Report of the Review Panel

Desirability of performing certain transuranic waste characterization tests

Institute for Regulatory Science

DISCLAIMER

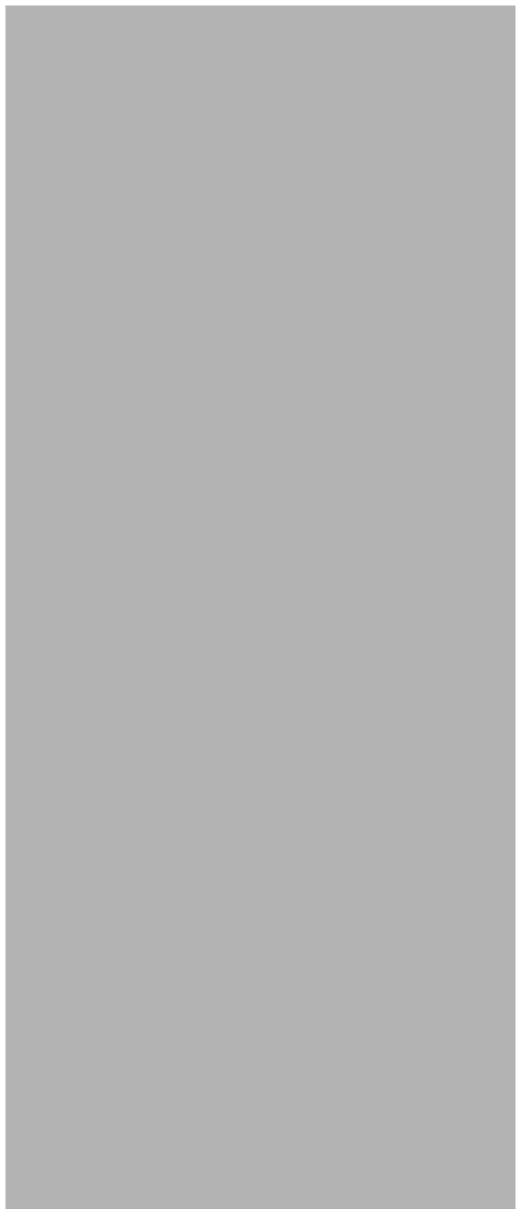
This report was prepared through the efforts of the Institute for Regulatory Science (RSI). Neither the RSI nor the Sponsor, or others involved in the preparation or review of this report nor any of their respective employees, members, or persons acting on their behalf, make any warranty, expressed or implied, or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represent that its uses would not infringe privately-owned rights.

Information contained in this work has been obtained by the RSI from sources believed to be reliable. However, neither RSI nor its reviewers, authors, or editors guarantee the accuracy or completeness of any information published in this report. Neither RSI nor its reviewers, authors, and editors shall be responsible for any errors, omissions, or damages arising out of the use of this information. The work is published with the understanding that RSI and its reviewers, authors, and editors are supplying information but are not attempting to render scientific, engineering, or other professional services. If such scientific, engineering, or professional services are required, the assistance of an appropriate professional should be sought.

Requests for permission to reproduce this document should be addressed to the RSI.

TABLE OF CONTENTS

Preface



This report contains the results of an independent peer review performed by the Institute for Regulatory Science (RSI). Based on a request from Bob Forrest, Mayor of Carlsbad, NM, a Review Panel (RP) was established to independently review the desirability of eliminating certain tests performed for characterization of hazardous waste constituents of transuranic waste. This request was precipitated by an anticipated action of the U.S. Senate mandating the elimination of these tests.

Most of the activities performed by RSI are in cooperation with certain professional societies. Consequently, detailed policies and procedures have been developed and implemented for performing independent peer review and assessment studies. The process requires the formation of a group consisting of individuals with appropriate education, experience, and peer recognition, that oversees the process. Consistent with these requirements, a Commission on Assessments and Reviews (CAR) has been formed. One of the primary tasks of CAR is to approve the qualifications of members of the RP for a specific peer review or assessment and ensure implementation of policies related to conflict of interest.

The members of the CAR are as follows:

Melvin W. Carter, Chair
Erich W. Bretthauer
Ernest L. Daman
Nathan H. Hurt
Peter Maggiore
Lawrence C. Mohr, Jr.
John E. Moore
Goetz K. Oertel
Harold W. Olsen
Charles O. Velzy
Roger P. Whitfield
Richard Wilson

The Principal Technical Secretary of the Peer Review Program at RSI prepared a list of potential members of the RP and provided it to the CAR for review and approval. This list was modified based on the comments of the CAR. Members of the RP approved by the CAR are as follows:

Goetz K. Oertel, Chair
Bruce M. Thomson, Vice Chair
Alan S. Corson
Robert E. Luna
Fritz A. Seiler

In addition, Peter Maggiore was a consultant to the Panel. The supporting staff of the assessment study for this report are as follows:

Betty R. Love: Executive Vice President, RSI; and Administrative Manager of the Peer Review Program.

Sorin R. Straja: Vice President for Science and Technology, RSI; and Principal Technical Secretary.

Michael C. Kirkland: Vice President Southeast Office, RSI, Aiken, SC.

Wren Prather-Stroud: Manager Western Office, RSI, Carlsbad, NM.

Sharon Jones: Director of Training Programs, RSI; Manager of Review Panel Operations.

The biographical summaries of the members of the RP, the CAR, and the technical staff are located at the end of this report.

The letter from Mayor Forrest (see Appendix 1) included three specific questions (review criteria) which were provided to the RP. The Mayor also asked for the principal conclusions of the RP to be available within a rather short time period. Consistent with RSI policy, the RP was instructed to limit its findings and recommendations to technical issues and avoid social; political; and other non-technical considerations.

In preparation for the review, the RSI staff undertook a concerted effort to gather relevant information from a variety of sources as quickly as possible. Primary sources of information included two reports of the National Research Council (NRC 2001, 2002), the research arm of the National Academy of Sciences; the National Academy of Engineering; and the Institute of Medicine. Dr. Matthew Silva, Director of Environmental Evaluation Group, was asked to provide relevant publications.

Several parts of this *Report of the Review Panel* were prepared by the staff of RSI. The *Process for Independent Peer Review and Independent Technical Assessment* describes various aspects of the process used to produce this report. The two subsequent sections—*Waste Isolation Pilot Plant Facility* and *RCRA Waste Characterization*—were prepared by the staff of RSI from peer-reviewed literature. The two other sections—*Legal Requirements* and the text of *U.S. Senate Report and Bill S. 1424*—are reproduced from official documents. Biographical summaries of participants in this peer review were prepared by the staff of RSI and approved by the relevant individuals.

Based on the desire of Mayor Forrest, the RP provided its principal conclusions in a letter (Appendix 2). Subsequently, the *Report of the Review Panel* was completed by the RP and underwent the customary copy editing.

This peer review was performed as a public service with no external funding. The completion of this report could not have been possible without the support of a number of individuals. We greatly appreciate the contribution of members of the CAR and the RP during various phases of preparation of this report.

Goetz Oertel, Chair of the Review Panel
A. Alan Moghissi, President, RSI

Appendix 1

CARLSBAD

Post Office Box 1569
Carlsbad, NM 88221-1569
(505) 887-1191
1-800-658-2713

BOB FORREST
Mayor

JON R. TULLY
City Administrator

August 12, 2003

A. Alan Moghissi, Ph.D.
President, Institute for Regulatory Science
5457 Twin Knolls Road, Suite 200
Columbia, MD 21045

Dear Dr. Moghissi:

This letter is to confirm our recent discussion of an issue of prime importance to the remediation of the nation's transuranic waste sites. I hereby request that the institute for Regulatory Science perform an independent peer review based on the following criteria:

1. Is the elimination of the waste confirmation requirements mentioned in U.S. Senate Report 108-105 and Bill S.1424 supported by the recommendations of the National Research Council Report "Improving Operations and Long-Term Safety of the Waste Isolation Pilot Plant?"

2. Is the elimination of the waste confirmation requirements mentioned in U.S. Senate Report 108-105 and Bill S.1424 supported by various statements and other publications of the New Mexico Environmental Evaluation Group?

3. Based on the information presented to the Review Panel, is the permit modification listed under Section 310 of U.S. Senate Bill 1424 technically defensible?

COUNCILORS

Ward 1	Ward 2	Ward 3	Ward 4
JIMMIE S. CISNEROS	MANUEL C. ANAYA, JR.	H. CALVIN BOWDITCH	LARRY HENDERSON
PAUL C. AGUILAR	JEFF DIAMOND	JUDI WATERS	ROBERT C. MURRAY II

Since time is of the essence, I would appreciate receiving the principal conclusions of the Review Panel no later than August 22, 2003. The full report could follow at a later date.

Sincerely,

Bob Forrest,
Mayor of Carlsbad, New Mexico

Appendix 2

RSI
Institute For Regulatory Science
5457 Twin Knolls Road, Suite 200, Columbia, MD 21045 USA
Phone: 301-596-1700 Fax: 301-596-1707

August 22, 2003

The Honorable Bob Forrest
Mayor of Carlsbad, NM
P.O. Box 1569
Carlsbad, NM 88221

Dear Mayor Forrest:

Thank you for your letter dated August 12, 2003 confirming our verbal agreement on a peer review to be performed by the Institute for Regulatory Science (RSI). In accordance with your request, RSI sought the assistance of the Commission on Assessment and Reviews (CAR) whose membership consists of 12 highly qualified and distinguished individuals. The biographical summaries of the members of the CAR appear in "*Assessment of Desirability of the Formation of a Center of Excellence on Hazardous Materials Management in Carlsbad, New Mexico.*" Through the efforts of the CAR, a Review Panel (RP) was formed consisting of the following individuals:

Goetz K. Oertel, Ph.D., Chair
Bruce M. Thomson, Ph.D., Vice Chair
Alan S. Corson
Robert E. Luna, Ph.D.
Fritz A. Seiler, Ph.D.

Additionally, Peter Maggiore served as a consultant to the RP.

Enclosed are the principal conclusions of the RP. The *Report of the Review Panel* will be made available to you as soon as it is completed.

Enclosed also for your information are the biographical summaries of the members of the RP and the consultant.

Sincerely,

A. Alan Moghissi, Ph.D.
President

AAM:brl

Enclosures

DESIRABILITY OF PERFORMING CERTAIN TRANSURANIC CHARACTERIZATION TESTS

PRINCIPAL CONCLUSIONS OF THE REVIEW PANEL

The Review Panel (RP) was asked to respond to three review criteria identified by the Mayor of Carlsbad, NM. During its deliberations, the RP limited its responses to the review criteria entirely to scientific and engineering issues and specifically avoided political, societal, and other non-technical considerations.

The RP reviewed the report *Improving operations and long-term safety of the Waste Isolation Pilot Plant* of the National Research Council (NRC)—the research arm of the National Academy of Sciences, National Academy of Engineering, and the Institute of Medicine. In addition, the RP reviewed a number of documents published by the Environmental Evaluation Group (EEG). The RP has concluded its deliberations, and its report is being copyedited. The RP will review the final draft shortly.

The principal conclusions of the RP are as follows:

1. Based on careful evaluation of the NRC report, the RP concludes that the elimination of the waste confirmation requirements mentioned in U.S. Senate Report 108-105 and Bill S.1424 is supported by the NRC.

2. It appears that EEG agrees that the current characterization requirements are excessive. It appears that EEG also agrees that monitoring VOCs in underground disposal rooms is sufficient.

3. Based on the information presented to the RP, the permit modification listed under Section 310 of U.S. Senate Bill 1424 is technically defensible. There is no reason to perform waste confirmation tests that: 1) provide insignificant health and safety benefits to the U.S. population;

and 2) pose serious radiological and occupational health and safety risks for the workers performing these tests.

The RP recommends that the Mayor of Carlsbad make available its report to the U.S. Senate Committee for Energy and Water.

Goetz K. Oertel, Ph.D.	8-22-2003
Chair of the Review Panel	Date

Executive Summary

This report contains the results of an independent peer review performed by the Institute for Regulatory Science (RSI) responding to a request from Bob Forrest, Mayor of Carlsbad, NM to critically review a claim included in a Senate Committee report. The Senate language indicated that the National Academy of Sciences and the Environmental Evaluation Group (EEG) had endorsed the elimination of certain tests currently performed to characterize hazardous waste constituents of transuranic (TRU) waste for disposal at the Waste Isolation Pilot Plant (WIPP). Consistent with the tradition of professional societies, RSI relied upon the Commission on Assessments and Reviews (CAR), a group of individuals with appropriate education, experience, and peer recognition, to oversee the assessment process. The CAR approved the qualifications of members of the Review Panel (RP) to evaluate the desirability of eliminating certain tests performed for characterization of hazardous waste constituents of TRU waste. Consistent with the RSI policy, the RP was instructed to limit its findings and recommendations to technical issues and avoid social, political, and other non-technical considerations.

The RP reviewed two relevant reports of the National Research Council (NRC 2001, 2002)—the research arm of the National Academy of Sciences, National Academy of Engineering, and the Institute of Medicine. In addition, the RP reviewed a number of documents published by the EEG, an independent group associated with New Mexico Institute of Mining and Technology.

As the principal facility for disposal of the nation's TRU waste generated as a result of nuclear weapons research, development, and production, WIPP must comply with relevant requirements of the U.S. Environmental Protection Agency (EPA) and New Mexico Environmental Department. Whereas the EPA regulates certain aspects of the radioactivity content of TRU waste, the New Mexico Environment Department regulates the hazardous waste constituents of TRU waste. In addition, WIPP must comply with relevant transportation regulations. Compliance with these requirements is based on certain characterization tests. In general, waste characterization activities include the following, although not all of these techniques are used on each container:

1. Radiography, which is an x-ray technique to determine physical contents of containers
2. Visual examination of opened containers as an alternative way to determine their physical contents or to verify radiography results
3. Headspace-gas sampling to determine volatile organic compounds (VOCs) content of gases in the void volume of the containers
4. Sampling and analysis of waste forms that are homogeneous and can be representatively sampled to determine concentrations of hazardous waste constituents and toxicity-characteristic contaminants of waste in containers
5. Compilation of acceptable knowledge (AK) documentation into an auditable record, including process knowledge and prior sampling and analysis data
6. Non-destructive assay, typically segmented gamma scans and passive/active neutron interrogation, to quantify radionuclides.

Confirmation that the waste complies with the requirement that it is not ignitable, corrosive, or reactive is accomplished by AK or appropriate tests.

The U.S. Senate Bill S.1424 states that waste confirmation for all waste received for storage and disposal be limited to:

1. confirmation that the waste contains no ignitable, corrosive, or reactive waste through the use of either radiography or visual examination of a statistically representative subpopulation of the waste; and

2. review of the Waste Stream Profile Form to verify that the waste contains no ignitable, corrosive, or reactive waste and that assigned Environmental Protection Agency hazardous waste numbers are allowed for storage and disposal by the WIPP Hazardous Waste Facility Permit.

Furthermore, the U.S. Senate Bill S.1424 states that compliance with the disposal room performance standards of the Waste Analysis Plan shall be demonstrated exclusively by monitoring airborne volatile organic compounds in underground disposal rooms in which waste has been emplaced until panel closure.

The Review Panel (RP) was asked to respond to three review criteria identified by the Mayor of Carlsbad, NM. During its deliberations, the RP limited its responses to the review criteria entirely to scientific and engineering issues and specifically avoided political, societal, and other non-technical considerations.

After careful review of documents provided to the RP and appropriate deliberations, the RP provided three Findings and one Recommendation. The principal conclusions of the RP are as follows:

1. Based on careful evaluation of the two relevant NRC reports, the RP concludes that the elimination of the waste confirmation requirements mentioned in U.S. Senate Report 108-105 and Bill S.1424 is supported by the NRC.

2. It appears that EEG agrees that the current characterization requirements are excessive. It appears that EEG also agrees that monitoring VOCs in underground disposal rooms is sufficient.

