionuclide composition and decay heat requirements require specific values for all containers.

The present CH WAC requires 100% of containers to be subject to nondestructive assay (NDA) for quantification and determination of isotopic ratios. The DOE had hoped that EPA would agree to less-than-100% NDA. The EEG has stated: "EEG believes that much more justification is needed before a future reduction in NDA requirements should be allowed."[2] We believe that

[2]January 30, 2002 letter from Matthew Silva to Inés Triay transmitting EEG's comments on Draft G of Contact-Handled Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant, Revision O (DOE/WIPP-Draft G-3122).

justification for less than 100% quantification and determination of isotopic ratios may be possible for some, but certainly not all, waste streams.

Headspace Gas Sampling

The Hazardous Waste Facility Permit (HWFP) requires that each CH TRU waste container be sampled for headspace gas or randomly sampled if it meets the criteria for reduced headspace gas sampling. One purpose of this requirement is to quantify the Volatile Organic Compounds (VOCs) that are emplaced at WIPP to ensure that the Room Based Concentration Limits in the HWFP are not exceeded. The TRAMPAC (which contains the NRC TRUPACT-II Certificate of Compliance requirements) also requires that flammable VOCs be less than 500 parts per million or comply with the unified flammable (gas/VOC) concentration limit. Headspace gas analysis also meets the requirement for a detailed chemical analysis of a representative sample of the waste.

EEG has concluded, "... the Confirmatory VOC Monitoring Plan at WIPP would detect concentrations that are three orders of magnitude below allowable Permit limits."[3] Because of this conclusion, we do not see why 100% headspace gas sampling at the sites should be necessary to assure compliance with Room Based Concentration Limits. There will still be a need to show compliance with TRAMPAC limits. The TRAMPAC allows appropriate acceptable knowledge to be used to show compliance. While some headspace gas sampling would still be required to show compliance with the TRAMPAC, this sampling would probably be much less than the 100% of containers currently required for debris wastes. Because of these concepts there has been some discussion of further reductions in headspace gas sampling requirements.

The Code of Federal Regulations requirement for a detailed chemical analysis of a representative sample of the waste is addressed only by headspace gas analysis for most of the debris waste.

[3]"Evaluation of Risks and Waste Characterization Requirements for the Transuranic Waste Emplaced in WIPP during 1999," page 60, EEG-75, May 2000.

These analyses do provide additional information on the contents of waste containers. Additional waste streams have been defined because of the results of these analyses, and on occasion additional RCRA hazardous waste numbers have been added to waste streams. The importance of these functions has occasionally been denigrated, primarily because this additional information is not used to control quantities of VOCs coming to WIPP other than to show compliance with the room based concentration limits or transportation limits.

The Committee may wish to provide recommendations to the DOE and regulators on whether the value of better information on waste stream classification and hazardous waste numbers warrants a requirement of 100% headspace gas sampling.

Waste Material Parameters

The EPA requires the quantification of cellulosics, plastics, and rubber in the waste because of its effect on gas generation in sealed repository rooms. The EPA limit is a maximum quantity for the entire repository. EEG believes the average allowable concentration should be limited for a smaller repository unit, such as a waste panel.

This quantification continues to be necessary because the limit is important to assumptions used in the performance assessment. However, it does not appear to be difficult to stay below the limit; the average concentration emplaced to date is < 82% of the allowable. Due to this observation, EEG does not object to the current DOE proposal to estimate bounding (rather than measured) concentrations in RH TRU waste canisters. Also, quantification on a waste stream (rather than individual container) basis should be acceptable if properly estimated.

The EPA has also placed a minimum requirement for ferrous metals in the repository, to maintain a reducing environment in the repository. EEG believes that the ferrous metal amounts should be tracked at the panel level. However, since the drums and other metal waste containers by themselves are expected to meet this requirement, and the ferrous metal in the repository may

have already met the current EPA requirement, there may be an argument for eliminating further tracking of this parameter.

Homogeneous Waste Sampling

The HWFP requires a fraction of homogeneous waste containers to be analyzed for toxic metals, other hazardous chemicals, volatile VOCs, and semi-volatile VOCs (SVOCs). The EEG has stated that we see no technical reason why it is necessary to analyze for metals and chemicals at all.[1] Our reasons are: (1) the quantity of these materials to be emplaced in the repository was not important enough to DOE to estimate in the HWFP Application nor for the New Mexico Environment Department to request, (2) the data are not to be used for any regulatory control under the HWFP, and (3) evaluations in EEG-72 concluded that human exposures to hazardous metals and chemicals would only occur from the same type of operational and human intrusion accidents that released radioactive materials. In EEG-72, the calculated radionuclide risk would be $\geq 5 \times 10^5$ times the hazardous metals risk.

Despite the above statement, we do recognize an advantage of toxic metals sampling; the possible detection of prohibited items, such as PCB concentrations greater than 50 parts per million.

Our concerns about VOC or SVOC sampling are the same as for headspace gas sampling (that room based concentration limit and transportation requirements be met in some manner). The Committee may wish to explore the need for VOC and SVOC sampling in order to provide additional information on homogenous wastes.

TRANSPORTATION REQUIREMENTS

NRC Certification

The EEG believes that all waste shipments in New Mexico for wastes that are destined for WIPP should be in Type B packages certified by the U.S. Nuclear Regulatory Commission (NRC). Furthermore, these shipments should comply with the payload requirements specified in the Certificate of Compliance issued by the NRC for these packages.

Double Containment

Section 71.63(b) in 10 CFR Part 71 requires that all shipments containing more than 20 curies of plutonium (including ^{241}Pu, a beta emitter) must be in Type B packages that provide double containment. Approximately three-quarters of the TRUPACT-IIs coming to WIPP at this time contain greater than 20 Ci of plutonium. EEG strongly supports the double containment requirements. In a recent (April 30, 2002) Proposed Rule the NRC proposed several changes to their Rule, including deletion of Section 71.63(b). The EEG objected to this proposal. We concluded that the assertion that single containment would result in lower occupational doses was incorrect for WIPP shipments. Also, the NRC made no attempt to estimate the weight penalty from double containment or quantify possible cost savings. We believe the primary advantage of double containment is that it would drastically decrease the probability of a release resulting from a serious accident.[4] This was the reason that the double containment requirement was adopted in the early 1970s.

WIPP transportation accidents are not merely a theoretical possibility. The two accidents to date amount to a rate of 1.45 per million loaded miles and would project to a total of 59 accidents over the lifetime of WIPP. Even a small release accident would have serious economic, shipping disruption, and public confidence implications.

---

[4]July 26, 2002 letter from Matthew K. Silva to the U.S. Nuclear Regulatory Commission on proposed modifications to 10 CFR Part 71.

Rail Transportation

EEG does not have a position for or against rail transportation involving NRC Certified Packages. It is likely that the overall radiological safety implications of rail shipments are similar to those for truck transport. A previous NAS Committee recommended in its final report that DOE consider revisiting use of the ATMX railcar. After further analysis, EEG remains opposed to the use of the ATMX rail car for shipments to WIPP because it is not NRC certified or double contained.[5] Also, the ATMX has no payload limits to control hydrogen gas generation.