3. Based on the information presented to the RP, the permit modification listed under Section 310 of U.S. Senate Bill 1424 is technically defensible. There is no reason to perform waste confirmation tests that: 1) provide insignificant health and safety benefits to the U.S. population; and 2) pose serious radiological and occupational health and safety risks for the workers performing these tests.

The RP recommends that the Mayor of Carlsbad make available its report to the U.S. Senate Committee for Energy and Water.

Peer Review Process

INTRODUCTION

There is a large degree of consensus within the technical community on basic criteria for acceptability of scientific information. However, the implementation of these criteria requires a reasonably detailed process for identification of the status of scientific information and for the establishment of reliability of the information regardless of its status.

The formation of the Institute for Regulatory Science (RSI) was based on the notion that societal decisions must be based on best available science (BAS). The implementation of the BAS concept required a systematic evaluation of various aspects of scientific information. Consequently, a hierarchy of scientific information and classification of scientific information was developed.

CLASSIFICATION OF SCIENTIFIC INFORMATION

The scientific information was classified into six categories as follows (Moghissi 1996):

Category Ia - Scientific Laws: This class consists of information that is clearly and unambiguously accepted by the scientific and engineering community.

Category Ib - Applied Science: This class consists of application of scientific laws to specific areas. Much of the engineering and many other areas of applied sciences such as industry and commerce fall into this class.

Category IIa - Extrapolated Science: Much of the contested areas of science falls into this class. This category is based on extrapolation of scientific laws beyond their accepted applicability.

Category IIb - Technical Judgement: In many cases, little or no scientific or engineering information is available and the decision maker must rely upon the judgement of qualified individuals.

Category IIIa - Speculation: This class is information that is based on speculation.

Category IIIb - Pseudo Science: Sometimes called "junk" science, this class is clearly based on information which contradicts basic scientific principles.

Similarly, the reliability of scientific information was categorized into four groups as follows:

Group I - Personal Opinion: This group is entirely unreliable unless it is based on the third or fourth group in this grouping system.

Group II - Gray Literature: This group consists of government reports, reports by private organizations, and all other information that has not been subjected to independent peer review. The reliability of this group is questionable.

Group III - Peer-Reviewed Information: This group is the most reliable information. It is based on an assessment of the information by those who are peers to the investigators and are independent of those who have a stake in the outcome of the review.

Group IV - Consensus-Processed Information: This group is particularly applicable to Category IIa and Category IIb of the scientific information. It is based on the notion that information falling into those classes is likely to be contested, and as additional knowledge is gained, the contested area may move to Category Ib or even Category Ia of the classification system. However, the collective wisdom of a profession can be used to reach a conclusion which has a high probability to be correct. For example, in a contested area of mechanical engineering, the collective judgement of the mechanical engineers, as represented by the American Society of Mechanical Engineers (ASME), is the most efficient method to reach a consensus on the likely answer.

PEER REVIEW VS TECHNICAL ASSESSMENT

Peer review consists of a critical evaluation of a product consisting of a document, a study, a program, a technology, a strategy, or any other topic by a group of individuals who—by virtue of their education, experience, and acquired knowledge—are qualified to be peers to the author of the subject that is being reviewed. In effect, the peers are asked to judge an existing, and partially or entirely completed activity. In its simplest form, peer review responds positively or negatively to the question: Is the claim of the author valid?

In contrast to peer review, a technical assessment guides the requester to a pathway that leads to a decision. In most cases, technical assessments provide detailed information on how an objective can be achieved. Instead of answering a question positively or negatively, an assessment provides a technical judgement on the approach, direction, and implementation of an issue.

PRINCIPLES OF PEER REVIEW AND TECHNICAL ASSESSMENT

Independent peer review, independent technical assessment, and the consensus process are key ingredients of acceptability of scientific information. A peer is an individual who is able to perform the project—or the segment of the project that is being reviewed—with little or no additional training or learning.

Recognizing that peer review constitutes the core of acceptability of scientific and engineering information, virtually all professional societies of scientists and engineers have instituted formal procedures for peer review for their activities. The peer review program of the RSI was developed as a result of its joint efforts with the ASME. The reports of the peer reviews resulting from this program have been published by ASME/RSI (1997, 1998, 1999, 2000, 2001a, 2001b, 2001c, 2002a, 2002b, 2002c, 2002d, 2002e, 2003a, 2003b) and RSI (1998, 2002, 2003).

The most important requirements for independent peer review or independent technical assessment are as follows:

Principle 1: *The selection of members of the review or assessment panel and the outcome of the review or assessment must result from the consensus of a group rather than the decision of an individual.*

This principle implies that all decisions dealing with selection of reviewers and the review must be made collectively by a group of qualified individuals rather than a single individual. Consequently, the RSI process uses the Commission on Assessment and Reviews (CAR) for the appointment of Panels who in turn perform the assessment or the review. Although individuals are involved in the identification of peer reviewers and their nomination, ultimately CAR makes the final decision. Wherever necessary, the CAR decides to change the makeup of the panels, thus demonstrating the necessary oversight.

Principle 2: *Clear and unambiguous policies must be provided to ensure that conflict of interest is avoided.*

The issue of conflict of interest is normally addressed by having each panel member sign a conflict-of-interest form certifying that the individual has no conflict of interest. However, this approach leaves the judgement entirely to the reviewer.

An independent peer review or independent technical assessment process requires clear policies indicating what constitutes a conflict of interest. The CAR relies upon the general conflict-of-interest policies of professional societies resulting in the policy: *Those who have a stake in the outcome of the review or assessment may not act as panel members or participate in the selection of panel members.*

Principle 3: *The findings and recommendations of the review or assessment panel must address unambiguous and clear questions (sometimes called criteria or lines of inquiry) identified by the sponsoring agency.*

Various terms are used in describing review or assessment criteria. These include criteria, questions, and lines of inquiry. During the evolution of the RSI process, much skepticism resulted from the past practice in which panel members had a free reign in addressing any issue. A properly-managed independent peer review or assessment should be based on clearly-identified criteria. These criteria must be technically reasonable and must respond to the needs of the manager.

Principle 4: *The findings and recommendations responding to the assessment or review criteria must be critical, constructive, professional, and collegial rather than adversarial.*

An important and hereto under-emphasized principle is an appreciation of the reason for peer review or assessment. A peer review or an assessment is intended to assist the managers in their decision process. Therefore, the outcome should be helpful to the decision makers rather than being confrontational.

Principle 5: *The participation of appropriately-selected stakeholders significantly enhances the credibility and acceptability of the results of peer review or assessment study.*

The participation of those who are personally impacted by a decision; those who must deal with it during the course of their occupation; and all others who have an interest in the outcome of the peer review or an assessment is desirable. Experience indicates that a properly-managed program of stakeholder participation can avoid the sometimes disorderly and chaotic conditions that can result from such participation. Also, the experience gained during this program indicates that a properly-designed and properly-conducted review or assessment will enhance the acceptance of the decision.

THE PROCESS

The structure of the peer review or technical assessment process established by RSI consists of a tiered system. The process is overseen by the CAR. The review or assessment of specific topics is performed by Review Panels (RPs) or Assessment Panels (APs).

Commission on Assessments and Reviews

The CAR oversees the peer review and assessment studies. Its members are chosen on the basis of their education, experience, and peer recognition. An attempt is made to ensure that all needed technical competencies and diversity of technical views are represented in the CAR.

As the overseer of the entire process, the CAR enforces all relevant policies, including compliance with professional and ethical requirements. A key function of the CAR is the approval of the appointment of members of RPs or APs for a specific project.

Panels

The review of a project, a document, a technology, or a program is performed by a panel consisting of a small group of highly-knowledgeable individuals. Upon the completion of their task, the panel is disbanded. The selection of panel members is based on the competencies required for the specific assignment. The same process is used for the formation and operation of Assessment Panels. The number of individuals in a panel depends upon the complexity of the subject to be reviewed or assessed. The selection of a panel member is based on the totality of that individual's qualifications. However, there are several generally-recognized and fundamental criteria for assessing qualifications of a panel member as follows:

1. **Education:** A minimum of a B.S. degree and preferably an advanced degree in an engineering or scientific field is required for any candidate.

2. **Experience:** In addition to education, the individual must have significant experience in the area that is being evaluated.

3. **Peer recognition:** Election to office of a professional society; serving on technical committees of scholarly organizations; and similar activities are considered to be a demonstration of peer recognition.

4. **Contributions to the profession:** The contributions to the profession may be demonstrated by publications in peer-reviewed journals. In addition, patents, presentations at meetings where the papers were peer-reviewed, and similar activities are also considered to be contributions to the profession.

5. **Conflict of Interest:** One of the most complex and contested issues is a set of subjects collectively called conflict of interest. The ideal panel member is an individual who is intimately familiar with the subject and yet

has no monetary interest in it. The guiding principle for conflict of interest is as follows:

Those who have a stake in the outcome of the review or assessment may not act as a panel member or participate in the selection of panel members.

Institute for Regulatory Science

RSI is a not-for-profit organization chartered under section 501(c)3 of the Internal Revenue Service. It is dedicated to the idea that societal decisions must be based on the best available scientific and engineering information. According to the RSI mission statement, peer review or assessment is the foundation of the best available scientific and engineering information. Consequently, RSI has promoted peer review or assessment within government and industry as the single most important measure of reliability of scientific and engineering information. In its activities, RSI seeks the cooperation of scholarly organizations. Historically, a large number of RSI activities have been performed in cooperation with professional societies. RSI is located in the Washington, D.C. Metropolitan Area with offices in Carlsbad, NM and Aiken, SC.

Project Summary

WASTE ISOLATION PILOT PLANT FACILITY

INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) is the principal facility for the disposal of the nation's transuranic (TRU) radioactive waste generated as a result of over 50 years of nuclear weapons research, development, and production. The selection of the WIPP site followed a lengthy search and extensive studies for the identification of a site for disposal of TRU wastes (NRC 1983, 1984). These efforts led to the selection of a 41-km^2 (16-mi^2) site, 26 mi (42 km) east of Carlsbad, NM. Following studies conducted during the 1950s of geological formations stable enough to contain wastes for thousands of years, the National Research Council (NRC 1957) identified deep geologic isolation in salt as a most desirable disposal mode for radioactive waste. Experiments conducted on salt mines revealed that there were no technical difficulties with waste disposal in salt (NRC 1984). The Carlsbad site was selected by the U.S. Department of Energy (DOE) because the deep salt beds located there are expected to provide the necessary stability for waste disposal. The site and the region surrounding it had been studied for many years, and mineral exploration of both potash and hydrocarbon deposits provided additional knowledge regarding the geology of the region. The U.S. Geological Survey and other agencies assisted DOE in identifying the New Mexico location for the repository. The salt deposit at this site, known as the Salado Formation, is a minimum of 2,000 ft (610 m) thick and located at a depth of 1,000-2,000 ft (305-610 m).

Salt allows significant deformation without fracturing. The Salado Formation is regionally extensive, and includes continuous beds of salt without complicated structures. The DOE identified the following four advantages of the site:

1. The salt deposit is in a stable geological area with little seismic activity, assuring the stability of a waste repository for thousands of years.
2. Salt deposits indicate the absence of flowing fresh water which could move waste to the surface. Water, if it had been or were present, would have dissolved the salt beds.

3. Salt is relatively easy to mine.
4. Rock salt exhibits a characteristic mechanical behavior (creep) that makes it an excellent host for waste isolation. In response to excavation-induced stress changes, salt slowly flows (or creeps), to close the mined openings. Creep closure starts immediately and continues until the salt has regained its original density and stress distribution. Salt formations tend to slowly and progressively fill mined areas and safely seal radioactive waste from the environment.

Geological data were collected from the WIPP site and surrounding area to evaluate its suitability as a radioactive waste repository. These data were collected principally by the DOE; the DOE's predecessor agencies; the U.S. Geological Survey; the New Mexico Bureau of Mines and Mineral Resources; and private organizations engaged in natural resource exploration and extraction. The DOE analyzed the data and has stated that the site is suitable for long-term isolation of radioactive waste.

The geology of the WIPP site has specific advantages identified by the DOE against potentially adverse environmental impacts. At the depth of the WIPP repository, the salt will slowly encapsulate the buried waste in the stable rock. Salt rock also shields radioactivity, providing a protection similar to that of concrete. Waste placed in the excavation at WIPP is expected to be encapsulated and all waste-filled spaces closed over a period of 75-200 years. The waste disposal depth of 2,150 ft (650 m) is close enough to the surface to make access reasonable.

Subsequent to the investigation of the subsurface geology, the DOE selected the Salado Formation as the site of the WIPP repository for the following reasons:

1. The Salado halite units have low permeability to fluid-flow, which impedes groundwater-flow into and out of the repository.
2. It is regionally widespread.
3. It includes continuous halite beds without complicated structure.
4. It is deep with little potential for dissolution.
5. It is close enough to the surface that access is reasonable.
6. It is largely free of mobile groundwater, as compared to existing mines and other potential repository sites.

Another of the favorable aspects of subsurface geology at the WIPP site is that the groundwater hydrology in the immediate proximity is characterized by geologic strata with low transmissivity and low hydrologic gradients.

WASTE PROCESSING STEPS AT WIPP

The handling and disposal of Contact-Handled (CH) TRU wastes at WIPP involve the following series of steps:

1. A waste shipment arrives at WIPP by truck. Each truck is capable of carrying up to three TRU Packaging Transport Model IIs (TRUPACT-IIs).
2. After an initial security inspection, a radiological survey, and a shipping documentation review, the truck is parked near the Waste Handling Building (WHB) for additional inspection and radiological survey. A forklift is used to transfer each TRUPACT-II from the trailer, through an air lock, and into the WHB, where it is placed in an area called a TRUDOCK, which is used by workers to unload the waste from the TRUPACT-IIs.
3. Radiological surveys are conducted to confirm that waste containers have not sustained damage during shipment or waste container removal.
4. At the TRUDOCK, an overhead crane is used to remove the waste containers from each TRUPACT-II and place them on a facility pallet.
5. A forklift moves the loaded facility pallet to the conveyance loading car at the waste handling shaft. The conveyance loading car is used to load the facility pallet onto the waste hoist.
6. The waste hoist descends 2,150 ft (705 m) to the WIPP repository.
7. An underground transporter pulls the loaded facility pallet off the hoist onto the transporter bed and moves the waste to the appropriate disposal room where a forklift removes the waste containers from the facility pallet and places them in the disposal area. Containers may be stacked three high in the disposal area.
8. Bags of magnesium oxide are placed on top of the stack of containers to serve as backfill. The magnesium oxide will control the solubility of radionuclides and is an added measure of assurance for long-term repository performance.

CONTAINER MANAGEMENT PRACTICES

Containers are to be managed in a specified manner that does not result in spills or leaks. Containers are required to be closed at all times, unless waste is being placed in the container or removed. Because containers at WIPP contain radioactive waste, safety concerns require that containers be continuously vented to obviate the buildup of gases within the container. These gases could result from radiolysis, which is the breakdown of moisture by radiation. The vents are filtered to enable any potential generated gas to escape while particulate matter is retained. Derived waste containers are kept closed at all times unless waste is being added or removed.

Containers with residual liquids

Defense production facilities are prohibited from shipping liquid wastes in the containers sent to the WIPP. In no case is the total residual liquid allowed to equal or exceed 1% (by volume) of the waste container. Consequently, calculations made to determine the secondary containment as required by regulations are based on 10% of 1% of the volume of the containers, or 1% of the largest container, whichever is greater.

Description of containers

Waste containers are to be in good condition prior to shipment from the generator sites, i.e., containers will be of high integrity, intact, and free of surface contamination above established limits. This condition is to be verified upon receipt of the waste at WIPP. Containers are vented through filters, allowing any gases that are generated by radiolytic and microbial processes within a waste container to escape, thereby preventing over-pressurization or development of conditions within the container that would lead to the development of ignitable, corrosive, reactive, or other characteristic wastes.

The volatile organic compounds (VOC) in the headspace of waste containers are limited to maximum allowable VOC room-averaged headspace concentration limits specified in the permit. There are no maximum allowable headspace gas concentration limits for individual containers, as some containers can exceed these values as long as container headspace averages in a disposal room do not.

Containers for CH TRU mixed waste will be either 55-gal (208-L) drums arranged singly in 7-packs; 85-gal (321-L) drums arranged singly in 4-packs; 100-gallon drums arranged singly or as three-packs; ten-drum overpacks (TDOP) either as overpacks or direct-loaded; or standard waste boxes (SWBs). Following is a summary description for each container type.

Standard 55-gallon drums: These drums meet the requirements for U.S. Department of Transportation specification 7A regulations. A standard 55-gal (208-L) drum has a gross internal volume of 7.4 ft^3 (0.208 m^3). One or more filtered vents (as described in Permit Section M1-1d(1)) is to be installed in the drum lid or body to prevent the escape of any radioactive particulate matter and to eliminate any potential for pressurization. Standard 55-gal (208-L) drums are constructed of mild steel and may also contain rigid, molded polyethylene (or other compatible material) liners.

Standard Waste Boxes (SWBs): One or more filtered vents are to be installed in the standard waste box lid or body to prevent the escape of any radioactive particulate matter and to eliminate any potential of pressurization. SWBs have an internal volume of 66.3 ft^3 (1.88 m^3).

One hundred-gallon drums: A 100-gal (379-L) drum has a gross internal volume of 13.4 ft^3 (0.39 m^3). One or more filtered vents are installed in the drum lid or body to prevent the escape of any radioactive particulate matter and to eliminate potential pressurization. These drums are constructed of mild steel and may also contain rigid, molded polyethylene (or other compatible material) liners. These drums may be used as overpacks or may be direct-loaded.

Ten-Drum Overpack: The TDOP is a metal container, similar to a SWB, and is certified to be noncombustible. It is a welded-steel cylinder, approximately 74 in (1.9 m) high and 71 in (1.8 m) in diameter with a gross internal capacity of 160 ft^3. The maximum loaded weight of a TDOP is limited to 6,700 lbs (3,040 kg). A bolted lid on one end is removable; sealing is accomplished by clamping a neoprene gasket between the lid and the body. Filter ports are located near the top of the TDOP. One or more filtered vents are installed in the ten-drum overpack lid or body to prevent the escape of any radioactive particulate matter and to eliminate any potential for pressurization. A TDOP may contain up to ten standard 55-gal (208-L) drums or one SWB. The TDOPs may be used to overpack drums or SWBs containing CH TRU mixed waste. The TDOP may also be direct-loaded with waste items that are too large to fit into the standard 55-gallon (208-L) drum; the 85-gallon drum; or the SWB.

Eighty-five gallon drums: The 85-gal (321-L) drum overpack is to be used primarily for overpacking contaminated 55-gal (208-L) drums at the WIPP facility. The 85-gal (321-L) drums may be direct-loaded with CH TRU-mixed waste and may be used to collect derived waste. One or more filtered vents are to be installed in the 85-gal (321-L) drum lid or body to prevent the escape of any radioactive particulate matter and to eliminate any potential of pressurization.

Container compatibility: All containers are made of steel, and some will contain rigid, molded polyethylene liners. Requirements to conduct compatibility studies include container materials to assure that containers are compatible with the waste.

RCRA WASTE CHARACTERIZATION

INTRODUCTION

There are certain waste characterization requirements for the radioactive content of transuranic (TRU) waste mandated by the U.S. Environmental Protection Agency (EPA). Compliance with characterization requirements of TRU waste for disposal at the Waste Isolation Pilot Plant (WIPP) is accomplished on a waste stream basis (i.e., waste material generated from a single process or activity that is similar in material, physical form, isotropic make-up, and hazardous constituents) and also on a container basis. Defense production facilities assign the waste stream identifier for each container of waste that is shipped. The waste designation is selected from one of three broad categories of solid wastes: Homogenous Solids, Soil/Gravel, and Debris Wastes (NMED 1999). In addition, a number of sub-categories are assigned to the wastes. Characterization and analysis methods vary for each category and subcategory of waste.

The Waste Analysis Plan (WAP), which is part of the Permit (DOE 1997b), describes waste characterization activities that a TRU waste generator/storage site must complete before shipping waste to WIPP for disposal. These activities include test methods; details of planned waste sampling and analysis processes; a description of the waste shipment screening and verification process; and a description of the quality assurance/quality control program. Before WIPP manages, stores, or disposes of Contact-Handled (CH) TRU mixed waste from a generator/storage site, the site is required to characterize waste in accordance with WAP requirements. For each container of waste destined for disposal, defense production facilities provide the WIPP operators with a written characterization summary known as a Waste Stream Profile Form (WSPF).

Waste characterization based on 40 CFR 194

Waste characterization, as mandated by the Resource Conservation and Recovery Act (RCRA); and as described in 40 CFR 194 (EPA 1998) requires that a system be in place to track and control the inventory of waste components to assure that limits associated with the components are not exceeded. The waste components to be tracked and controlled, and the associated limits, are set by a Performance Assessment (PA) conducted by the U.S. Department of Energy (DOE) to show that the WIPP complies with the performance criteria of 40 CFR 191 (EPA 1993). The waste components and the limits, all of which are total inventory limits at repository closure, are presented in the WIPP Compliance Certification Application (CCA).

ORIGIN OF CH TRU WASTE AND ITS ACCEPTANCE CRITERIA AT WIPP

The TRU mixed wastes that are shipped to the WIPP originate at DOE generator/storage sites and contain both radiological and hazardous waste constituents. The DOE and EPA agreed that, of the hundreds of radionuclides present within these wastes, only ten are important for the WIPP performance assessment: ^{241}Am, ^{244}Cm, ^{137}Cs, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{90}Sr, ^{233}U, and ^{234}U. Of these ten, ^{234}Sr, ^{233}U, and ^{137}Cs are important for Remote-Handled (RH) but not for CH waste streams.

Major types of operations generating waste

Examples of the major types of operations that generate this waste include the following:

Production of nuclear products: This category includes reactor operation; radionuclide separation or finishing; and weapons fabrication and manufacturing. The majority of the TRU mixed wastes were generated by weapons fabrication and radionuclide separation or finishing processes. More specifically, wastes resulting from this category consist of residues from chemical processes; air and liquid filtration; casting; machining; cleaning; product quality sampling; analytical activities; and maintenance and refurbishment of equipment and facilities.

Plutonium recovery: These wastes are residues from the recovery of plutonium-contaminated molds; metals; glass; plastics; rags; salts used in electro-refining; precipitates; firebrick; soot; and filters.

Research and development: This group includes a variety of hot-cell or glovebox activities that often simulate full-scale operations described above, producing similar TRU mixed wastes. Other types of R&D projects include metallurgical research; actinide separations; process demonstrations; and chemical and physical properties determinations.

Decontamination and decommissioning: Facilities and equipment that are no longer needed or usable are decontaminated and decommissioned, resulting in TRU mixed wastes consisting of scrap materials; cleaning agents; tools; piping; filters; plexiglass; gloveboxes; concrete rubble; asphalt; cinder blocks; and other building materials. These materials are expected to be the largest category by volume of TRU mixed waste to be generated in the future.

The TRU mixed wastes that are to be shipped to the WIPP facility for disposal have been placed into waste categories based on their physical and chemical properties (Table 1). The waste generating processes can be described in five general categories:

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

2. Wastes generated when materials which contain metals and metal ions believed to exhibit the toxicity characteristic (EPA 1996b) become contaminated with radioactivity as the result of plutonium operations (leaded rubber, some glass, and metal waste are typical examples). These materials may also become contaminated with solvents during decontamination or plutonium recovery activities.

3. A class of plutonium processes where non-metallic objects are used and become contaminated with radioactive materials. These objects

are subsequently cleaned with solvents to recover plutonium. Surfaces of the objects (such as graphite, filters, and glass) are contaminated with both radioactive and hazardous constituents.

4. Waste-generating processes involving foundry operations where impurities are removed from plutonium. These impurities may result in the deposition of toxicity characteristic (EPA 1996b) metals and metal ions.

5. In all of the process waste categories in the second half of Table 1, the hazardous and radioactive constituents are physically mixed together as a result of the treatment process. In these wastes, the release of any portion of the waste matrix will involve both the hazardous and the radioactive waste components, because the treatment process generates a relatively homogeneous waste form.

Table 1. Summary of waste generation processes and waste forms.

Waste Category	Hazardous Waste Codes	Description of Processes	Description of Waste Form
Combustibles	F001, F002, F003, D008, D019	Cloth and paper wipes are used to clean parts and wash down gloveboxes. Wood and plastic parts are removed from gloveboxes after they are cleaned. Lead may occur as shielding tape or as minor noncombustible waste in this category.	Materials such as metals may retain traces of organics left on surfaces that were cleaned. Waste may remain on the cloth and paper that was used for cleaning or for wiping up spills.
Graphite		Graphite molds, which may contain impurities of metals, are scraped and cleaned with solvents to remove the recoverable plutonium.	Surfaces may retain residual solvents. Lead may be used as shielding or may be an impurity in the graphite.
Filters	F001, F002	Filters are used to capture radioactive particulate in air streams associated with numerous plutonium operations and to filter particulate from aqueous streams.	Filter media may retain organic solvents that were present in the air or liquid streams.

Table 1. (cont'd)

Waste Category	Hazardous Waste Codes	Description of Processes	Description of Waste Form
Benelex® and Plexiglas®	F001, F002, D008	Materials are used in gloveboxes as neutron absorbers. The glovebox assembly often includes leaded glass. All surfaces may be wiped down with solvents to remove residual plutonium.	Surfaces may retain residual solvents from wiping operations. Leaded glass may also be present.
Firebrick and Ceramic Crucibles	F001, F002, F005, D006, D007, D008	Firebrick is used to line plutonium processing furnaces. Ceramic crucibles are used in plutonium analytical laboratories. Both may contain metals as surface contaminants.	Metals deposited during plutonium refining or analytical operations could remain as residuals on surfaces. Surfaces may retain residual solvents.
Leaded Rubber	D008	Leaded rubber includes lead oxide impregnated materials such as gloves and aprons.	The leaded rubber could potentially exhibit the toxicity characteristic.
Metal	F001, F002, D008	Metals range from large pieces removed from equipment and structures to nuts, bolts, wire, and small parts. Many times, metal parts will be cleaned with solvents to remove residual plutonium.	Solvents may exist on the surfaces of metal parts. The metals themselves potentially exhibit the toxicity characteristic.
Glass	F001, F002, D006, D007, D008, D009	Glass includes Raschig rings removed from processing tanks, leaded glass removed from gloveboxes, and miscellaneous laboratory glassware.	Solvents may exist as residuals on glass surfaces and in empty containers. The leaded glass may exhibit the toxicity characteristic.
Inorganic Wastewater Treatment Sludge	F001-F003, D006-D009, P015	Sludge is vacuum filtered and stabilized with cement or other appropriate sorbent prior to packaging.	Traces of solvents and heavy metals may be contained in the treated sludge which is in the form of a solid dry monolith, highly viscous gel-like material, or dry crumbly solid.

Table 1. (cont'd)

Waste Category	Hazardous Waste Codes	Description of Processes	Description of Waste Form
Organic Liquid and Sludge	F001, F003	Organic liquids such as oils, solvents, and lathe coolants are immobilized through the use of various solidification agents or sorbent materials.	Solvents and metals may be present within the matrix of the solids created through the immobilization process.
Solidified Liquid	F001, F003, D006, D008	Liquids that are not compatible with the primary treatment processes and have to be batched. Typically these liquids are solidified with portland or magnesium cement.	Solvents and metals may be present within the matrix of the solids created through the immobilization process.
Inorganic Process Solids and Soil	F001, F002, F003, D008	Solids that cannot be reprocessed or process residues from tanks, firebrick fines, ash, grit, salts, metal oxides, and filter sludge. Typically solidified with portland or gypsum-based cements.	Solvents and metals may be present within the matrix of the solids created through the immobilization process.
Pyrochemical Salts	D007	Molten salt is used to purify plutonium and americium. After the radioactive metals are removed, the salt is discarded.	Residual metals may exist in the salt depending on impurities in the feedstock.
Cation and Anion Exchange Resins	D008	Plutonium is sorbed on resins and is eluted and precipitated.	Feed solutions may contain traces of solvents or metals depending on the preceding process.

Categories of TRU mixed waste

TRU mixed wastes from the above operations are listed by defense production facilities as belonging in one of three broad Summary Category Groups. The characterization is based on the final physical form of the wastes as follows:

Summary category group S3000—homogeneous solids: These wastes include a minimum of 50% (by volume) solid inorganic process residues such as inorganic sludge, salt waste, and pyrochemical salt waste—but exclude soil. Other waste streams are included in this Summary Category Group based on the specific waste stream types and final waste form. This Summary Category Group is expected to contain toxic metals and spent solvents.

Summary Category Group S4000—Soils/Gravel: This Category is assigned to waste streams containing at least 50% (by volume) soil and gravel. This Summary Category Group is expected to contain toxic metals and is also further categorized by the amount of debris included in the matrix.

Summary Category Group S5000—Debris Wastes: These are heterogenous wastes that are at least 50% (by volume) materials that exceed 2.36 inch (60 mm) particle size and that are manufactured objects; plant or animal matter; or natural geologic materials. Smaller particles may be considered debris if they are manufactured objects and if they do not belong to S3000 or S4000. Examples of S5000 waste include gloves; hoses; aprons; floor tile; insulation; plastic; rubber; wood; paper; cloth; and biological materials.

The most common RCRA-regulated hazardous constituents in TRU mixed waste

1. **Metals and metal ions:** Some of the TRU mixed waste to be emplaced in the WIPP facility contains toxic metals contained in EPA hazardous waste codes D004 through D011 (EPA 2000). Cadmium, chromium, lead, mercury, selenium, and silver are present in discarded tools and equipment; solidified sludge; cemented laboratory liquids; and waste from decontamination and decommissioning activities. A large percentage of the waste consists of lead-lined gloveboxes; leaded rubber gloves and aprons; lead bricks and piping; lead tape; and other lead items. Lead, because of its radiation-shielding applications, is the most prevalent toxicity-characteristic metal present.

2. **Halogenated volatile organic compounds:** Some of the TRU mixed waste to be emplaced in the WIPP facility contains spent

halogenated volatile organic compound (VOC) solvents listed as EPA hazardous waste numbers F001 through F005 (EPA 2000). Tetrachloroethylene; trichloroethylene; methylene chloride; carbon tetrachloride; 1,1,1-trichloroethane; and 1,1,2-trichloro-1,2,2-trifluoroethane (EPA hazardous waste codes F001 and F002) are the most prevalent halogenated organic compounds identified in TRU mixed waste that may be managed at the WIPP facility during the Disposal Phase. These compounds are commonly used to clean metal surfaces prior to plating, polishing, or fabrication; to dissolve other compounds; or as coolants. Because they are highly volatile, only small amounts typically remain on equipment after cleaning or, in the case of treated wastewater, in the sludge after clarification and flocculation. Radiolysis may also generate halogenated volatile organic compounds.

3. **Non-halogenated volatile organic compounds:** Xylene, methanol, and n-butanol are the most prevalent nonhalogenated VOCs in TRU mixed waste that may be managed at the WIPP facility. Like the halogenated VOCs, they are used as degreasers and solvents and are similarly volatile. The same analytical methods that are used for halogenated VOCs are used to detect the presence of nonhalogenated VOCs.