Rail transportation would have several potential advantages; cost savings and the transport of larger and heavier objects. But there are a different set of problems that would need to be worked out: (1) control of shipments en route, (2) training of emergency responders along rail lines (as well as highways), (3) handling of the large volumes of wastes arriving at WIPP in one shipment, and (4) a less efficient use of shipping packages.

[5]October 19, 2000 Presentation to the Radioactive Waste Consultation Task Force by Matthew Silva.

DATE: January 13, 2003

TO: Barbara Pastina

FROM: Matthew Silva

SUBJECT: EEG Response to transuranic Waste Characterization committee's December 6, 2002 Questions

Attached are EEG's Responses to your Committee's questions. Please call Jim Channell (505) 828-1003 if there are questions.

Attachment

MKS:BAW:JKC:pf

EEG RESPONSE

to

NATIONAL RESEARCH COUNCIL COMMITTEE'S QUESTIONS ON TRANSURANIC WASTE CHARACTERIZATION

December 6, 2002

QUESTIONS FOR DOE

(Regulators and members of the public are also invited to comment)

DRIVERS FOR CHARACTERIZATION REQUIREMENTS

1. *Please provide a matrix of characterization activities vs. the regulatory or departmental requirements to which the activities respond*.

The EEG has no such matrix, which would require extensive resources to develop. As pointed out in the response to the Committee's question #5, the WIPP waste characterization requirements were developed under circumstances that would leave such a matrix of limited value and vulnerable to potential misinterpretation.

2. *What characterization requirements would apply if DOE only needed to comply with EPA requirements*?

Only AK and NDA requirements listed in Appendix A of the *Contact-Handled Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (the CH-WAC; DOE/WIPP-02-3122, Rev 0), and radiography results for ferrous and non-ferrous metals, cellulose, rubber, plastics, and liquids.

3. *What characterization requirements would apply if DOE only needed to comply with NMED requirements*?

AK, headspace gas, solids sampling and analysis, RTR/VE; the WAC (Attachments B to the WIPP Hazardous Waste Facility Permit (HWFP).

4. *What characterization requirements would apply if DOE only needed to comply with transportation requirements*?

AK, RTR/VE, headspace gas flammables analysis, payload container surface dose measurements, fissile material quantity measurements for payload containers, radionuclide description for at least 95% of the activity in each shipment. The wording of the transportation requirements is such that the DOE would determine when characterization activities beyond the

initial AK determination would need to be used. For some of the waste, existing AK alone would be adequate.

5. *What WIPP waste characterization requirements, if any, has DOE imposed that go beyond EPA, NMED, and transportation requirements*?

None that the EEG is aware of. The DOE established a unique system for waste characterization in order to satisfy the various requirements for opening the WIPP facility and allowing TRU wastes from across the country to be disposed of in New Mexico. These were worked out over several years through various methods with the various agencies and the DOE Generator/Storage Sites, involving give-and-take on both sides. During these negotiations, the DOE wished to deviate from the usual hazardous waste processes for a disposal facility. These deviations were apparently because of the DOE's limited knowledge about the TRU waste, the introduction of RCRA requirements to the DOE holdings, the complications caused by the presence of radionuclides, a desire to have the waste analyzed by those most familiar with them (the generator/storage sites), the uniqueness of the WIPP as a geological repository rather than a landfill, and other considerations. Thus, it is less a condition of whether or not the DOE has imposed requirements that go beyond those of the regulatory agencies than it of whether or not the DOE is going beyond the agreements established with the agencies.

6. Do NMED permit conditions regarding the characterization of wastes under RCRA differ significantly from RCRA requirements applied at other facilities that store or generate TRU waste? If so, how? What is the regulatory basis for those differences?

Such a comparison would be of limited value and credibility. "Other facilities that store or generate TRU waste" are mostly required to meet the requirements of 40 CFR 262, whereas the WIPP is a storage and disposal facility which must meet the requirements of 40 CFR 264. Other facilities storing TRU waste were usually storing it prior to the application of RCRA requirements to DOE facilities.

IMPLEMENTATION OF THE CURRENT CHARACTERIZATION PLAN

7. *Please provide a detailed list of characterization activities for TRU waste What is the impact of such activities on public health, worker safety, and the environment?*

A list of "characterization activities" for TRU waste could only be compiled with help from the various TRU waste generator/storage/shipping sites, as these groups have established various methodologies for performing the methods to meet the "public health, worker safety, and environment" requirements established for waste characterization.

The WIPP TRAMPAC, the Compliance Certification Application to meet the EPA's long-term performance criteria in 40 CFR 194 (CCA), the WIPP Safety Analysis Report (SAR) requirements, and the application for the WIPP HWFP were developed to ensure the public

health, worker safety, and environment were protected. The TRAMPAC, SAR, CCA, and WIPP HWFP requirements are found in the CH-WAC (DOE/WIPP-02-3122). This document contains a detailed list of characterization requirements;[1] the waste characterization *activities* have been established by generator sites to ensure that the waste meets the "waste envelope" in the WAC. Appendix A to the CH-WAC and the WAP (the series of "B" Attachments to the HWFP) include or reference such documents as SW-846 (the EPA's guidance document for hazardous waste sampling and analysis) and TO-14A, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*, and all these documents specify many of the activities that are currently required to be performed as a part of waste characterization.

Both Appendix A and the WAP have been modified significantly from the original form approved by the regulating agencies.

All of the requirements when adopted were obviously felt by either DOE or the regulators to have a positive impact on public health, worker safety, and the environment. The concern at present is to reevaluate the importance of these requirements.

8. *For CH Waste: what fraction of the existing waste not yet emplaced will be processed or re-packaged?*

This is a number that changes greatly from study to study that the DOE performs. DOE documents continue to show significant variety as to what wastes will come to the WIPP, let alone what repackaging will be performed. Sites reassign inventories as planning changes occur, and there is no indication that the current plans are any more stable than those of the past. It is unlikely that the fraction that will repackaged or reprocessed will be known until much more than the 5% or so of the waste that has currently been characterized has been compared to the WIPP WAC requirements

9. *For a small generator (e.g., BCL), who is responsible for waste characterization - the original generator or the hub site?*

The principal document used to open the WIPP–the WIPP CCA–indicates that this responsibility is optional. Small quantity sites can either characterize the waste directly, or send it to an interim site for characterization and certification. However, RCRA regulations specify that the generator is responsible for the waste generated, and the WIPP HWFP, based on the DOE's application, is currently written so that the generator/storage site is responsible for the waste

[1]Previous versions of the WAC (DOE/WIPP-069) contained information as to where each requirement originated (transportation, HWFP, CCA, etc). This has been a valuable tool in the past, and one of the principal benefits of the document. In reviewing the latest version, the EEG requested that the previous practice of including the source of the requirements be continued.

characterization. This does not mean that the waste characterization can't be performed by other entities–it just means that the generator/storage site retains responsibility for the waste characterization, and must establish certain positions of responsibility for waste characterization. The WTS Central Characterization Project (CCP) currently utilizes this process at SRS, ANL-E, and NTS, and a similar arrangement could be easily arranged between a hub site and other small generators (or the CCP, working at the hub site, and the small generator).

Uncertainties allowed in Waste Characterization Data

10. *Have precision, accuracy, acceptable error rates, and other measurement targets been established for waste characterization? If so, what are they and how were they developed?*

For radionuclide measurements, the precision and accuracy are established in individual site documents, reflecting the requirements currently in effect as listed in Appendix A of the CH-TRU WAC (DOE/WIPP 02-3122, Rev 0). The current WAC precision and accuracy were amended from Appendix A of the previous WAC (DOE/WIPP-069, Revision 7, November 1999), which was based on Chapter 9 of the *Transuranic Waste Characterization Quality Assurance Plan*, CAO-94-1010, Revision 0 (TRU Waste QAPP). The TRU Waste QAPP was promulgated by the DOE in April1995 as a compendium of all waste characterization requirements for the WIPP, and served as the primary source of waste characterization requirements until the implementation of the WAC Revision 7 and the WIPP HWFP in late November of 1999. The TRU Waste QAPP was developed simultaneously with the original application for the HWFP by the DOE; the EEG, in Chapter 2 of EEG-75, noted only insignificant differences between the QAOs for accuracy and precision in the TRU Waste QAPP and the original version of the promulgated HWFP.

The precision and accuracy requirements in the TRU Waste QAPP were apparently developed by the DOE after the bin and alcove tests were dropped in 1993. There appears to have been a re-evaluation of these measurement parameters between the promulgation of the *Quality Assurance Program Plan for the Waste Isolation Pilot Plant Experimental Waste Characterization Program*, DOE/EM/48063-1 (Revision 1, July, 1991) and the TRU Waste QAPP (April, 1995). The requirements in the TRU Waste QAPP were established after extensive discussion and review by DOE personnel knowledgable in NDA and were reviewed by outside organizations (the EPA and the EEG among others) before the document was promulgated.

The current WAC Appendix A requirements are significantly different from those in the TRU Waste QAPP, and dropped precision and accuracy requirements. This revision was also extensively reviewed by DOE personnel knowlegable in NDA prior to presentation to the EPA for concurrence. The EEG also reviewed the document prior to its promulgation in May of 2002.

For headspace gas measurements, the precision and accuracy requirements are nearly the same in the 1991 document (Table 3-5), and the TRU Waste QAPP (Table 12-1). However, the headspace sampling process was extensively revised and simplified between the 1991 document and the TRU Waste QAPP, and thus one might assume that the analysis requirements were also reviewed. These same requirements appear in the current HWFP (Table B3-2), and are principally based on the EPA guidance documents SW-846 and TO-14A.

There were no solid sampling requirements in the 1991 document-it appears that the precision and accuracy requirements established for solids VOC, SVOC, and metals analysis were developed specifically for the disposal phase waste characterization process. These requirements are also established in accordance with SW-846 guidance.

Note that each of these documents (1991 QAPP, TRU Waste QAPP, Appendix A, and the HWFP) all have other required measurement quality objectives-minimum detectable limits (MDAs, MDCs, LLDs), program required quantitation limits, completeness, comparability, and representativeness, and, for NDA, establishment of measurement uncertainty to support the 2- and 3-sigma confidence levels of Table A-3 in the current WAC Appendix A. These also were established based on expert reviews and the same EPA guidance documents.

Error rates are established for radiography of the wastes, by performing visual examination of a representative sample selected using a hypergeometric distribution approach. The errors discovered have direct feedback into the establishment of the number of containers necessary for the next representative sample selection. This process was established by DOE when the TRU Waste QAPP and application for the HWFP were being developed in the 1993-1995 time frame.

11. *What work has DOE done to interpret the "representative sample" language in the RCRA requirements?*

There has been much discussion between the DOE and the NMED concerning what constitutes a "representative sample" over the years; however, the EEG is unaware of any documentation of these discussions. The following information is based on verbal explanations supplied by both DOE (CBFO and generator site) and NMED personnel that led to the waste sampling requirements found in the HWFP.

For debris waste streams, the heterogeneity is extensive enough that representative samples of the matrix itself cannot be recovered without what appear to be an extravagant use of resources (i.e., destroying the structure of all waste components in a container, mixing them to create a homogeneous matrix, then sampling that matrix). Because of the same heterogeneity between waste containers none of the containers can be said to be representative, so that headspace gas samples are taken from each of them. For homogeneous (solidified wastes and soil/gravel) waste streams, the uniformity is such that statistically representative samples can be taken from a few containers for both headspace gases and the waste matrix itself, thus reducing the number of

samples that need to be taken for both.

12. *What are the assumptions used in the compliance certification application with respect to the waste inventory? Are there uncertainties attached to these assumptions? How much uncertainty is allowed in waste characterization and waste inventories?*

One assumption was that the 1995 *Transuranic Waste Baseline Inventory Report* (TWBIR; DOE/CAO-95-1121) provided an adequate description of the WIPP-bound waste in the DOE complex. While this assumption may be valid, it rests primarily on the accuracy of the waste generator site submissions, at a time when (with the exception of retrievably stored waste at the INEEL) these sites had assembled scant documentation to support acceptable knowledge-nor was such knowledge available for some portions of the waste. There was also no assurance that the summarizing and reporting of these data in the TWBIR would be useful. Consequently, the CCA relied primarily on establishing bounding conditions for waste components and characteristics, using the TWBIR waste descriptions, but not the amounts. The CCA showed that waste characterized within the boundaries as established by the WIPP WAC and the LWA would meet the 40 CFR 191/194 requirements; the waste characteristics and their uncertainties, as documented by waste characterization, would be tracked as the waste was placed in the repository to ensure that the CCA bounding conditions would be met (see Chapter 4 of the CCA for the complete discussion).

OPERATIONAL EXPERIENCE WITH WASTE CHARACTERIZATION TO DATE

13. *DOE now has emplaced over 3% of the total CH-TRU waste inventory and has obtained significant experience in characterizing, transporting and disposing of that material. What are the plans to evaluate that data and publish the results to make future operations more efficient and cost effective? Is a summary of waste characterization data available?*

Such summaries or plans may not be particularly useful. As noted by the NMED presenters during the October 2002 NAS Committee meeting, only a few of the " approximately 970 waste streams listed in Revisions 2 and 3 of the TWBIR (Vol 1. Xi) have so far been accepted for shipment to the WIPP, and for many of those streams only a few containers, or perhaps none, have been shipped. For the waste that has been shipped, most of the waste streams originated in the relatively simple and well-defined production processes at RFETS, and may not be representative of the types of waste that the overall repository will contain.