Prohibited Items

The TRU mixed waste forms describe both radioactive and hazardous characteristics exhibited by the wastes. The Permit Treatment, Storage, and Disposal Facility Waste Acceptance Criteria (TSDF-WAC) places limits on the waste that can be shipped to the WIPP facility based on the characteristics of the waste form. The following TRU mixed wastes are prohibited at the WIPP facility:

1. Liquid waste which includes residual liquid in the container in excess of what is reasonably achievable by pouring, pumping, and/or aspirating; liquid in the internal container in excess of 1 inch (2.5 cm) of liquid in the bottom of the container; or total residual liquid in any payload container (e.g., 55 gallon drum or standard waste box) in excess of 1% (by volume) of that container
2. Pyrophoric materials, such as elemental potassium
3. Hazardous wastes not occurring as co-contaminants with TRU wastes

4. Wastes incompatible with backfill; seal and panel closures materials; container and packaging materials; shipping container materials; or other wastes
5. Wastes containing explosives or compressed gases
6. Wastes with polychlorinated biphenyl (PCB) concentration of 50ppm (50 mg/kg) or more
7. Wastes exhibiting the characteristic of ignitability, corrosivity, or reactivity (EPA Hazardous Waste Numbers D001, D002, or D003)
8. Any waste container that does not have VOC concentration values reported for the headspace
9. Any waste container which has not undergone either radiographic or visual examination
10. Any waste container from a waste stream which has not been preceded by an appropriate, certified Waste Stream Profile Form

Before accepting a container holding TRU mixed waste, WIPP operators audit the radiography or visual examination (VE) data records of the generator/storage sites to verify that the container holds no unvented compressed gas, and that residual liquid does not exceed 1% (volume) in any payload container. Radiography tapes are to be selected randomly for at least 1% of containers received at the WIPP, at which time they are reviewed and compared to radiographic data forms. If waste does not include at least 50% of any given category by volume, characterization shall be performed using the waste characterization process required for the category constituting the greatest volume of waste for that waste stream. To ensure the integrity of the WIPP facility, waste streams identified as containing incompatible materials or materials incompatible with waste containers are not to be shipped to the WIPP unless they are treated to remove the incompatibility.

Waste generated as a result of waste container handling and processing activities at the WIPP facility are known as “derived” wastes. Because derived wastes can contain only those RCRA-regulated materials present in the waste from which they were derived, no additional characterization of the derived waste is required for disposal purposes. In other words, generator/storage site characterization data as well as knowledge of the processes at the WIPP facility will be used to identify and characterize hazardous waste and hazardous constituents in derived waste.

TRU waste, by definition, must contain 100 nCi/g or more of transuranic elements of waste, which means that the radioactive component of the waste will always be present within the waste in significant concentrations. The TSDF-WAC limitations and restrictions are provided to ensure that any waste form received at the WIPP facility is stable and can be managed safely. One benefit of waste form restrictions—such as no liquids—is that they limit the kinds of releases that could occur to those that would be readily detectable through visual inspection (i.e., large objects that fall out of ruptured containers) or through the use of radiation monitoring—either locally or within the adjacent area—to detect materials that have escaped from containers.

Releases and spills

Some waste forms only contain radioactive contamination on the surface, because they are not the result of a treatment process or are not porous in form. These include glass, leaded rubber, metals, graphite, ceramics, firebricks, and plastics. In theory, a hazardous waste release could occur if the interiors of these materials became exposed and were involved in a release or spill. Such an occurrence is not likely during operations, because no activities are planned or anticipated that would result in the breaking of these materials to expose fresh surfaces. The WIPP facility will handle only sealed containers of waste and derived waste. The practice of handling sealed containers minimizes the opportunity for releases or spills. For the purposes of safety analysis, it was assumed that releases and spills during operations occur by either of two mechanisms: 1) surface contamination; and 2) accidents. Regardless of how the release occurs, the nature of the waste and the processes that generated it is such that the radioactive and hazardous components are intimately mixed. A release of one without the other is not likely, except for releases of VOCs from containers. Surface contamination is the only credible source of contamination external to the containers during normal operations. Surface contamination is assumed to be caused by waste management activities at the generator site that result in the contamination of the outside of a waste container. Contamination would most likely consist of particulate matter (dirt or dust) that would be deposited during generator-site handling/loading activities. This contamination may not be detected by visible inspections. Surface contamination is monitored upon arrival at the WIPP facility through the use of swipes and radiation monitoring equipment, as specified in the WIPP Permit (NM Hazardous Waste Regulations, Title 20; NMED 1999). Detection using radioactivity is very sensitive and allows for the detection of contamination that may not be visible on the surface of the container. This exceeds the capability required by the RCRA, which is generally limited to inspections that detect only visible evidence of spills or leaks. Releases can occur from accidents, and those that occur within the waste handling process are assumed to result in the release of radioactive contaminants and VOCs. Radioactive releases are detectable using surface-sampling (swipe) techniques. The most common RCRA-regulated hazardous constituents in TRU mixed waste to be managed at the WIPP facility consist of: metals; halogenated volatile organic compounds; and non-halogenated volatile organic compounds.

WASTE STREAM IDENTIFICATION

Waste characterization activities at generator/storage sites include the following, although not all of these techniques will be used on each container:

1. Radiography, which is an x-ray technique to determine physical contents of containers
2. Visual examination (VE) of opened containers as an alternative way to determine their physical contents or to verify radiography results
3. Headspace-gas sampling to determine VOC content of gases in the void volume of the containers
4. Sampling and analysis of waste forms that are homogeneous and can be representatively sampled to determine concentrations of hazardous waste constituents and toxicity-characteristic contaminants of waste in containers
5. Compilation of acceptable knowledge (AK) documentation into an auditable record, including process knowledge and prior sampling and analysis data
6. Non-destructive assay, typically segmented gamma scans and passive/active neutron interrogation, to quantify radionuclides for 40 CFR 194 waste characterization compliance

Auditable records allow DOE operators to conduct a systematic assessment, analysis, and evaluation of generator/storage site compliance with the WAP and the Permit. Waste analysis parameters to be characterized include confirmation of physical form; presence of toxicity characteristic contaminants; and exclusion of prohibited items. The characterization techniques used by generator/storage sites include AK, which incorporates confirmation by headspace-gas sampling and analysis; radiography; and homogeneous waste sampling and analysis. All confirmation and characterization activities are to be performed in accordance with the WAP. The analytical requirements are specified by the analytical method being used such as Fourier Transform Infrared Spectroscopy, and Gas Chromatography/Mass Spectrometry.

Waste analysis parameters characterized for the 40 CFR 194 (EPA 1998) characterization program are quantity of metals; quantities of cellulosics; plastics; and rubber; quantity of free water; and a list of ten radionuclides. The characterization techniques used by generator/storage sites for these parameters also include AK and radiography as well as non-destructive assay.

Radiography

Radiography techniques have been developed by DOE to aid in the examination and identification of containerized waste. There are specific requirements that relate to radiography methods used at respective facilities. A radiography system typically consists of: 1) an X-ray-producing device; 2) an imaging system; 3) an enclosure for radiation protection; 4) a waste container handling system; 5) an audio/video recording system; and 6) an operator control and data acquisition station.

Although these six components are required, it is expected that there will be some variation within a given system between sites. The radiography of a waste container is recorded by an audio/videotape or equivalently non-alterable media and is maintained as a non-permanent record. The estimated waste material parameter and weights should be determined by compiling an inventory of waste items, residual materials, and packaging materials. Containers whose contents prevent full examination to the extent expected for the radiography technique and waste form, are subject to visual examination.

Visual examination

As an additional quality control (QC) check on radiography, or in lieu of radiography, the waste container contents are verified directly by visual examination. The visual examination consists of a semi-quantitative and/or qualitative evaluation of the waste container contents, and is recorded on audio/videotape. Visual examination is performed on a statistically determined portion of waste containers to verify the results of radiography. This verification includes use of the Waste Matrix Code; waste material parameter weights; and the assurance of the absence of prohibited items.

Visual examination includes describing the contents of a waste container, and estimating or measuring the weight of the contents. The description identifies the discernible waste items, residual materials, packaging materials, and waste material parameters. Estimated weights are established through the use of historically-derived waste weight tables and an estimation of the waste volumes.

Headspace-gas sampling and analysis

Headspace-gas sampling is performed on waste containers that are in compliance with the container temperature equilibrium requirements (i.e., 72 h at 18°C or higher). Waste containers designated as summary category S5000 (Debris waste) are sampled for headspace gas a minimum of 142 d after packaging. Waste containers designated as Summary Categories S3000 (Homogenous solids) and S4000 (Soil/gravel) are sampled a minimum of 225 d after packaging. This drum-age criteria ensures that the drum contents have reached 90% of steady state concentration within each layer of confinement to allow a representative sample to be taken (NMED 1999.) Two types of headspace-gas sampling protocols may be employed: 1) the manifold headspace-gas sampling protocol, and 2) the direct canister headspace-gas sampling protocol.

Once the headspace gas sample has been collected in accordance with the Hazardous Waste Facility Permit (HWFP) requirements, the sample is taken to a laboratory for analysis. The laboratory analyzes the sample using the allowable methods in the HWFP and reports the concentration of all analytes on the target analyte list. In addition, the presence of any tentatively identified compounds (TICs) observed during the analysis is reported.

Sampling and analysis of homogenous solids and soil/gravel

The methods used to collect samples of TRU mixed waste classified as homogenous solids and soil/gravel from waste containers, are designed to ensure that the samples are representative of the waste from which they are taken. A sufficient number of samples are collected to adequately represent the waste being sampled. For those waste streams defined as Summary Category Groups S3000 or S4000, debris that may also be present within these wastes need not be sampled. Samples of retrievably stored waste containers are collected using appropriate coring equipment or other EPA-approved methods to collect a representative sample. Newly-generated wastes that are sampled from a process as they are generated may be sampled using EPA-approved methods—including scoops and ladles—that are capable of collecting a representative sample.

The QC requirements for sampling homogenous solids and soil/gravel include: collecting co-located samples from cores or other sample types to determine precision; equipment blanks to verify cleanliness of the sampling and coring tools and sampling equipment; and analysis of reagent blanks to ensure that reagents, such as deionized or high-pressure liquid chromatography (HPLC) water, are of sufficient quality.

Once the homogeneous solid or soil/gravel sample has been collected in accordance with the HWFP requirements, the sample is taken to a laboratory for analysis. The laboratory analyzes the sample using the allowable methods in the HWFP and reports the concentration of all analytes on the target analyte list. In addition, the presence of any TICs observed during the analysis is reported.

Acceptable knowledge

This characterization technique incorporates confirmation by headspace-gas sampling and analysis; radiography; and homogeneous waste sampling and analysis. Both RCRA regulations and the New Mexico Hazardous Waste Management Regulations (NMED 1997) authorize the use of AK in appropriate circumstances by waste generators—or treatment, storage, or disposal facilities—to characterize hazardous waste. Acceptable knowledge is described by the EPA (EPA 1994) as an alternative to sampling and analysis; it can be used to meet all or part of the waste characterization requirements under the RCRA. AK includes a number of techniques used to characterize TRU mixed waste, such as process knowledge; records of analysis acquired prior to RCRA; and other supplemental sampling and analysis data (EPA 1994). AK is used in TRU mixed waste characterization activities in three ways:

1. To delineate TRU mixed waste streams
2. To assess if TRU mixed heterogeneous debris wastes exhibit a toxicity characteristic (NMED 1997)
3. To assess if TRU mixed wastes are listed (NMED 1997)

TRU mixed waste streams are evaluated by applicable provisions of the AK process prior to management, storage, or disposal by the Permittees at the WIPP. TRU mixed waste management AK information defines waste categorization schemes and terminology; provides a breakdown of the types and quantities of TRU mixed wastes that are generated and stored at the site; and describes how wastes are tracked and managed at the site—including historical and current operations. Information related to TRU mixed waste certification procedures and the types of documentation (e.g., waste profile forms) used to summarize AK are also provided. The amount and type of supplemental AK information required from generator/storage sites is site-specific and cannot be mandated, but sites collect information as appropriate to support required AK information.

The AK written record includes a summary that identifies all sources of waste characterization information used to delineate the waste stream. For each TRU mixed waste stream, the generating sites compile all process information and data supporting the AK used to characterize that waste stream. The type and quantity of supporting documentation will vary by waste stream, depending on the process generating the waste and site-specific requirements imposed by the DOE.

STATISTICAL METHODS USED IN SAMPLING AND ANALYSIS

Generator/storage sites use statistical methods to: 1) select waste containers for visual inspection; 2) select retrievably-stored waste containers for totals analysis; 3) set the upper confidence limit; and 4) apply control charting for newly-generated waste stream sampling. Statistical sampling techniques are not currently employed in waste characterization activities employed for 40 CFR 194 (EPA 1998) compliance.

Selecting waste containers for visual examination

As a QC check on the radiographic examination of waste containers, a statistically-selected portion of the certified waste containers is opened and visually examined. The data from visual examination is used to verify the matrix parameter category, waste material parameter weights, and absence of prohibited items, as determined by radiography. The data obtained from the visual examination can also be used to determine—with acceptable confidence—the percentage of miscertified waste containers from the radiographic examination. Miscertified containers are those that radiography indicates meet the WIPP Waste Acceptance Criteria and Transuranic Package Transporter-II Authorized Methods for Payload Control, but visual examination indicates do not meet these criteria. Participating sites initially use an 11% miscertification rate to calculate the number of waste containers that are visually examined until a site-specific miscertification rate has been established.

The site-specific miscertification rate is applied initially to each Summary Category Group to determine the number of containers in that Summary Category Group requiring visual examination. However, a Summary Category Group-specific miscertification rate is determined when either six months have passed since radiographic characterization commenced on a given Summary Category Group or at least 50% of a given Summary Category Group has undergone radiographic characterization, whichever occurs first. The Summary Category Group is then subject to the visual examination requirements of this reevaluated Summary Category Group-specific miscertification rate to ensure that the entire Summary Category Group is appropriately characterized. The site-specific miscertification rate is reassessed annually.

Statistical sampling and analysis of homogeneous solids and soil/gravels for totals

The statistical approach for characterizing retrievably-stored homogeneous solids and soil/gravel waste using sampling and analysis relies on using acceptable knowledge to segregate waste containers into relatively homogeneous waste streams. Once segregated by waste stream, random selection and sampling of the waste containers followed by analysis of the waste samples are performed to ensure that the resulting mean contaminant concentration provides an unbiased representation of the true mean contaminant concentration for each waste stream.

Preliminary estimates of the mean concentration and variance of each RCRA-regulated contaminant in the waste are used to determine the number of waste containers to select for sampling and analysis. The preliminary estimates are made by obtaining a preliminary number of samples from the waste stream or from previous sampling from the waste stream. Preliminary estimates are based on samples from a minimum of five waste containers. Samples collected to establish preliminary estimates that are selected, sampled, and analyzed in accordance with applicable provisions of the Waste Analysis Plan (WAP) are used as part of the required number of samples to be collected.

The calculated total number of required waste containers can then be randomly sampled and analyzed. Waste container samples from the preliminary mean and variance estimates may be counted as part of the total number of calculated required samples if and only if:

1. there is documented evidence that the waste containers for the preliminary estimate samples were selected in the same random manner as is chosen for the required samples.
2. there is documented evidence that the method of sample collection in the preliminary estimate samples were identical to the methodology to be employed for the required samples.
3. there is documented evidence that the method of sample analysis in the preliminary estimate samples was identical to the analytical methodology employed for the required samples.
4. there is documented evidence that the validation of the sample analyses in the preliminary estimate samples was comparable to the

validation employed for the required samples. In addition, the validated samples results should indicate that all sample results were valid according to the analytical methodology.

Upon collection and analysis of the preliminary samples, or at any time after the preliminary samples have been analyzed, the generator/storage site may assign hazardous waste codes to a waste stream. For waste streams with calculated upper confidence limits below the regulatory threshold, the site must collect the required number of samples if the site intends to establish that the constituent is below the regulatory threshold.

Statistical headspace gas sampling and analysis

If a waste stream meets the conditions for representative headspace gas sampling, then headspace-gas sampling of that waste stream may be done on a randomly-selected portion of containers in the waste stream. The minimum number of containers that are sampled is determined by taking an initial VOC sample from 10 randomly-selected containers. These samples are analyzed for all the target analytes.

The mean and standard deviation calculated after sampling *n* containers is then used to calculate a UCL_{90} for each of the headspace gas VOCs.

Control charting for newly-generated waste stream sampling

Significant process changes and process fluctuations associated with newly-generated waste are determined using statistical process control (SPC) charting techniques. These techniques require historical data for determining limits for indicator species, and subsequent periodic sampling to assess process behavior relative to historical limits. SPC is performed on waste prior to solidification or packaging for ease of sampling. If the limits are exceeded for any toxicity characteristic parameter, the waste stream can be recharacterized, and the characterization can be performed according to procedures required in the WAP.

A Shewhart control chart (Gilbert 1987) is a control chart for statistical means that is used for checking whether current data are consistent with past data and whether shifts or trends in means have occurred. If a current sample mean from the process lies within the limits, the process is said to be "in control," or consistent with historical data. If the current mean exceeds the limits, the process has likely changed from historical periods. Logical sets of historical data to be used for the construction of limits in this application are the data from the initial characterization of the waste stream, if available; from characterization of a different lot of the waste stream; or from a retrievably-stored waste stream of the same type from the same process. At a minimum, the logical set includes ten representative sample values collected and analyzed from the newly-generated waste stream. The data used for construction of the limits is justified. The underlying assumptions for control charts are that the data are independent and normally-distributed with constant mean μ and constant variance σ^2. The statistical tests for normality can be conducted and data transformation to normality performed, if necessary. Transformations should take place prior to any calculations that use the data.

Each limit is constructed such that there is a 90% confidence that the true mean does not exceed a limit. One-sided control limits are used because once a waste stream has been determined to be RCRA-hazardous and the limit exceedance of interest is on the lower side—that is when the process may become nonhazardous. Likewise, once a waste stream has been determined not to be RCRA-hazardous and the limit exceedance of interest is on the upper side—that is when the process may become RCRA-hazardous. Whether or not exceeding the limit would result in a change in the RCRA-hazardous nature of the waste stream depends on how close the observed control limits are to RCRA limits.

Current process data are collected and averaged for comparison to the control limit for the mean. The collection period and number of samples included in the average are dependent on the waste stream characteristics. A small number of samples will reflect more of the process variability and there will be more limit exceedances. If two or three samples are collected for the mean in the required annual (or batch) sampling of a relatively homogeneous waste stream, limit exceedances may not occur. If the waste stream is less homogeneous, it will be necessary to collect more samples to meet the required confidence limit. Periodically, it will be necessary to update the control limit for a process. An update that includes all historical data is performed if there is no evidence of a trend in the process or a shift in the mean for the process. If there has been a shift in the mean, only more recent data that reflect the shift are used. Control limits shall be based on at least ten data points that are representative of the process and do not exhibit outliers or a trend with time.

Legal Requirements

INTRODUCTION

The Waste Isolation Pilot Plant project was authorized in 1979 (PL96-164) as a research and development activity to demonstrate the safe disposal of radioactive waste originating from the U.S. nuclear weapons program. This and several other laws and regulations have resulted in the construction and operation of the Waste Isolation Pilot Plant (WIPP) as a unique facility for the disposal of transuranic (TRU) waste.

TRU waste is defined as a waste containing alpha-emitting isotopes of transuranic elements equal to or in excess of 100 nCi/g of waste. The half-lives of the isotopes of these elements must be greater than 20 years.

Much of the TRU waste contains chemical constituents subject to the regulations of the Resource Conservation and Recovery Act (RCRA) and the New Mexico Hazardous Waste Act. TRU wastes that contain both chemical and radioactive waste are referred to as TRU mixed waste. According to RCRA, WIPP is required to have a hazardous waste permit to receive waste containing hazardous waste constituents. The State of New Mexico has adopted the relevant RCRA regulations by reference and thus is authorized to issue hazardous waste permits. WIPP received a permit (NMED 1999) on October 27, 1999 for contact-handled (CH) waste, defined as having a surface radiation dose rate not greater than 200 mrem/h (2 mSv/h). TRU waste having a greater dose rate than 200 mrem/h (2 mSv/h) is defined as Remote Handled (RH) TRU Waste.

The enactment of the WIPP Land Withdrawal Act (WIPP/LWA 1992) resulted in permanent withdrawal and transfer of the administration of federal land for the site from the U.S. Department of Interior to the DOE. This law mandated that the U.S. Environmental Protection Agency (EPA) certify the DOE's compliance with EPA's relevant, generally applicable environmental standards for radioactive materials. Subsequently, the EPA (1996a) issued the criteria to be used in certifying compliance. In response, the DOE provided the EPA with appropriate documents; model; and evaluations of the geology, hydrology, and climate as well as projected performance of the entire disposal system, including the mined repository, shaft seals, panel closures, borehole plugs, and mine backfill. Finally, the

EPA (1998) certified that the WIPP met all of the criteria required for the disposal of TRU waste.

The WIPP/LWA limited the amount and types of TRU wastes that can be emplaced at WIPP. The limits include the following:

1. The volume WIPP capacity is limited to 1.75 x 10^5 m^3 (6.2 x 10^6 ft^3) total TRU waste.
2. No more than 5% (by volume) of RH-TRU waste may have a surface dose rate in excess of 100 rem/h (1Sv/h).
3. No RH-TRU waste may have a surface dose rate in excess of 1,000 rem/h (10 Sv/h).
4. RH-TRU waste containers shall not exceed 23 Ci/L (851 GBq/L) maximum activity level averaged over the volume of the container.
5. The total radioactivity of RH-TRU waste shall not exceed 5.1 MCi (188.7 Gbq).
6. Of the allowed waste disposal volume of 1.75 x 10^5 m^3 (6.2 x 10^6 ft^3), the Consultation and Cooperation Agreement with the State of New Mexico limits the volume of RH-TRU waste to 7,080 m^3 (250,000 ft^3).

The 41 km^2 (16 mi^2) area under DOE's jurisdiction at WIPP is deemed sufficient to ensure that at least 1 mi. (1.6 km) of intact salt exists laterally between the waste disposal area and the accessible environment, and also to ensure that no permanent residences will be established in close proximity to the facility.

BRIEF WIPP CHRONOLOGY

1957 National Research Council recommended salt as host rock, identified areas to investigate, and identified favorable siting criteria

1974 Atomic Energy Commission selected site near Carlsbad for exploratory work

1979 Congress authorized WIPP for research and development for safe disposal of defense-generated radioactive waste

1980 DOE issued Final Environmental Impact Statement (FEIS)

1981 DOE issued Record of Decision

1981 DOE began construction of WIPP Exploratory Shaft

1985 EPA issued 40 CFR 191—radioactive waste disposal standards applicable to WIPP

1986 EPA stated facilities must comply with Resource Conservation and Recovery Act (RCRA) for disposal of mixed (hazardous and radioactive) waste

1990 New Mexico was authorized by EPA to regulate mixed waste

1990 DOE issued first Supplemental Environmental Impact Statement (SEIS)

1991 DOE submitted Parts A and B of the RCRA Permit Application to New Mexico

1992 WIPP Land Withdrawal Act permanently segregated land for WIPP and gave EPA regulatory authority to certify WIPP compliance to 40 CFR 191.

1995 DOE submitted revised RCRA Permit Application to New Mexico Environment Department

1996 EPA issued 40 CFR 194, compliance criteria in February

1996 DOE submitted 84,000 page Compliance Certification Application to EPA

1998 DOE issued SEIS II in January

1998 EPA certified WIPP ready for disposal

1998 New Mexico Environment Department issued draft hazardous waste facility permit (HWFP) for disposal of transuranic mixed waste

1999 First shipment non-mixed waste in March

1999 New Mexico Environment Department issued Hazardous Waste Facility Permit

2000 First shipment of mixed waste in September

EPA'S CRITERIA FOR WIPP CERTIFICATION

Criteria for certification and re-certification of WIPP were published in final form by the EPA (1996a). These criteria were detailed and contained specific requirements related to the radioactivity content of TRU waste. In its regulations, EPA provided requirements not only for quality assurance and characterization but also specific requirements for expert judgement and peer review. Although EPA's certification and re-certification do not apply to radioactive waste constituents of TRU waste, the description of peer review requirements may be useful as they can be advantageously used also for hazardous waste constituents. The following are excerpts from EPA's regulations:

"§ 194.27 Peer review.

(a) Any compliance application shall include documentation of peer review that has been conducted, in a manner required by this section, for:

(1) Conceptual models selected and developed by the Department;

(2) Waste characterization analyses as required in § 194.24(b); and

(3) Engineered barrier evaluation as required in § 194.44.

(b) Peer review processes required in paragraph (a) of this section, and conducted subsequent to the promulgation of this part, shall be conducted in a manner that is compatible with NUREG-1297, "Peer Review for High-Level Nuclear Waste Repositories," published February 1988. (Incorporation by reference as specified in § 194.5.)

(c) Any compliance application shall:

(1) Include information that demonstrates that peer review processes required in paragraph (a) of this section, and conducted prior to the implementation of the promulgation of this part, were conducted in accordance with an alternate process substantially equivalent in effect to NUREG-1297 and approved by the Administrator or the Administrator's authorized representative; and

(2) Document any peer review processes conducted in addition to those required pursuant to paragraph (a) of this section. Such documentation shall include formal requests, from the Department to outside review groups or individuals, to review or comment on any information used to support compliance applications, and the responses from such groups or individuals."

The packaging of waste at the originating sites; transport to the site; transport vehicles; and disposal of heat-generating waste are beyond the scope of this study and are not dealt with in this report.

The health and safety consequences of the postulated repository failure mechanisms appear to be so minimal that simplifications in design may be justified, and cost-effectiveness studies should be carried out to determine whether they would be acceptable. However, the probability and the consequences of potentially rapid flow of brine solutions containing radionuclides, through more permeable formations, have not been completely determined. Once these have been resolved, conventional safety considerations (e.g., number of shafts and packaging of waste for highway transport) might determine the optimum design.

Relaxation of the WIPP waste acceptance criteria (e.g., elimination of the incineration of some of the waste at the Process Experimental Pilot Plant (PREPP) facility and removal of the requirement for the use of steel-case overpack of the wooden boxes) may also have minimal consequences.

PUBLIC LAW 102-579
THE WASTE ISOLATION PILOT PLANT LAND WITHDRAWAL ACT

as amended by Public Law 104-201
(H.R. 3230, 104th Congress)

SECTION I. SHORT TITLE; TABLE OF CONTENTS.

(a) SHORT TITLE.—This Act may be cited as the "Waste Isolation Pilot Plant Land Withdrawal Act".

(b) TABLE OF CONTENTS.—

SEC. 2. DEFINITIONS.

For purposes of this Act:

(1) ADMINISTRATOR.—The term “Administrator” means the Administrator of the Environmental Protection Agency.

(2) AGREEMENT.—The term “Agreement” means the July 1, 1981, Agreement for Consultation and Cooperation, as amended by the November 30, 1984 “First Modification”, the August 4, 1987 “Second Modification”, and the March 18, 1988 “Third Modification” or as it may be amended after the date of enactment of this Act between the State and the United States Department of Energy as authorized by section 213(b) of the Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980 (Pub. L. 96-164; 93 Stat. 1259, 1265).

(3) CONTACT-HANDLED TRANSURANIC WASTE.—The term “contact-handled transuranic waste” means transuranic waste with a surface dose rate not greater than 200 millirem per hour.

(4) DECOMMISSIONING PHASE.—The term “decommissioning phase” means the period of time beginning with the end of the disposal phase and ending when all shafts at the WIPP repository have been backfilled and sealed.

(5) DISPOSAL.—The term “disposal” means permanent isolation of transuranic waste from the accessible environment with no intent of recovery, whether or not such isolation permits the recovery of such waste.

(6) DISPOSAL PHASE.—The term “disposal phase” means the period of time, during which transuranic waste is disposed of at WIPP, beginning with the initial emplacement of transuranic waste underground for disposal and ending when the last container of transuranic waste, as determined by the Secretary, is emplaced underground for disposal.

(7) DISPOSAL REGULATIONS.—The term “disposal regulations” means the environmental regulations for the disposal of spent nuclear fuel, high-level radioactive waste, and transuranic waste under section 8.

(8) EEG.—The term “EEG” means the Environmental Evaluation Group for the Waste Isolation Pilot Plant referred to in section 1433 of the National Defense Authorization Act, Fiscal Year 1989 (Pub. L. 100-456; 102 Stat. 1918, 2073).

(9) ENGINEERED BARRIERS.—The term “engineered barriers” means backfill, room seals, panel seals, and any other manmade barrier components of the disposal system.

(10) HIGH-LEVEL RADIOACTIVE WASTE.—The term "high-level radioactive waste" has the meaning given such term in section 2(12) of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10101(12)).
(11) NO-MIGRATION DETERMINATION.—The term "No-Migration Determination" means the Final Conditional No-Migration Determination for the Department of Energy Waste Isolation Pilot Plant published by the Environmental Protection Agency on November 14, 1990 (55 Fed. Reg. 47700), and any amendments thereto, pursuant to the Solid Waste Disposal Act (42 U.S.C. 6901 et seq.).
(12) REMOTE-HANDLED TRANSURANIC WASTE.—The term "remote-handled transuranic waste" means transuranic waste with a surface dose rate of 200 millirem per hour or greater.
(13) RETRIEVAL.—The term "retrieval" means the removal of transuranic waste and the container in which it has been retained and any material contaminated by such waste from the underground repository at WIPP.
(14) SECRETARY.—The term "the Secretary" means the Secretary of Energy.
(15) SPENT NUCLEAR FUEL.—The term "spent nuclear fuel" has the meaning given such term in section 2(23) of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10101(23)).
(16) STATE.—The term "the State" means the State of New Mexico.
(17) SUPPLEMENTAL STIPULATED AGREEMENT.—The term "Supplemental Stipulated Agreement" means the Supplemental Stipulated Agreement Resolving Certain State Off-Site Concerns Over WIPP, dated December 27, 1982, to the Stipulated Agreement Between DOE and the State in *State of New Mexico ex rel. Bingaman v. DOE*, Case No. CA 81-0363 JB (D. N. Mex.), dated July 1, 1981.
(18) TRANSURANIC WASTE.—The term "transuranic waste" means waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for—

(A) high-level radioactive waste;

(B) waste that the Secretary has determined, with the concurrence of the Administrator, does not need the degree of isolation required by the disposal regulations; or

(C) waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with part 61 of title 10, Code of Federal Regulations.

(19) WIPP.—The term "WIPP" means the Waste Isolation Pilot Plant project authorized under section 213 of the Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980 (Pub. L. 96-164; 93 Stat. 1259 1265) to demonstrate the safe disposal of radioactive waste materials generated by atomic energy defense activities.
(20) WITHDRAWAL.—The term "Withdrawal" means the geographical area consisting of the lands described in section 3(c).

SEC. 3. LAND WITHDRAWAL AND RESERVATION FOR WIPP.

(a) LAND WITHDRAWAL, JURISDICTION, AND RESERVATION.—
(1) LAND WITHDRAWAL.—Subject to valid existing rights, and except as otherwise provided in this Act, the lands described in subsection (c) are withdrawn from all forms of entry, appropriation, and disposal under the public land laws, including without limitation the mineral leasing laws, the geothermal leasing laws, the material sale laws (except as provided in section 4(b)(4) of this Act), and the mining laws.
(2) JURISDICTION.—Except as otherwise provided in this Act, jurisdiction over the Withdrawal is transferred from the Secretary of the Interior to the Secretary.
(3) RESERVATION.—Such lands are reserved for the use of the Secretary for the construction, experimentation, operation, repair and maintenance, disposal, shutdown, monitoring, decommissioning, and other authorized activities associated with the purposes of WIPP as set forth in section 213 of the Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980 (Pub. L. 96-164; 93 Stat. 1259, 1265), and this Act.
(b) REVOCATION OF PUBLIC LAND ORDERS.—Public Land Order 6403 of June 29, 1983, as modified by Public Land Order 6826 of January 28, 1991, and any memoranda of understanding accompanying such land orders, are revoked.
(c) LAND DESCRIPTION.—
(1) BOUNDARIES.—The boundaries depicted on the map issued by the Bureau of Land Management of the Department of the Interior, entitled "WIPP Withdrawal Site Map," dated October 9, 1990, and on file

with the Bureau of Land Management, New Mexico State Office, are established as the boundaries of the Withdrawal.