14. *Has the experience with waste characterization, both for the waste emplaced in WIPP to date and by waste stream, found problems not identified by using AK? If so, please provide details.*

Yes. One fairly recent example is the "dewatering" issue at the INEEL, wherein sludges that

were thought to be solidified were found to have excess liquids that extrude from the matrix and are re-absorbed by it. The extrusion is apparently caused by simply moving the drum. The extent of this problem is still not clear. The presence of free water in excess of the 1% allowance in sludge containers is a violation of requirements in the TRAMPAC, the WIPP SAR, the HWFP, and the EPA's 40 CFR 191/194 certification.

Several of the 37 waste streams certified so far have had additional EPA hazardous waste numbers added by the results of headspace gas sampling, and drums have been re-assigned to other waste streams based on radiography and visual examination data. Radiography at SRS has also discovered such a high percentage of drums with prohibited items (pressurized cans, excess water) that eventually a pre-WIPP characterization program, as mentioned at the last NAS Committee meeting, was initiated to separate these containers from the WIPP population prior to initiating waste characterization activities.

For radionuclide content, several DOE ORPS reports (e.g. RFO-KHLL-WSTMGTOPS - 2001-0003 and 0025)have noted that measurements accepted by the DOE's internal Safeguards accounting for nuclear materials, which become a part of the AK package, were found to be significantly in error when containers were re-measured using WIPP-certified instruments. Since the only time ORPS reports are created is when the discrepant measurements result in violation of the authorization basis for storage of the wastes, it may be that there are many other significant differences between AK determination of radionuclides and the measurements determined by WIPP-certified instruments.

15 *What is the most common problem encountered during audits or inspections?*

For the technical side of waste characterization, failure to follow procedures, and lack of attention to detail are the most common problems. However, probably more problems are uncovered in training and records handling than in the actual waste characterization itself (with the same two problems–failure to follow procedures, lack of attention to detail). Of course, if a worker is inadequately trained, or the record of waste characterization is inadequate, then there is no surety that the characterization was adequate, or that the proper information concerning wastes disposed at the WIPP will be in the WWIS.

16. *What distribution of measured concentrations have been observed in headspace gas measurements, both for all of the waste that has been emplaced in WIPP and by waste stream? What is the relation between headspace gas concentrations and disposal limits? Transportation limits? Worker safety?*

Distribution values can be obtained from the WWIS and are currently well below room based concentration limits, transportation limits and levels of concern for worker safety.

17. *How is AK information reflected in the WIPP Waste Information System?*

Printouts of WWIS reports would provide this information. All waste information in the WWIS can be considered to be AK. When the physical processes used to confirm AK find discrepant information, that new data becomes a part of the AK. Thus, any waste stream or container information in the WWIS is AK information.

Cost of Characterization

18. *Are there any published (or unpublished) reports on the costs of complying with regulatory requirements for the characterization of radiological constituents in TRU waste and with RCRA requirements in the TRU mixed waste?*

A 1999 WIPP waste characterization study was performed by the CBFO (then CAO) National TRU Program; and the 2002 DOE Center for Acquisition and Business Excellence Report cited by Dr. David Moody in his presentation to during the October 28, 2002 NAS Committee meeting are the two that come to mind. Several estimates have been presented at meetings in the interim. However; until the estimates provided by Dr. Moody of $6,200 to $8,500 for each debris waste container (without solids sampling and analysis), the estimates have more often been closer to $3,000 per container level.

19. *Are there any TRU waste characterization requirements in the current program that exceed EPA and NMED requirements? If these requirements exist, how much cost is incurred in addressing these requirements?*

Transportation requirements concerning flammable gases are in excess of those required by the EPA and the NMED. Quality assurance requirements in the CBFO Quality Assurance Program Document (QAPD) are applied to waste characterization activities; while the EPA has mandated those in use for those processes related to 40 CFR 191/194, the HWFP only requires that the quality assurance practices in the CBFO QAPD be followed, and there may be a way of altering the QAPD so as to lessen the requirements for non-radioactive waste characterization. However, for a variety of reasons, the EEG believes that a change in the QA requirements would not substantially decrease waste characterization requirements and would likely result in less assurance that the program was in compliance.

20. *What studies and data exist to assess the degree to which cost differences for characterization across different DOE sites are due to differences in productivity, in technology, or in accounting procedures? For example, information given to the committee at Carlsbad, show that the costs of radiographing a drum appear to vary considerably. Why?*

The EEG has no specific information on these cost data.

DOE'S PLAN: A TRANSITION TO A RISK-BASED APPROACH

21. *How does DOE propose to move from the current characterization program to a risk-based approach? Please provide us with the "roadlines" or "roadmaps" planned in working with the regulators*.

The EEG is unaware of any consistent planning related to establishing a "risk-based" approach. The process was originally introduced into HWFP modification requests in 2000; these modifications were inadequate for various reasons, and were rejected or withdrawn. Dr. Moody's presentation at the October 27-28, 2002 Committee meeting indicates that a more thoughtful approach is in the process of development.

22. *If, as was stated by speakers at the Carlsbad meeting, DOE is pursuing a step-by-step approach to changes in characterization and transportation requirements for WIPP wastes, why is that approach being taken instead of proposing changes to EPA and NMED in a single package (i.e., by proposing a new Hazardous Waste Facility Permit and EPA Compliance Certification Application)?*

The WIPP is a pioneering effort and there is often no clearly defined "roadmap" which it can follow. Just as the development of the WIPP so far has been primarily step-by-step, the EEG believes that the process will likely not be considered acceptable by regulators and the public unless it is presented in smaller, more easily evaluated steps, rather than utilizing the all-at-once method.

23. *What are the advantages and disadvantages of characterizing waste at the WIPP facility?*

The EEG, and others, have provided extensive comments on the DOE proposed permit modifications to allow characterization of waste at WIPP.

RELATIONSHIP BETWEEN RISK AND CHARACTERIZATION ACTIVITIES

24. *Has the linkage between waste characteristics and protection of public health and the environment for wastes disposed of in WIPP been studied? If so, what are the results*?

The EPA requirements are linked to assuring that the long-term performance of the repository will be equal to or better than that modeled from assumptions of radionuclide and other waste characteristics. NMED requirements are based on assuring that environmental risks from VOC emissions are not exceeded and that waste is adequately characterized.

25. *Do worker doses from characterization activities at CH-waste generator sites vary significantly among sites? If so, what site-specific characterization and waste processing*

procedures might account for the differences?

The EEG has no specific information on this topic. Data in DOE reports (e.g. DOE/EH-0660) is not sufficiently detailed to provide this information.

Risk Related To Transportation Mode

26. *What is the linkage between waste characteristics and transportation safety*?

The basis of transportation requirements is to avoid problems from contamination, detonation, criticality and liquid releases during routine transportation and from accidents.

27. *Are there major differences in WIPP waste-characterization shipping requirements between a risk-related approach and the present approach? If so, what are they*?

The EEG believes that all the WIPP waste-characterization shipping requirements have a risk - related purpose and are reasonable. The fact that risks to the public, to workers, and to the environment are not easily quantified does not mean that requirements for a stable waste form and robust container are not risk-based.

28. *Would rail shipments of TRU waste to WIPP from the generator sites result in less overall risk--radiation-related and conventional shipping risks--than truck risks*?

The EEG currently does not have a position on this issue. However preliminary studies by others suggest there may be slightly less risk from rail shipments.

29. *Please describe the status of DOE's investigation of hydrogen "getters."*

While the EEG does not have the most current information on the DOE's investigations, it may be worth noting that Chapter 4, Containment Review, of NUREG 1609, *Standard Review Plan for Transportation Packages for Radioactive Material*, (Section 4.5.2.3) Combustible-Gas Generation states: "Confirm that the application demonstrates that any combustible gases generated in the package during a period of one year do not exceed 5% (by volume) of the free gas volume in any confined region of the package. No credit should be taken for getters, catalysts, or other recombination devices." Thus, it would appear that the NRC has strong reservations about using "getters" as credit for meeting the safety envelope for nuclear waste transportation packaging such as the TRUPACT-II.

One DOE view of getters can be found in the *Hydrogen Gas Generation Workshop Minutes* (WMTS-RPT-038, Rev 0). This workshop was conducted in Albuquerque by the DOE-AL National Transportation Program on January 26-27, 2000, "...to discuss a broad spectrum of

hydrogen gas concentration issues and the research that is being conducted to mitigate concerns."(p. 1). One presenter at the workshop was Mike Wangler, of DOE-HQ's Office of Safety, Health, and Security (EM-5). A portion of Section 2.8.1 of the Minutes states (p. 13): Mr. Wangler was asked his perspective of using getters. His response was that he took a dim view of their use, but his organization has not been requested to review their use in certified packages. Getters are viewed essentially as filters and 10 CFR 71 specifically excludes the use of filters. If an application is submitted that includes the use of getters it must have a very thorough justification. Weapons Surety Division (WSD) representatives concurred with Mr. Wangler." This interpretation may have been based on a confusion of the sense of "getters as chemical filters" with "filters between the contained area and the environment", but other interpretations are also possible.

30. *How does the double containment provision affect safety*?

EEG presented its views on double containment to the committee in October 2002. We favor double containment because it should significantly decrease the likelihood of a radionuclide release in the event of a severe accident and will slightly decrease radiation doses during routine operation to truck drivers, workers, and the public along the route because of the additional shielding of gamma radiation provided by the second containment vessel. There is a weight penalty from double containment but most WIPP shipments are not weight limited and there are no known studies that have quantified the cost of this weight penalty.

QUESTIONS FOR NMED

(EPA, DOE, and members of the public are also invited to comment)

31. *Does NMED consider costs in its requirements for waste characterization? If not, is NMED constrained from doing so under the provisions of RCRA?*

We will defer to NMED on this question.

32. *How does NMED interpret the "representative sample" language in the RCRA requirements*?

A representative sample reflects the average properties of the universe from which it is obtained, according to EPA-530-R-94-024, *Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Waste*, Section 2-3. However, the WIPP HWFP promulgated by the NMED has been written to take into account that the DOE is not able to provide adequate documentation that containers are from the same "universe".

QUESTIONS FOR EPA

(NMED, DOE, and members of the public are also invited to comment)

33. *Please delineate responsibilities for characterization of TRU waste of EPA Region VI vs.*

EPA HQ.

We will defer to EPA on this question.

34. *Has EPA used a risk-based approach to establish characterization requirements? If so, are such analyses available? If not, what bases were used to establish requirements?*

The EPA has not established waste characterization requirements--the DOE has established them, the EPA has approved of them. The EPA obviously places constraints on what is acceptable for those characterizations related to long-term disposal at the WIPP; however, the DOE creates and administers the requirements.

QUESTIONS FOR MEMBERS OF THE PUBLIC

(Regulators and DOE are also invited to comment)

35. *What is your assessment of the characterization program? What are your major concerns about current WIPP operations? Please suggest how these concerns may be addressed by DOE. Are there any changes you would like to see implemented?*

The EEG has observed and participated in the development of the current waste characterization program over many years, and believes that the current process has created an effective process for ensuring that the safety, health, and environment in New Mexico will be minimally affected by wastes stored and disposed at the WIPP. However, a current EEG concern (that arose from problems at INEEL) is whether the free liquid limit (less than 1% by volume) will always be met in waste sludges.

36. *Is the public health and environment currently being adversely affected by WIPP operations? Will it be in the future? If so, please indicate what issues DOE should address*.

EEG does not believe that current WIPP operations are adversely affecting the public health and environment and are unlikely to do so in the future. Potential health and safety issues involving workers are more likely and are the primary focus of those requirements addressing waste stability.

37. *What criteria should the committee use in reviewing the current program? By what criteria should the committee judge whether suggested changes improve the program*?

The primary concern is whether the requirements are necessary to insure a stable waste form and provide the quantitative data necessary to ensure operational and long-term control requirements of the permits. Of course, mandatory requirements of regulations must be met, but many of the current requirements involve regulatory discretion.

38. *What parts of the characterization program do you see as essential*?

(1) Measurement of radionuclides in containers by EPA-approved radiation measurement devices. (2) Assurance of a stable waste form. (3) Adequate HW characterization to ensure VOC Room Based Concentration Limits and flammable gas concentration limits are met.

39. *The cost of characterizing the TRU waste for the non radiological RCRA constituents to have zero releases for 30 years post closure is alleged by DOE to cost billions, whereas the costs for characterizing the radiological constituents to limit releases for 10,000 years is small: Some people also contend that protecting against post-closure release of the radiological constituents will also protect against the release of RCRA constituents. Do you agree with these points? If not, please explain how your views differ.*

The question of what happens after the repository is closed is only part of the concern related to waste characterization. Will shipment of the waste be safe? Will worker and public safety and health, and the environment, be maintained during WIPP operations? Or will the WIPP site become another on of the AEA/ERDA/DOE sites, all of which have significant radiological and/or non-radiological pollution problems?

The EEG agrees that the hazard of the radiological constituents is much greater than the RCRA constituents (EEG-72 estimated about 10,000 times as great) and that the cost of RCRA waste characterization is substantial. However, it needs to be recognized that many of the waste characterization requirements of the Hazardous Waste Facility Permit are also of benefit to radiological and transportation requirements. These include acceptable knowledge, radiography, visual examination, waste form stability, and flammable gas requirements. We believe that post-closure control for radionuclides should adequately control long-term problems from RCRA constituents. During the operational period however, the VOC emission limitation must be controlled via VOC measurements.

40. *Should the regulatory agencies remove requirements that do not protect public health or the environment, if any such requirements are conclusively identified and agencies have the authority under law to remove them*?

Yes, as long as the requirements are "conclusively identified" and workers are also adequately protected. However, a number of the requirements do have a H & S basis, but are not subject to quantification. Such requirements require a common sense balancing of costs vs. possible benefit. There are two approaches that should be used for other requirements: (1) is the data obtained used for any purpose of control or compliance; and (2) are the present sensitivity, sampling (e.g. 100%), and accuracy requirements necessary to obtain the data needed.