(2) LEGAL DESCRIPTION AND MAP.—Within 30 days after the date of the enactment of this Act, the Secretary of the Interior shall—

(A) publish in the Federal Register a notice containing a legal description of the Withdrawal; and

(B) file copies of the map described in paragraph (1) and the legal description of the Withdrawal with the Congress, the Secretary, the Governor of the State, and the Archivist of the United States.

(d) TECHNICAL CORRECTIONS.—The map and legal description referred to in subsection (c) shall have the same force and effect as if they were included in this Act. The Secretary of the Interior may correct clerical and typographical errors in the map and legal description.

(e) WATER RIGHTS.—This Act does not establish, nor may any provision be construed to establish, a reservation to the United States with respect to any water or water rights. Nothing in this Act shall affect any water rights acquired by the United States prior to the date of enactment of this Act. The United States may apply for and obtain water rights for purposes associated with this Act only in accordance with the substantive and procedural requirements of the laws of the State.

SEC. 4. ESTABLISHMENT OF MANAGEMENT RESPONSIBILITIES.

(a) GENERAL AUTHORITY.—The Secretary shall be responsible for the management of the Withdrawal, consistent with the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701 et seq.), this Act, and other applicable law, and shall consult with the Secretary of the Interior and the State in discharging such responsibility.

(b) MANAGEMENT PLAN.—

(1) DEVELOPMENT.—Within 1 year after the date of the enactment of this Act, the Secretary, in consultation with the Secretary of the Interior and the State, shall develop a management plan for the use of the Withdrawal until the end of the decommissioning phase.

(2) PRIORITY OF WIPP-RELATED USES.—Any use of the Withdrawal for activities not associated with WIPP shall be subject to such conditions and restrictions as may be necessary to permit the conduct of WIPP-related activities.

(3) NON-WIPP RELATED USES.—The management plan developed under paragraph (1) shall provide for the maintenance of wildlife habitat and shall provide that the Secretary may permit such non-WIPP related uses of the Withdrawal as the Secretary determines to be appropriate, including domestic livestock grazing and hunting and trapping in accordance with the following requirements:

(A) GRAZING.—The Secretary may permit grazing to continue where established before the date of the enactment of this Act, subject to such regulations, policies, and practices as the Secretary, in consultation with the Secretary of the Interior, determines to be necessary or appropriate. The management of grazing shall be conducted in accord with applicable grazing laws and policies, including—

(i) the Act entitled "An Act to stop injury to public grazing lands by preventing overgrazing and soil deterioration, to provide for their orderly use, improvement, and development, to stabilize the livestock industry dependent upon the public range, and for other purposes," approved June 28, 1934 (43 U.S.C. 315 et seq., commonly referred to as the "Taylor Grazing Act");

(ii) title IV of the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1751 et seq.); and

(iii) the Public Rangelands Improvement Act of 1978 (43 U.S.C. 1901 et seq.).

(B) HUNTING AND TRAPPING.—The Secretary may permit hunting and trapping within the Withdrawal in accordance with applicable laws and regulations of the United States and the State, except that the Secretary, after consultation with the Secretary of the Interior and the State, may issue regulations designating zones where, and establishing periods when, no hunting or trapping is permitted for reasons of public safety, administration, or public use and enjoyment.

(4) DISPOSAL OF SALT TAILINGS.—The Secretary shall dispose of salt tailings extracted from the Withdrawal that the Secretary determines are not needed for backfill at WIPP. Disposition of such tailings shall be made under sections 2 and 3 of the Act of July 31, 1947, (30 U.S.C. 602, 603; commonly referred to as the "Materials Act of 1947").

(5) MINING.—

(A) IN GENERAL.—Except as provided in subparagraph (B), no surface or subsurface mining or oil or gas production, including slant drilling from outside the boundaries of the Withdrawal, shall be permitted at any time (including after decommissioning) on lands on or under the Withdrawal.

(B) EXCEPTION.—Existing rights under Federal Oil and Gas Leases No. NMNM 02953 and No. NMNM 02953C shall not be affected unless the Administrator determines, after consultation with the Secretary and the Secretary of the Interior, that the acquisition of such leases by the Secretary is required to comply with the final disposal regulations.

(c) CLOSURE TO PUBLIC.—If during the land withdrawal made by section 3(a) the Secretary determines, in consultation with the Secretary of the Interior, that the health and safety of the public or the common defense and security require the closure to the public use of any road, trail, or other portion of the Withdrawal, the Secretary may take whatever action the Secretary determines to be necessary to effect and maintain the closure and shall provide notice to the public of such closure.

(d) MEMORANDUM OF UNDERSTANDING.—The Secretary and the Secretary of the Interior shall enter into a memorandum of understanding to implement the management plan developed under subsection (b). Such memorandum shall remain in effect until the end of the decommissioning phase.

(e) SUBMISSION OF PLAN.—Within 1 year after the date of the enactment of this Act, the Secretary shall submit the management plan developed under subsection (b) to the Congress and the State. Any amendments to the plan shall be submitted promptly to the Congress and the State.

SEC. 6. TEST PHASE ACTIVITIES.

(a) STUDY—The following study shall be conducted:

(1) IN GENERAL.—Within 3 years after the date of the enactment of this Act, the Secretary shall complete a study on remote-handled transuranic waste in consultation with affected States, the Administrator, and after the solicitation of views of other interested parties.

(2) REQUIREMENTS OF STUDY.—Such study shall include an analysis of the impact of remote-handled transuranic waste on the performance assessment of WIPP and a comparison of remote-handled transuranic waste with contact-handled transuranic waste on such issues

as gas generation, flammability, explosiveness, solubility, and brine and geochemical interactions.

(3) PUBLICATION.—The Secretary shall publish the findings of such study in the Federal Register.

(b) PERFORMANCE ASSESSMENT REPORT.—

(1) IN GENERAL.—The Secretary shall publish a performance assessment report as necessary to demonstrate the long-term performance of WIPP. Each such report shall be provided to the State, the Administrator, the National Academy of Sciences, and the EEG for their review and comment.

(2) RESPONSES BY SECRETARY TO COMMENTS.—If, within 120 days of the publication of a performance assessment report under paragraph (1), the State, the Administrator, the National Academy of Sciences, or the EEG provide written comments on the report, the Secretary shall submit written responses to the comments to the State, the Administrator, the National Academy of Sciences, and the EEG, and to other appropriate entities or persons after consultation with the State, within 120 days of receipt of the comments.

SEC. 7. DISPOSAL OPERATIONS.

(a) TRANSURANIC WASTE LIMITATIONS.—

(1) REM LIMITS FOR REMOTE-HANDLED TRANSURANIC WASTE.—

(A) 1,000 REMS PER HOUR.—No transuranic waste received at WIPP may have a surface dose rate in excess of 1,000 rems per hour.

(B) 100 REMS PER HOUR.—No more than 5 percent by volume of the remote-handled transuranic waste received at WIPP may have a surface dose rate in excess of 100 rems per hour.

(2) CURIE LIMITS FOR REMOTE-HANDED TRANSURANIC WASTE.—

(A) CURIES PER LITER.—Remote-handled transuranic waste received at WIPP shall not exceed 23 curies per liter maximum activity level (averaged over the volume of the canister).

(B) TOTAL CURIES.—The total curies of the remote-handled transuranic waste received at WIPP shall not exceed 5,100,000 curies.

(3) CAPACITY OF WIPP.—The total capacity of WIPP by volume is 6.2 million cubic feet of transuranic waste.

(b) REQUIREMENTS FOR COMMENCEMENT OF DISPOSAL OPERATIONS.—The Secretary may commence emplacement of transuranic waste underground for disposal at WIPP only upon completion of—

(1) the Administrator's certification under section 8(d)(1) that the WIPP facility will comply with the final disposal regulations;

(2) the acquisition by the Secretary (whether by purchase, condemnation, or otherwise) of Federal Oil and Gas Leases No. NMNM 02953 and No. NMNM 02953C, unless the Administrator determines under section 4(b)(5) that such acquisition is not required; and

(3) the 30-day period beginning on the date on which the Secretary notifies Congress that the requirements of section 9(a)(1) have been met.

SEC. 8. ENVIRONMENTAL PROTECTION AGENCY DISPOSAL REGULATIONS.

(a) REINSTATEMENT.—

(1) IN GENERAL.—Except as provided in paragraph (2), the disposal regulations issued by the Administrator on September 19, 1985, and contained in subpart B of part 191 of title 40, Code of Federal Regulations, shall be in effect.

(2) EXCEPTIONS.—Paragraph (1) shall not apply to—

(A) the 3 aspects of sections 191.15 and 191.16 of such regulations that were the subject of the remand ordered in Natural Resources Defense Council, Inc. v. United States Environmental Protection Agency, 824 F.2d 1258 (1st Cir. 1987); and

(B) the characterization, licensing, construction, operation, or closure of any site required to be characterized under section 113(a) of Public Law 97-425.

(b) ISSUANCE OF REGULATIONS.—

(1) IN GENERAL.—Subject to the limitation in paragraph (2), the Administrator shall issue, not later than 6 months after the date of the enactment of this Act, final disposal regulations. Such regulations shall be issued in a rulemaking proceeding conducted under section 553 of title 5, United States Code, except that sections 556 and 557 of such title shall not apply.

(2) LIMITATION.—The regulations required by this subsection shall not be applicable to the characterization, licensing, construction, operation,

or closure of any site required to be characterized under section 113(a) of Public Law 97-425.

(c) ISSUANCE OF CRITERIA FOR CERTIFICATION OF COMPLIANCE WITH DISPOSAL REGULATIONS.—

(1) PROPOSED CRITERIA.—Not later than 1 year after the date of the enactment of this Act, the Administrator shall, by rule pursuant to section 553 of title 5, United States Code, propose criteria for the Administrator's certification of compliance with the final disposal regulations, and sections 556 and 557 of such title shall not apply.

(2) FINAL CRITERIA.—Not later than 2 years after the date of the enactment of this Act, the Administrator shall, by rule pursuant to section 553 of title 5, United States Code, issue final criteria for the Administrator's certification of compliance with the final disposal regulations, and sections 556 and 557 of such title shall not apply.

(d) DISPOSAL REGULATIONS.—

(1) APPLICATION FOR COMPLIANCE.—Within 30 days after the date of the enactment of the Waste Isolation Pilot Plant Land Withdrawal Amendment Act, the Secretary shall provide to Congress a schedule for the incremental submission of chapters of the application to the Administrator beginning no later than 30 days after the date of the submittal of the schedule. The Administrator shall review the submitted chapters and provide requests for additional information from the Secretary as needed for completeness within 45 days of the receipt of each chapter. The Administrator shall notify Congress of such requests. The schedule shall call for the Secretary to submit all chapters to the Administrator no later than October 31, 1996. The Administrator may at any time request additional information from the Secretary as needed to certify, pursuant to paragraph (2), whether the WIPP facility will comply with the final disposal regulations.

(2) CERTIFICATION BY ADMINISTRATOR.—Within 1 year of receipt of the application under paragraph (1), the Administrator shall certify, by rule pursuant to section 553 of title 5, United States Code, whether the WIPP facility will comply with the final disposal regulations, and sections 556 and 557 of such title shall not apply.

(3) JUDICIAL REVIEW.—Judicial review of the certification of the Administrator under paragraph (2) shall not be restricted by the provisions of section 221 c. of the Atomic Energy Act of 1954 (42 U.S.C. 2271(c)).

(4) LIMITATION.—Any certification of the Administrator under paragraph (2) may only be made after the full application has been submitted to the Administrator under paragraph (1).

(e) CONFLICT RESOLUTION.—If the State disagrees with the Secretary's application under subsection (d)(1)(A), the State may invoke the conflict resolution provisions of the Agreement.

(f) PERIODIC RECERTIFICATION.—

(1) BY SECRETARY.—Not later than 5 years after the initial receipt of transuranic waste for disposal at WIPP, and every 5 years thereafter until the end of the decommissioning phase, the Secretary shall submit to the Administrator and the State documentation of continued compliance with the final disposal regulations.

(2) CONCURRENCE BY ADMINISTRATOR.—The Administrator shall, not later than 6 months after receiving a submission under paragraph (1), determine whether or not the WIPP facility continues to be in compliance with the final disposal regulations. A determination under this paragraph shall not be subject to rulemaking or judicial review.

(g) ENGINEERED AND NATURAL BARRIERS, ETC.—The Secretary shall use both engineered and natural barriers and any other measures (including waste form modifications) to the extent necessary at WIPP to comply with the final disposal regulations.

SEC. 9. COMPLIANCE WITH ENVIRONMENTAL LAWS AND REGULATIONS.

(a) IN GENERAL.—

(1) APPLICABILITY.—Beginning on the date of the enactment of this Act, the Secretary shall comply with respect to WIPP, with—

(A) the regulations issued by the Administrator establishing the generally applicable environmental standards for the management and storage of spent nuclear fuel, high-level radioactive waste, and transuranic radioactive waste and contained in subpart A of part 191 of title 40, Code of Federal Regulations;

(B) the Clean Air Act (40 U.S.C. 7401 et seq.);

(C) the Solid Waste Disposal Act (42 U.S.C. 6901 et seq.);

(D) title XIV of the Public Health Service Act (42 U.S.C. 300f et seq.; commonly referred to as the "Safe Drinking Water Act");

(E) the Toxic Substances Control Act (15 U.S.C. 2601 et seq.);

(F) the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9601 et seq.);

(G) all other applicable Federal laws pertaining to public health and safety or the environment; and

(H) all regulations promulgated, and all permit requirements, under the laws described in subparagraphs (B) through (G).

With respect to transuranic mixed waste designated by the Secretary for disposal at WIPP, such waste is exempt from treatment standards promulgated pursuant to section 3004(m) of the Solid Waste Disposal Act (42 U.S.C. 6924(m)) and shall not be subject to the land disposal prohibitions in section 3004(d), (e), (f), and (g) of the Solid Waste Disposal Act.

(2) PERIODIC OVERSIGHT BY ADMINISTRATOR AND STATE.—The Secretary shall, not later than 2 years after the date of the enactment of this Act, and biennially thereafter, submit documentation of continued compliance with the laws, regulations, and permit requirements described in paragraph (1) to the Administrator, and, with the law described in paragraph (l)(C), to the State.

(3) DETERMINATION BY ADMINISTRATOR OR STATE.—The Administrator or the State, as appropriate, shall determine not later than 6 months after receiving a submission under paragraph (2) whether the Secretary is in compliance with the laws, regulations, and permit requirements described in paragraph (1) with respect to WIPP.

(c) DETERMINATION OF NONCOMPLIANCE DURING DISPOSAL PHASE AND DECOMMISSIONING PHASE.—

(1) DETERMINATION BY THE ADMINISTRATOR.—If the Administrator determines at any time during the disposal phase or decommissioning phase that the WIPP facility does not comply with any law, regulation, or permit requirement described in subsection (a)(1), the Administrator shall request a remedial plan from the Secretary describing actions the Secretary will take to comply with such law, regulation, or permit requirement.

(d) SAVINGS PROVISION.—The authorities provided to the Administrator and to the State pursuant to this section are in addition to the enforcement authorities available to the State pursuant to State law and to the Administrator, the State, and any other person, pursuant to the Solid Waste Disposal Act (42 U.S.C. 6901 et seq.) and the Clean Air Act (40 U.S.C. 7401 et seq.).