EEG RESPONSE TO NAS WIPP COMMITTEE
QUESTIONS FOR MAY 19, 2003 MEETING

The EEG has made three presentations and submitted two written statements to the current Committee on a number of aspects of the CH-TRU waste characterization issue (EEG statements and comments are available on the EEG webpage at: http://www.eeg.org/EEGsite.nsf/Statements?OpenPage). A number of our statements, as well as our general philosophy, relate to the latest questions. Therefore, most of our responses to the questions will be briefly summarized.

The general philosophy that we apply to evaluations of all waste characterization issues was stated in our October 29, 2002 statement to the Committee:

(1) We believe overall waste characterization requirements are excessive. However, any proposed relaxation needs to be evaluated in sufficient detail to convince regulators, EEG, and stakeholders that the modification is justified.

Implicit in this statement is the belief that any changes need to be made in a step-by-step approach and through existing regulatory procedures of NMED, EPA, and NRC. This approach requires adequate justification and has worked effectively to get approval for a number of changes from all three regulators.

Our conclusions on individual waste characterization requirements are based on health and safety, and environmental considerations. We do not presume to speak for the regulators in offering opinions of legal and regulatory requirements.

(2) Since EEG has concluded that the radiological risk is about 10,000 times that of the hazardous waste risk we concentrate on those waste characterization requirements that affect the transuranic waste during our health and safety evaluations.

However, it needs to be kept in mind that a number of the requirements in the Hazardous Waste Facility Permit (HWFP) have a role in ensuring that radiological and transportation requirements are met. For example, there are requirements that ensure a stable waste form (minimal residual liquids and limits on sealed containers, no pyrophoric radioactive materials, no incompatible chemical materials, no explosives, no corrosives, and no compressed gases). Also: (a) EPA requirements for cellulosics, plastics, and rubber are determined from Real Time Radiography or visual examination, (b) HSG data are useful for ensuring that flammable gas limits are not exceeded, and (c) acceptable knowledge is necessary for both transportation and radiological characterization.

(3) The relaxation of audit requirements and QA/QC is not an appropriate way to reduce the regulatory burden.

Question #1: What is the connection between the HSG (Headspace Gas) requirements and protection of public health and the environment?

One purpose of HSG measurements is to ensure that the room-based concentration limits (RBCLs) of volatile organic compounds (which were set to control the risk to off-site individuals during operation)

are not exceeded. RBCLs can be controlled either by appropriate (not necessarily 100%) HSG sampling of individual containers or by the confirmatory VOC monitoring plan at WIPP.

A comprehensive HSG sampling program is also the most direct means of ensuring compliance with the flammable gas concentration limits for transportation that are included in the TRAMPAC. Although the TRAMPAC does not explicitly require HSG sampling, it will be necessary in some cases to ensure compliance.

HSG sampling is the primary way DOE has chosen to meet the "detailed chemical analysis... of a representative sample of the waste" that is specified in the New Mexico Administrative Code. This information is used (in conjunction with acceptable knowledge) to assign hazardous waste numbers to each waste container. However, EEG is not aware that these hazardous waste numbers are used to exclude waste from WIPP or to otherwise control the hazardous waste. These data probably provide an incidental benefit to confirming AK and ensuring that the various Waste Acceptance Criteria (WAC) requirements that address waste stability are met.

EEG believes that it is desirable to maintain a comprehensive HSG program for WIPP CH-TRU wastes. However, it should be possible to require less than 100% sampling in some cases. This determination needs to be made on small batches or waste streams where there is reason to believe relative uniformity exists. Also, the detailed approach necessary to ensure that representative data is still obtained needs to be justified by a proposed modification request (PMR) to the HWFP in the same manner that existing PMRs are justified.

Question #2: With respect to the AMWTF (Advanced Mixed Waste Treatment Facility): Why is HSG sampling necessary after contents have been repackaged with all prohibited items removed and the super compaction has occurred? Is there going to be any headspace gas left?

Prohibited items do not necessarily contain the VOCs that are analyzed for. Also, even if all headspace gas were to escape at the time of compaction, any VOCs present in the waste would continue to emanate and become HSG in the 100 gallon drum and be evaluated when the HSG is sampled after the DAC (Drum Age Criteria) has been satisfied. So, there is as much reason to take HSG samples from AMWTF waste after compaction as there is for other wastes.

Question #3: Is it possible to have a modified set of HWFP characterization requirements for the AMWTF, given the differences in the characterization plans?

It is possible that some modifications to the current waste characterization requirements could be justified for the AMWTF. Changes should be proposed through the current regulatory procedures with sufficient justification.

It should be noted that there are several different treatment processes at the AMWTF. Figure 1 of BNFL-5232-RPT-TRUW-02 estimates that 30% of the waste will be non debris waste (organic and inorganic sludges) which will be shipped directly with no treatment other than repackaging. Fifty-two percent of the waste is expected to be boxes which will be opened, sorted, repackaged into 55-gallon drums and compacted into pucks to be placed in 100-gallon puck drums. About 14% of waste will be in 55-gallon drums that will be compacted without visual examination. Another 4% of the waste is

expected to be in 55-gallon drums that will be visually inspected, sorted and repackaged before compaction. It is apparent that these different process flows would have to be considered separately when proposing modifications to waste characterization requirements.

A fourth question was also asked about the HWFP in general: "We have a collage of characterization requirements that was posted up over two decades. We now have some experience (although not always representative of future scenarios), both in operations and regulation. How do we codify to only what is necessary and sufficient (which would include a safety margin) for both public health and worker exposure?"

We believe modifying the HWFP is best done in the future as it is being done now; i.e. by step-by-step PMRs with adequate justification. The question correctly recognizes that there needs to be a safety margin and that future scenarios (specifically, much different waste streams) need to be kept in mind.

APPENDIX B

LIST OF EEG REPORTS

LIST OF EEG REPORTS

EEG-1 Goad, Donna, A Compilation of Site Selection Criteria Considerations and Concerns Appearing in the Literature on the Deep Disposal of Radioactive Wastes, June 1979.

EEG-2 Review Comments on Geological Characterization Report, Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico SAND 78-1596, Volume I and II, December 1978.

EEG-3 Neill, Robert H., et al., (eds.) Radiological Health Review of the Draft Environmental Impact Statement (DOE/EIS-0026-D) Waste Isolation Pilot Plant, U.S. Department of Energy, August 1979.

EEG-4 Little, Marshall S., Review Comments on the Report of the Steering Committee on Waste Acceptance Criteria for the Waste Isolation Pilot Plant, February 1980.

EEG-5 Channell, James K., Calculated Radiation Doses From Deposition of Material Released in Hypothetical Transportation Accidents Involving WIPP-Related Radioactive Wastes, October 1980.

EEG-6 Geotechnical Considerations for Radiological Hazard Assessment of WIPP. A Report of a Meeting Held on January 17-18, 1980, April 1980.