SEC. 10. SENSE OF CONGRESS ON COMMENCEMENT OF EMPLACEMENT OF TRANSURANIC WASTE.

It is the sense of Congress that the Secretary should complete all actions required under section 7(b) to commence emplacement of transuranic waste underground for disposal at WIPP not later than November 30, 1997, provided that before that date all applicable health and safety standards have been met and all applicable laws have been complied with.

SEC. 11. MINE SAFETY.

(a) MINE SAFETY AND HEALTH ADMINISTRATION.—The Mine Safety and Health Administration of the Department of Labor shall inspect WIPP not less than 4 times each year and in the same manner as it evaluates mine sites under the Federal Mine Safety and Health Act of 1977 (30 U.S.C. 801 et seq.), and shall provide the results of its inspections to the Secretary. The Secretary shall make the results of such inspections publicly available and shall take necessary actions to ensure the prompt and effective correction of any deficiency, including suspending specific activities as necessary to address identified health and safety deficiencies.
(b) BUREAU OF MINES.—The Bureau of Mines of the Department of the Interior shall prepare an annual evaluation of the safety of WIPP.

SEC. 12. BAN ON HIGH-LEVEL RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL.

The Secretary shall not transport high-level radioactive waste or spent nuclear fuel to WIPP or emplace or dispose of such waste or fuel at WIPP.

SEC. 13. DECOMMISSIONING OF WIPP.

The Secretary shall develop a plan for the management and use of the Withdrawal following the decommissioning of WIPP or the termination of the land withdrawal. The Secretary shall consult with the Secretary of the Interior and the State in the preparation of such plan and shall submit such plan to the Congress.

SEC. 14. SAVINGS PROVISIONS.

(a) CAA AND SWDA.—Except for the exemption from the land disposal restrictions described in section 9(a)(1), no provision of this Act may be construed to supersede or modify the provisions of the Clean Air Act (42 U.S.C. 7401 et seq.) or the Solid Waste Disposal Act (42 U.S.C. 6901 et seq.).

(b) EXISTING AUTHORITY OF EPA AND STATE.—No provision of this Act may be construed to limit, or in any manner affect, the Administrator's or the State's authority to enforce, or the Secretary's obligation to comply with—

(1) the Clean Air Act (42 U.S.C. 7401 et seq.);

(2) the Solid Waste Disposal Act (42 U.S.C. 6901 et seq.), except that the transuranic mixed waste designated by the Secretary for disposal at WIPP is exempt from the land disposal restrictions described in section 9(a)(1); or

(3) any other applicable clean air or hazardous waste law.

SEC. 15. ECONOMIC ASSISTANCE AND MISCELLANEOUS PAYMENTS.

(a) 14-YEAR AUTHORIZATION.—There are authorized to be appropriated to the Secretary for payments to the State $20,000,000 for each of the 14 fiscal years beginning with fiscal year 1998. The authorization of appropriations for funds for payments to the State under the preceding sentence shall be separate from any authorization of appropriations of funds for WIPP.

(b) SUBSEQUENT AUTHORIZATIONS.—There are authorized to be appropriated to the Secretary, for payments to the State for any fiscal year after the last fiscal year to which subsection (a) applies, such sums as the Congress may, by law, authorize to be appropriated.

(c) INFLATION ADJUSTMENT.—

(1) IN GENERAL.—In the case of any fiscal year after the first fiscal year to which subsection (a) applies, the dollar amount specified in such subsection shall be increased or decreased, as the case may be, by an amount equal to—

(A) such dollar amount; multiplied by

(B) the inflation increase or decrease determined under paragraph (2).

(2) CALCULATION OF INFLATION INCREASE OR DECREASE.—For purposes of paragraph (1), the inflation increase or decrease for any fiscal year is the percentage (if any) by which the inflation index for the preceding fiscal year is greater than or less than, as the case may be, the inflation index for the fiscal year prior to the first fiscal year to which subsection (a) applies.

(3) INFLATION INDEX.—For purposes of paragraph (2), the inflation index for any fiscal year is the average of the Consumer Price Index (as published by the Department of Labor) for the 12 months in such fiscal year.

(d) ELIGIBLE ASSISTANCE.—A portion of the payments under this section—

(1) shall be made available to units of local government in Lea and Eddy counties in the State; and

(2) may also be provided for independent environmental assessment and economic studies associated with WIPP.

SEC. 16. TRANSPORTATION.

(a) SHIPPING CONTAINERS.—No transuranic waste may be transported by or for the Secretary to or from WIPP, except in packages—

(1) the design of which has been certified by the Nuclear Regulatory Commission; and

(2) that have been determined by the Nuclear Regulatory Commission to satisfy its quality assurance requirements. The determination under paragraph (2) shall not be subject to rulemaking or judicial review.

(b) NOTIFICATION.—In addition to activities required pursuant to the Supplemental Stipulated Agreement, prior to any transportation of transuranic waste by or for the Secretary to or from WIPP, the Secretary shall provide advance notification to States and Indian tribes through whose jurisdiction the Secretary plans to transport transuranic waste to or from WIPP.

(c) ACCIDENT PREVENTION AND EMERGENCY PREPAREDNESS.—

(1) TRAINING.—

(A) IN GENERAL.—In addition to activities required pursuant to the Supplemental Stipulated Agreement, the Secretary shall, to the extent provided in appropriation Acts, provide technical assistance and funds for the purpose of training public safety officials, and other emergency responders as described in part 1910.120 of title 29, Code of Federal Regulations, in any State or Indian tribe through whose jurisdiction the Secretary plans to transport transuranic waste to or from WIPP. Within 30 days of the date of the enactment of this Act, the Secretary shall submit a report to the Congress and to the States and Indian tribes through whose jurisdiction the Secretary plans to transport transuranic waste on the training provided through fiscal year 1992.

(B) ONGOING TRAINING.—If determined by the Secretary, in consultation with affected States and Indian tribes, to be necessary and appropriate, training described in subparagraph (A) shall continue after the date of the enactment of this Act until the transuranic waste shipments to or from WIPP have been terminated.

(C) REVIEW OF TRAINING.—The Secretary shall periodically review the training provided pursuant to subparagraph (A) in consultation with affected States and Indian tribes. The training shall also be reviewed by the Occupational Safety and Health Administration, and the National Institute for Occupational Safety and Health, for compliance with part 1910.120 of title 29, Code of Federal Regulations.

(D) COMPONENTS OF TRAINING.—The training shall cover procedures required for the safe routine transportation of transuranic waste, as well as procedures for dealing with emergency response situations, including—

(i) instruction of government officials and public safety officers in procedures for the command and control of the response to any incident involving the waste;

(ii) instruction of emergency response personnel in procedures for the initial response to an incident involving transuranic waste being transported to or from WIPP;

(iii) instruction of radiological protection and emergency medical personnel in procedures for responding to an incident involving transuranic waste being transported to or from WIPP; and

(iv) a program to provide information to the public about the transportation of transuranic waste to or from WIPP.

(2) EQUIPMENT.—The Secretary shall enter into agreements to assist States through monetary grants or contributions in-kind, to the extent provided in appropriation Acts, in acquiring equipment for response to an incident involving transuranic waste transported to or from WIPP.

(d) TRANSPORTATION SAFETY PROGRAMS.—The Secretary shall, to the extent provided in appropriation Acts, provide in-kind, financial, technical, and other appropriate assistance to any State or Indian tribe through whose jurisdiction the Secretary plans to transport transuranic waste to or from WIPP, for the purpose of WIPP-specific transportation safety programs not otherwise addressed in this section. These programs shall be developed with, and monitored by, the Secretary.

(e) SANTA FE BYPASS.—No transuranic waste may be transported from the Los Alamos National Laboratory to WIPP until—

(1) an amount of funds sufficient to construct the Santa Fe bypass has been made available to the State;

(2) the Santa Fe bypass has been completed; or

(3) the Administrator has made the certification required under section 8(d)(1)(B).

(f) STUDY OF TRANSPORTATION ALTERNATIVES.—

(1) IN GENERAL.—The Secretary shall conduct a study comparing the shipment of transuranic waste to the WIPP facility by truck and by rail, including the use of dedicated trains, and shall submit a report on the study in accordance with paragraph (2). Such report shall include—

(A) a consideration of occupational and public risks and exposures, and other environmental impacts;

(B) a consideration of emergency response capabilities; and

(C) an estimation of comparative costs.

(2) REPORT.—The report required in paragraph (1) shall be submitted to the Congress not later than 1 year after the date of the enactment of this Act.

(g) EMERGENCY RESPONSE MEDICAL TRAINING.—

(1) DETERMINATION OF SECRETARY.—If the Secretary determines that emergency response medical training for incidents involving transuranic waste being transported to or from WIPP is inadequate, the Secretary shall take immediate action to correct the inadequacies and, if necessary, suspend transportation of such transuranic waste. If the State disagrees with the Secretary's determination under

this paragraph, the State may invoke the conflict resolution provisions of the Agreement.

(2) STATE ADVISORY GROUP.—The Secretary shall encourage the Governor of the State to appoint, within 30 days after the date of the enactment of this Act, an advisory group of health professionals and other experts in the field to review emergency response medical training programs for incidents involving transuranic waste being transported to or from WIPP. If such advisory group is established—

(A) its purpose shall be to review, within 60 days after its establishment and annually thereafter, the Department of Energy's emergency response medical training programs for incidents involving transuranic waste being transported to or from WIPP, and to report its findings to the State, the Secretary of Labor, acting through the Occupational Safety and Health Administration, and the Secretary; and

(B) the Secretary shall review the findings of the advisory group in consultation with the Secretary of Labor, acting through the Occupational Safety and Health Administration.

SEC. 17. ACCESS TO INFORMATION.

(a) IN GENERAL.—The Secretary shall—

(1) provide the State, the National Academy of Sciences, and the EEG with free and timely access to data relating to health, safety, or environmental issues at WIPP;

(2) provide the State and the EEG with preliminary reports relating to health, safety, or environmental issues at WIPP; and

(3) to the extent practicable, permit the State and the EEG to attend meetings relating to health, safety, or environmental issues at WIPP with expert panels and peer review groups.

(b) EVALUATION AND PUBLICATION.—The State, the National Academy of Sciences, and the EEG may evaluate and publish analyses of the Secretary's plans for test phase activities, monitoring, transportation, operations, decontamination, retrieval, performance assessment, compliance with Environmental Protection Agency regulations, decommissioning, safety analyses, and other activities relating to WIPP.

(c) CONSULTATION AND COOPERATION.—The Secretary shall consult and cooperate with the EEG under the terms of Contract No. DE-AC04-89AL53309 in the performance of its responsibility to conduct an independent technical review and evaluation of WIPP under section 1433 of the National Defense Authorization Act, Fiscal Year 1989 (102 Stat. 2073).

SEC. 18. JUDICIAL REVIEW OF EPA ACTIONS.

A civil action for judicial review of any final action of the Administrator under this Act may be brought only in the United States Court of Appeals for the Tenth Circuit or for the District of Columbia, and shall be brought not later than the 60th day after the date of such final action.

SEC. 19. TECHNOLOGY STUDY.

Within 3 years after the date of the enactment of this Act, the Secretary shall submit to the Congress a study reviewing the technologies that are available and that are being developed for the processing or reduction of volumes of radioactive wastes. The study shall include an identification of technologies involving the use of chemical, physical, and thermal (including plasma) processing techniques.

SEC. 20. STATEMENT FOR PURPOSES OF PUBLIC LAW 96-164.

For purposes of subsection (c) of section 213 of the Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980 (Pub. L. 96-164; 93 Stat. 1265), this Act shall be considered to amend such section.

SEC. 21. CONSULTATION AND COOPERATION AGREEMENT.

Nothing in this Act shall affect the Agreement or the Supplemental Stipulated Agreement between the State and the United States Department of Energy except as explicitly stated herein.

SEC. 22. BUY AMERICAN REQUIREMENTS.

(a) COMPLIANCE WITH BUY AMERICAN ACT.—No funds appropriated or transferred pursuant to this Act may be expended by an entity unless the entity agrees that in expending the assistance the entity will comply with sections 2 through 4 of the Act of March 3, 1933 (41 U.S.C. 10a-10c, popularly known as the “Buy American Act”).

(b) PURCHASE OF AMERICAN-MADE EQUIPMENT AND PRODUCTS.—

(1) IN GENERAL.—In the case of any equipment or product that may be authorized to be purchased with financial assistance provided under this Act, it is the sense of the Congress that entities receiving the assistance should, in expending the assistance, purchase only American-made equipment and products.

(2) NOTICE TO RECIPIENTS OF ASSISTANCE.—In providing financial assistance under this Act, the Secretary shall provide to each recipient of the assistance a notice describing the statement made in paragraph (1) by the Congress.

SEC. 23. AUTHORIZATIONS OF APPROPRIATIONS.

(a) FOR ADMINISTRATOR.—

(1) IN GENERAL.—There are authorized to be appropriated to the Administrator for the purpose of fulfilling the responsibilities of the Administrator under this Act, $10,000,000 for fiscal year 1992, $12,000,000 for fiscal year 1993, $14,000,000 for fiscal year 1994, and such sums as may be necessary for fiscal years 1995 through 2001.

(2) REPORT.—The Administrator shall, not later than September 30, 1993, and annually thereafter, issue a report to the Congress on the status of and resources required for the fulfillment of the Administrator’s responsibilities under this Act.

(b) TRANSFERS FROM SECRETARY TO ADMINISTRATOR AND SECRETARY OF LABOR.—The Secretary is authorized to transfer from amounts appropriated for environmental restoration and waste management for fiscal years 1992 and 1993, and (to the extent approved in appropriation Acts) for fiscal years 1994 through 2001, such sums as may be necessary to fulfill the responsibilities of the Administrator under this Act and the Secretary of Labor under, paragraphs (4) and (6) of section 6(b).

(c) ACQUISITION OF LEASEHOLD.—There are authorized to be appropriated to the Secretary such sums as may be necessary to acquire the Federal Oil and Gas Leases No. NMNM 02953 and No. NMNM 02953C.

Approved October 30, 1992.
Amended September 23, 1996.

U.S. NUCLEAR REGULATORY COMMISSION

U.S. ENVIRONMENTAL PROTECTION AGENCY

Joint Guidance on Testing Requirements for Mixed Radioactive and Hazardous Waste

Clarification of RCRA Hazardous Waste Testing Requirements for Low-Level Radioactive Mixed Waste—Final Guidance

Disclaimer: The policies discussed in this document are not final Agency actions, but are intended solely as guidance. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. The Environmental Protection Agency and Nuclear Regulatory Commission may follow the guidance, or act at variance with the guidance, based on an analysis of specific site circumstances. The agencies also reserve the right to change the guidance at any time, without public notice.

I. Background

Mixed waste is defined as waste that contains both hazardous waste subject to the requirements of the Resource Conservation and Recovery Act (RCRA) and source, special nuclear, or byproduct material subject to the requirements of the Atomic Energy Act (AEA).[1] This guidance addresses testing activities related to mixed low-level waste (LLW), which is a subset of mixed waste.[2] The term ''mixed waste,'' for the purposes of this document, will refer to mixed LLW. Additional information on the testing of hazardous wastes, which could apply to both mixed LLW and other types of mixed waste (e.g., high-level and transuranic mixed waste), is found in Appendix A. The information below is intended for use by Nuclear Regulatory Commission (NRC) licensees that may not be familiar with the hazardous waste characterization and testing requirements that apply to mixed waste. The guidance assumes that the reader is familiar with the NRC's regulations and regulatory framework for the management of radioactive material and focuses on compliance with the Environmental Protection Agency's (EPA's) requirements for the management of hazardous waste. Although it is written for commercial mixed waste generators, the guidance may also be useful for Federal facilities that generate mixed waste.