EEG-7 Chaturvedi, Lokesh, WIPP Site and Vicinity Geological Field Trip. A Report of a Field Trip to the Proposed Waste Isolation Pilot Plant Project in Southeastern New Mexico, June 16 to 18, 1980, October 1980.

EEG-8 Wofsy, Carla, The Significance of Certain Rustler Aquifer Parameters for Predicting Long-Term Radiation Doses from WIPP, September 1980.

EEG-9 Spiegler, Peter, An Approach to Calculating Upper Bounds on Maximum Individual Doses From the Use of Contaminated Well Water Following a WIPP Repository Breach, September 1981.

EEG-10 Radiological Health Review of the Final Environmental Impact Statement (DOE/EIS-0026) Waste Isolation Pilot Plant, U. S. Department of Energy, January 1981.

EEG-11 Channell, James K., Calculated Radiation Doses From Radionuclides Brought to the Surface if Future Drilling Intercepts the WIPP Repository and Pressurized Brine, January 1982.

EEG-12 Little, Marshall S., Potential Release Scenario and Radiological Consequence Evaluation of Mineral Resources at WIPP, May 1982.

EEG-13 Spiegler, Peter, Analysis of the Potential Formation of a Breccia Chimney Beneath the WIPP Repository, May, 1982.

EEG-14 Not published.

EEG-15 Bard, Stephen T., Estimated Radiation Doses Resulting if an Exploratory Borehole Penetrates a Pressurized Brine Reservoir Assumed to Exist Below the WIPP Repository Horizon - A Single Hole Scenario, March 1982.

LIST OF EEG REPORTS (continued)

EEG-16 Radionuclide Release, Transport and Consequence Modeling for WIPP. A Report of a Workshop Held on September 16-17, 1981, February 1982.

EEG-17 Spiegler, Peter, Hydrologic Analyses of Two Brine Encounters in the Vicinity of the Waste Isolation Pilot Plant (WIPP) Site, December 1982.

EEG-18 Spiegler, Peter and Dave Updegraff, Origin of the Brines Near WIPP from the Drill Holes ERDA-6 and WIPP-12 Based on Stable Isotope Concentration of Hydrogen and Oxygen, March 1983.

EEG-19 Channell, James K., Review Comments on Environmental Analysis Cost Reduction Proposals (WIPP/DOE-136) July 1982, November 1982.

EEG-20 Baca, Thomas E., An Evaluation of the Non-Radiological Environmental Problems Relating to the WIPP, February 1983.

EEG-21 Faith, Stuart, et al., The Geochemistry of Two Pressurized Brines From the Castile Formation in the Vicinity of the Waste Isolation Pilot Plant (WIPP) Site, April 1983.

EEG-22 EEG Review Comments on the Geotechnical Reports Provided by DOE to EEG Under the Stipulated Agreement Through March 1, 1983, April 1983.

EEG-23 Neill, Robert H., et al., Evaluation of the Suitability of the WIPP Site, May 1983.

EEG-24 Neill, Robert H. and James K. Channell, Potential Problems From Shipment of High-Curie Content Contact-Handled Transuranic (CH-TRU) Waste to WIPP, August 1983.

EEG-25 Chaturvedi, Lokesh, Occurrence of Gases in the Salado Formation, March 1984.

EEG-26 Spiegler, Peter, Proposed Preoperational Environmental Monitoring Program for WIPP, November 1984.

EEG-27 Rehfeldt, Kenneth, Sensitivity Analysis of Solute Transport in Fractures and Determination of Anisotropy Within the Culebra Dolomite, September 1984.

EEG-28 Knowles, H. B., Radiation Shielding in the Hot Cell Facility at the Waste Isolation Pilot Plant: A Review, November 1984.

EEG-29 Little, Marshall S., Evaluation of the Safety Analysis Report for the Waste Isolation Pilot Plant Project, May 1985.

EEG-30 Dougherty, Frank, Tenera Corporation, Evaluation of the Waste Isolation Pilot Plant Classification of Systems, Structures and Components, July 1985.

EEG-31 Ramey, Dan, Chemistry of the Rustler Fluids, July 1985.

EEG-32 Chaturvedi, Lokesh and James K. Channell, The Rustler Formation as a Transport Medium for Contaminated Groundwater, December 1985.

LIST OF EEG REPORTS (continued)

EEG-33 Channell, James K., et al., Adequacy of TRUPACT-I Design for Transporting Contact-Handled Transuranic Wastes to WIPP, June 1986.

EEG-34 Chaturvedi, Lokesh, (ed.), The Rustler Formation at the WIPP Site, February 1987.

EEG-35 Chapman, Jenny B., Stable Isotopes in Southeastern New Mexico Groundwater: Implications for Dating Recharge in the WIPP Area, October 1986.

EEG-36 Lowenstein, Tim K., Post Burial Alteration of the Permian Rustler Formation Evaporites, WIPP Site, New Mexico, April 1987.

EEG-37 Rodgers, John C., Exhaust Stack Monitoring Issues at the Waste Isolation Pilot Plant, November 1987.

EEG-38 Rodgers, John C. and Jim W. Kenney, A Critical Assessment of Continuous Air Monitoring Systems at the Waste Isolation Pilot Plant, March 1988.

EEG-39 Chapman, Jenny B., Chemical and Radiochemical Characteristics of Groundwater in the Culebra Dolomite, Southeastern New Mexico, March 1988.

EEG-40 Review of the Final Safety Analyses Report (Draft), DOE Waste Isolation Pilot Plant, December 1988, May 1989.

EEG-41 Review of the Draft Supplement Environmental Impact Statement, DOE Waste Isolation Pilot Plant, July 1989.

EEG-42 Chaturvedi, Lokesh, Evaluation of the DOE Plans for Radioactive Experiments and Operational Demonstration at WIPP, September 1989.

EEG-43 Kenney, Jim W., et al., Preoperational Radiation Surveillance of the WIPP Project by EEG 1985-1988, January 1990.

EEG-44 Greenfield, Moses A., Probabilities of a Catastrophic Waste Hoist Accident at the Waste Isolation Pilot Plant, January 1990.

EEG-45 Silva, Matthew K., Preliminary Investigation into the Explosion Potential of Volatile Organic Compounds in WIPP CH-TRU Waste, June 1990.

EEG-46 Gallegos, Anthony F. and James K. Channell, Risk Analysis of the Transport of Contact Handled Transuranic (CH-TRU) Wastes to WIPP Along Selected Highway Routes in New Mexico Using RADTRAN IV, August 1990.

EEG-47 Kenney, Jim W. and Sally C. Ballard, Preoperational Radiation Surveillance of the WIPP Project by EEG During 1989, December 1990.

EEG-48 Silva, Matthew, An Assessment of the Flammability and Explosion Potential of Transuranic Waste, June 1991.

LIST OF EEG REPORTS (continued)

EEG-49 Kenney, Jim, Preoperational Radiation Surveillance of the WIPP Project by EEG During 1990, November 1991.

EEG-50 Silva, Matthew K. and James K. Channell, Implications of Oil and Gas Leases at the WIPP on Compliance with EPA TRU Waste Disposal Standards, June 1992.

EEG-51 Kenney, Jim W., Preoperational Radiation Surveillance of the WIPP Project by EEG During 1991, October 1992.

EEG-52 Bartlett, William T., An Evaluation of Air Effluent and Workplace Radioactivity Monitoring at the Waste Isolation Pilot Plant, February 1993.

EEG-53 Greenfield, Moses A. and Thomas J. Sargent, A Probabilistic Analysis of a Catastrophic Transuranic Waste Hoist Accident at the WIPP, June 1993.

EEG-54 Kenney, Jim W., Preoperational Radiation Surveillance of the WIPP Project by EEG During 1992, February 1994.

EEG-55 Silva, Matthew K., Implications of the Presence of Petroleum Resources on the Integrity of the WIPP, June 1994.

EEG-56 Silva, Matthew K. and Robert H. Neill, Unresolved Issues for the Disposal of Remote-Handled Transuranic Waste in the Waste isolation Pilot Plant, September 1994.

EEG-57 Lee, William W.-L, Lokesh Chaturvedi, Matthew K. Silva, Ruth Weiner, and Robert H. Neill, An Appraisal of the 1992 Preliminary Performance Assessment for the Waste Isolation Pilot Plant, September 1994.

EEG-58 Kenney, Jim W., Paula S. Downes, Donald H. Gray, and Sally C. Ballard, Radionuclide Baseline in Soil Near Project Gnome and the Waste Isolation Pilot Plant, June 1995.

EEG-59 Greenfield, Moses A. and Thomas J. Sargent, An Analysis of the Annual Probability of Failure of the Waste Hoist Brake System at the Waste Isolation Pilot Plant (WIPP), November 1995.

EEG-60 Bartlett, William T. and Ben A. Walker, The Influence of Salt Aerosol on Alpha Radiation Detection by WIPP Continuous Air Monitors, January 1996.

EEG-61 Neill, Robert, Lokesh Chaturvedi, William W.-L. Lee, Thomas M. Clemo, Matthew K. Silva, Jim W. Kenney, William T. Bartlett, and Ben A. Walker, Review of the WIPP Draft Application to Show Compliance with EPA Transuranic Waste Disposal Standards, March 1996.

EEG-62 Silva, Matthew K., Fluid Injection for Salt Water Disposal and Enhanced Oil Recovery as a Potential Problem for the WIPP: Proceedings of a June 1995 Workshop and Analysis, August 1996.

EEG-63 Maleki, Hamid and Lokesh Chaturvedi, Stability Evaluation of the Panel 1 Rooms and the E140 Drift at WIPP, August 1996.

LIST OF EEG REPORTS (continued)

EEG-64 Neill, Robert H., James K. Channell, Peter Spiegler, and Lokesh Chaturvedi, Review of the Draft Supplement to the WIPP Environmental Impact Statement, DOE/EIS-0026-S-2, April 1997.

EEG-65 Greenfield, Moses A. and Thomas J. Sargent, Probability of Failure of the Waste Hoist Brake System at the Waste Isolation Pilot Plant (WIPP), January 1998.

EEG-66 Channell, James K. and Robert H. Neill, Individual Radiation Doses From Transuranic Waste Brought to the Surface by Human Intrusion at the WIPP, February 1998.

EEG-67 Kenney, Jim W., Donald H. Gray, and Sally C. Ballard, Preoperational Radiation Surveillance of the WIPP Project by EEG During 1993 Though 1995, March 1998.

EEG-68 Neill, Robert H., Lokesh Chaturvedi, Dale F. Rucker, Matthew K. Silva, Ben A. Walker, James K. Channell, and Thomas M. Clemo, Evaluation of the WIPP Project's Compliance with the EPA Radiation Protection Standards for Disposal of Transuranic Waste, March 1998.

EEG-69 Rucker, Dale, Sensitivity Analysis of Performance Parameters Used In Modeling the Waste Isolation Pilot Plant, April 1998.

EEG-70 Bartlett, William T. and Jim W. Kenney, EEG Observations of the March 1998 WIPP Operational Readiness Review Audit, April 1998.

EEG-71 Maleki, Hamid, Mine Stability Evaluation of Panel 1 During Waste Emplacement Operations at WIPP, July 1998.

EEG-72 Channell, James K. and Robert H. Neill, A Comparison of the Risks From the Hazardous Waste and Radioactive Waste Portions of the WIPP Inventory, July 1999.

EEG-73 Kenney, Jim W., Donald H. Gray, Sally C. Ballard, and Lokesh Chaturvedi, Preoperational Radiation Surveillance of the WIPP Project by EEG from 1996 - 1998, October 1999.

EEG-74 Greenfield, Moses A. and Thomas J. Sargent, Probability of Failure of the TRUDOCK Crane System at the Waste Isolation Pilot Plant (WIPP), April 2000.

EEG-75 Channell, James K. and Ben A. Walker, Evaluation of Risks and Waste Characterization Requirements for the Transuranic Waste Emplaced in WIPP During 1999, May 2000.

EEG-76 Rucker, Dale F., Air Dispersion Modeling at the Waste Isolation Pilot Plant, August 2000.

EEG-77 Oversby, Virginia M., Plutonium Chemistry Under Conditions Relevant for WIPP Performance Assess, Review of Experimental Results and Recommendations for Future Work, September 2000.

EEG-78 Rucker, Dale F., Probabilistic Safety Assessment of Operational Accidents at the Waste Isolation Pilot Plant, September 2000.

EEG-79 Gray, Donald H., Jim W. Kenney, and Sally C. Ballard, Operational Radiation Surveillance of the WIPP Project by EEG During 1999, September 2000.

LIST OF EEG REPORTS (continued)

EEG-80 Kenney, Jim W., Recommendations to Address Air Sampling Issues at WIPP, January 2001.

EEG-81 Gray, Donald H. and Sally C. Ballard, EEG Operational Radiation Surveillance of the WIPP Project During 2000, October 2001.

EEG-82 Allen, Lawrence E., Matthew K. Silva, James K. Channell, John F. Abel, and Dudley R. Morgan, Evaluation of Proposed Panel Closure Modifications at WIPP, December 2001.

EEG-83 Allen, Lawrence E., Matthew K. Silva, and James K. Channell, Identification of Issues Relevant to the First Recertification of WIPP, September 2002.

EEG-84 Gray, Donald H., Sally C. Ballard, and James K. Channell, EEG Operational Radiation Surveillance of the WIPP Project During 2001, December 2002.

EEG-85 Allen, Lawrence E and James K. Channell, Analysis of Emplaced Waste Data and Implications of Non-Random Emplacement for Performance Assessment for the WIPP, May 2003.

EEG-86 Silva, Matthew K., James K. Channell, Ben A. Walker, and George Anastas, Contact Handled Transuranic Waste Characterization Requirements at the Waste Isolation Pilot Plant, September 2003.