Users of this guidance should have a good understanding of how mixed waste is defined (see above), and what authority, or authorities, regulate mixed waste testing activities. The hazardous component of mixed waste is regulated by EPA in those States where EPA implements the entire RCRA Subtitle C hazardous waste program (i.e., unauthorized States). Currently, EPA regulates mixed waste in Alaska, Hawaii, Iowa, Puerto Rico, the Virgin Islands, and American Samoa. In most instances mixed waste is regulated by State governments. Thirty-nine States and one territory (Guam) have been delegated authority by EPA to implement the base RCRA hazardous waste program and to regulate mixed waste activities (see 51 *FR* 24504, July 3, 1986, and Appendix B). These States are referred to as ''mixed waste authorized States.'' Nine additional States are authorized for the RCRA base hazardous waste program but have not been delegated authority by EPA to regulate mixed waste.[3] In these States mixed waste is not regulated by EPA, but may be regulated by States under the authority of State law. It is important that licensees contact the State hazardous waste agencies in authorized States to determine the specific testing, analysis, and other hazardous waste requirements that may apply to mixed waste managed in their State, because their State may have more stringent requirements than the Federal requirements discussed in this guidance.

This guidance describes:

(1) The current regulatory requirements for determining if a waste is a RCRA hazardous waste;
(2) The role of waste knowledge for hazardous waste determinations;
(3) The waste analysis information necessary for proper treatment, storage, and disposal of mixed waste; and,
(4) The implications of the RCRA land disposal restrictions (LDRs) on the waste characterization and analysis requirements.

This information should be useful for:

(1) radioactive waste generators, who must determine if their waste is a RCRA hazardous waste, and therefore a mixed waste;

(2) for those generators storing mixed waste on-site in tanks, containers or containment buildings for longer than 90 days, that consequently become responsible for complying with RCRA and NRC storage requirements; and
(3) those facilities that accept mixed waste for off-site treatment, storage, or disposal.

Generators and/or treatment, storage, and disposal facilities (TSDFs) handling wastes under RCRA must characterize their waste for several purposes:

(1) To determine if their waste is a hazardous waste (40 CFR 262.11);
(2) To comply with general waste analysis requirements for new or permitted TSDFs, for TSDFs operating under interim status, and for certain generators that treat land disposal prohibited wastes in 40 CFR 264.13, 265.13 and 268.7, respectively. These analysis requirements include:
(a) chemical/physical analysis of a representative sample (and/or, in some cases, use waste knowledge (see below); and,
(b) preparation of a waste analysis plan.
(3) To meet the waste analysis requirements that apply to the specific waste management methods in 40 CFR 264.17, 264.314, 264.341, 264.1034(d), and 268.7;
(4) To ensure, prior to land disposal, that the restricted waste meets the required treatment standard (40 CFR 268.7).[4]

This guidance addresses the need for chemical analysis of mixed wastes to meet these purposes. The guidance also emphasizes ways in which unnecessary testing of mixed waste may be avoided. This is important when handling mixed waste, since each sampling, workup, or analytical event may involve an incremental exposure to radiation. This guidance encourages mixed waste handlers to use waste knowledge, such as process knowledge, where possible, in making RCRA hazardous waste determinations involving mixed waste. It also encourages the elimination of redundant testing by off-site treatment and disposal facilities, where valid generator-supplied, and certified, data are available.

Because mixed waste testing may pose the possibility of increased radiation exposures, this guidance also describes methods by which individuals who analyze mixed waste samples may reduce their occupational radiation exposure and satisfy the intent of the RCRA testing requirements. Testing to determine whether wastes are hazardous under the RCRA toxicity characteristic may pose special concerns which are examined in Section III of this guidance.

All of the activities described in this guidance are subject to the requirements of both the AEA and RCRA. The focus of this guidance is the RCRA requirements. NRC and NRC Agreement State licensees are authorized to receive, possess, use (which includes storing, sampling, testing, and treating), and dispose of AEA-licensed materials. NRC licensees handling mixed waste should ensure that their RCRA hazardous waste testing activities are consistent with NRC, or Agreement State, regulations and license conditions. Flexibility in the RCRA requirements is emphasized so that the As Low As is Reasonably Achievable (ALARA) concept can be incorporated into the mixed waste testing activities.[5] If other AEA requirements, or RCRA requirements are difficult to meet in a specific mixed waste management situation, licensees should seek resolution by requesting license amendments, approval of modifications to their RCRA permits or interim status Part A applications, or resolution under both authorities.

Section 1006(a) of RCRA states ''Nothing in this Act shall be construed to apply to (or authorize any State, interstate, or local authority to regulate) any activity or substance which is subject to * * * the Atomic Energy Act of 1954 * * * except to the extent that such application (or regulation) is not inconsistent with the requirements of such Acts.'' If a resolution cannot be achieved through the flexibility provided by the two regulatory frameworks, then and only then, should licensees seek resolution under Section 1006(a) of RCRA. Licensees should note that, if an inconsistency exists, relief will be limited to that specific RCRA requirement, and that the determination of an inconsistency would not relieve the licensee from all other RCRA requirements. Section 1006(a) and radiological hazard considerations are addressed more fully in Sections III and IV of this guidance. NRC licensees should also include the necessary flexibility in their RCRA permit waste analysis plans to accommodate the sampling and testing required to meet AEA requirements.

II. Use of Waste Knowledge for Hazardous Waste Determinations

The use of waste knowledge by a generator and/or a TSDF to characterize mixed waste is recommended throughout this document to eliminate unnecessary or redundant waste testing. EPA interprets "waste knowledge" or "acceptable knowledge" of a waste broadly to include, where appropriate:

- "Process knowledge";
- Records of analyses performed by generator or TSDF prior to the effective date of RCRA regulations; or,
- A combination of the above information, supplemented with chemical analysis.

Process knowledge refers to detailed information on processes that generate wastes subject to characterization, or to detailed information (e.g., waste analysis data or studies) on wastes generated from processes similar to that which generated the original waste. Process knowledge includes, for example, waste analysis data obtained by TSDFs from the specific generators that sent the waste off-site, and waste analysis data obtained by generators or TSDFs from other generators, TSDFs or areas within a facility that test chemically identical wastes.[6]

Waste knowledge is allowed by RCRA regulations for the following hazardous waste characterization determinations:

- To determine if a waste is characteristically hazardous (40 CFR 262.11(c)(2)) or matches a RCRA listing in 40 CFR Part 261, Subpart D (40 CFR 262.11(a) and (b));
- To comply with the requirement to obtain a detailed chemical/physical analysis of a representative sample of the waste under 40 CFR 264.13(a);
- To determine whether a hazardous waste is restricted from land disposal (40 CFR 268.7(a)); and,
- To determine if a restricted waste the generator is managing can be land disposed without further treatment (see the generator certification in 40 CFR 268.7(a)(3) and information to support the waste kn/wledge determination in 40 CFR 268.7(a)(6)).

Hazardous waste, including mixed waste, may be characterized by waste knowledge alone, by sampling and laboratory analysis, or a combination of waste knowledge, and sampling and laboratory analysis. The use of waste knowledge alone is appropriate for wastes that have physical properties that are not conducive to taking a laboratory sample or performing laboratory analysis. As such, the use of waste knowledge alone may be the most appropriate method to characterize mixed waste streams where increased radiation exposures are a concern. Mixed waste generators should contact the appropriate EPA regional office to determine whether they possess adequate waste knowledge to characterize their mixed waste.

III. Determinations by Generators That a Waste Is Hazardous

A solid waste is a RCRA hazardous waste if it meets one of two conditions:

(1) the waste is specifically "listed" in 40 CFR Part 261, Subpart D, or;
(2) the waste exhibits one of the four "characteristics" identified in 40 CFR Part 261, Subpart C. These characteristics are:

- Ignitability;
- Corrosivity;
- Reactivity; or,
- Toxicity.

(a) Listed Hazardous Wastes

Generators of waste containing a radioactive and solid waste component must establish whether the solid waste component is a RCRA hazardous waste. Determinations of whether a waste is a listed hazardous waste can be made by comparing information on the waste stream origin with the RCRA listings set forth in 40 CFR Part 261, Subpart D. These listings are separated into three major categories or lists, and are identified by EPA hazardous waste numbers. Most hazardous waste numbers are associated with a specific waste description, specific processes that produce wastes, or certain chemical compounds. For example, K103 waste is defined as "process residues from aniline extraction from the production of aniline." A generator who produces such residues should know, without any sampling or analysis, that these wastes are "listed" RCRA hazardous wastes by examining the K103 hazardous waste description in the hazardous waste lists. Other hazardous waste numbers describe wastes generated from generic processes that are common to various industries and activities. These wastes are referred to as hazardous wastes from nonspecific sources. Radioactively contaminated spent solvents are the most likely mixed wastes to be nonspecific source listed wastes. For example, a generator using one of the F002 halogenated solvents (e.g., tetrachloroethylene, trichloroethylene, and chlorobenzene, etc.) to remove paint from a radiologically contaminated surface, can determine that this waste is a listed RCRA hazardous waste by examining the F002 waste definition for the solvent type, and for a solvent mixture/blend, the percent solvent by volume.

In addition to wastes that are specifically listed as hazardous, the "derived from" and "mixture" rules state that any solid waste derived from the treatment, storage, or disposal of a listed RCRA hazardous waste, or any solid waste mixed with a listed RCRA hazardous waste, respectively, is itself a listed RCRA hazardous waste until delisted (see 40 CFR 261.3).[7] (Note that soil and debris can be managed as hazardous wastes if they contain listed hazardous wastes or they exhibit one or more hazardous waste characteristics. See hazardous debris definition in 40 CFR 268.2.)

Exceptions to the "mixture rule" and "derived from" rules exist for certain solid wastes. For example, wastewater discharges subject to Clean Water Act permits, under certain circumstances, are not RCRA hazardous (see 40 CFR 261.3(a)(2)(iv)). Also, hazardous wastes which are listed solely for a characteristic identified in Subpart C of 40 CFR Part 261 (e.g., a F003 spent solvent which is listed only because it is ignitable) are not considered hazardous wastes when they are mixed with a solid waste and the resultant mixture no longer exhibits any characteristic of a hazardous waste (see 40 CFR 261.3(a)(2)(iii)). Likewise, waste pickle liquor sludge "derived from" the lime stabilization of spent pickle liquor (e.g., K062) is not a RCRA listed hazardous waste, if the sludge does not exhibit a hazardous waste characteristic (see discussion below on characteristic hazardous wastes). It should be noted, however, that wastes such as F003 and K062 *must* meet LDR treatment standards. Outside of the exceptions mentioned here and in the RCRA regulations, a hazardous waste that was generated via the "mixture rule" or the "derived from" rule must be delisted through a specific EPA petition process for the listed waste to be considered only a solid waste, and no longer managed as a listed hazardous waste under the RCRA Subtitle C system.

When applying the mixture rule to hazardous wastes, including mixed wastes, generators should be aware that EPA prohibits the dilution (i.e., mixing) of land disposal restricted waste or treatment residuals as a substitute for adequate treatment (see 40 CFR 268.3). An exception to the prohibition is the dilution of purely corrosive, and in some cases, reactive, or ignitable nontoxic wastes to eliminate the characteristic, or the aggregation of characteristic wastes in (pre)treatment systems regulated under the Clean Water Act (55 *FR* 22665).

(b) Characteristic Hazardous Wastes

Hazardous characteristics are based on the physical/chemical properties of wastes. Thus, physical/chemical testing of waste may be appropriate for determining whether a waste is a characteristic hazardous waste. *RCRA regulations, however, do not require testing. Rather, generators must determine whether the waste is a RCRA hazardous waste.* Such a determination may be made based on one's knowledge of the materials or chemical processes that were used. EPA's regulations are clear on this point. 40 CFR 262.11(c) states:

". . . if the waste is not listed [as hazardous waste] in Subpart D [of 40 CFR Part 261], the generator must then determine whether the waste is identified in Subpart C of 40 CFR Part 261 by either:

(1) Testing the waste according to the methods set forth in Subpart C of 40 CFR Part 261, or according to an equivalent method approved by the Administrator under 40 CFR 260.21; or
(2) Applying knowledge (emphasis added) of the hazardous characteristic of the waste in light of the materials or the processes used."

Therefore, where sufficient material or process knowledge exists, the generator need not test the waste to make a hazardous characteristic determination, although generators and subsequent handlers would be in violation of RCRA, if they managed hazardous waste erroneously classified as non-hazardous, outside of the RCRA hazardous waste system. For this reason, facilities wishing to minimize testing often assume a questionable waste is hazardous and handle it accordingly.

A generator must also comply with the land disposal restriction regulations in 40 CFR 268 which require the generator to determine whether the waste is prohibited from land disposal (refer to Section V for a detailed discussion of these requirements).[8] With respect to the hazardous characteristic, and the determination as to whether a waste is restricted from land disposal under 40 CFR 268.7(a), a generator may select the option of using waste knowledge. However, if the waste is determined to be land disposal restricted in 40 CFR 268.7(a), some testing will generally be required prior to land disposal, except where technologies are specified as the treatment standard. For mixed waste, EPA recommends that the frequency of such testing be held to a minimum, in order to avoid duplicative testing and repeated exposure to radiation.

In determining whether a radioactive waste is a RCRA hazardous waste, the generator may test a surrogate material (i.e., a chemically identical material with significantly less or no radioactivity) to determine the RCRA status of the radioactive waste. This substitution of a surrogate material may either partially or completely supplant the testing of the waste. A surrogate material, however, should only be used if the surrogate material faithfully represents the hazardous constituents of the mixed waste.[9] The following example discusses the use of surrogates. A generator is required to determine if a process waste stream containing lead (D008) exceeds the regulatory level of 5.0 milligrams per liter for the toxicity characteristic (40 CFR 261.24). If this determination cannot be made based on material and process knowledge only, the generator would need to test the hazardous material. Rather than testing the radioactive waste stream, the generator may opt to test a surrogate or chemically identical non-radioactive, or lower activity, radioactive waste stream generated by similar maintenance activities in another part of the plant. This substitution of materials is acceptable as long as the surrogate material faithfully represents the characteristics of the actual waste, and testing provides sufficient information for the generator to reasonably determine if the waste is hazardous under RCRA. Non-radioactive or lower activity quality control samples/species and spiked solutions, for instance, are acceptable to minimize exposure to radiation from duplicative mixed waste testing.

As part of the hazardous waste determination, a generator must document test results or other data and methods that it used. Specifically, 40 CFR 262.40(c) states that "a generator must keep records of any test results, waste analyses, or other determinations made in accordance with 40 CFR 262.11 for at least three years from the date that the waste was last sent to on-site or offsite treatment, storage, or disposal." Section V of this guidance contains information on record keeping requirements for land disposal restricted hazardous (and mixed) wastes.

In summary, testing listed wastes to make the hazardous waste determination is not necessary, because most RCRA hazardous waste codes or listings identify specific waste streams from specific processes or specific categories of wastes. Testing will most often occur to determine if a waste exhibits a hazardous characteristic. However, testing is not required if a generator has sufficient knowledge about the waste and its physical/chemical properties to determine that it is non-hazardous.[10] It is recognized that certain mixed waste streams, such as wastes from remediation activities or wastes produced many years ago, may have to be identified using laboratory analysis, because of a lack of waste or process information on these waste streams. Nonetheless, hazardous waste determinations based on generator knowledge can be used to reduce the sampling of mixed waste and prevent unnecessary exposure to radioactivity. The same principle holds for a generator's determination that a waste is subject to the RCRA land disposal restrictions in 40 CFR 268.7(a).

IV. Testing Protocols for Characteristics

When testing is conducted to determine whether a waste is a RCRA hazardous waste, there are acceptable test protocols or criteria for each of the four characteristics. Testing for characteristics must be done on a representative sample of the waste or using any applicable sampling methods specified in Appendix I of 40 CFR 261.[11]

Ignitability—For liquid wastes, other than aqueous solutions containing by volume less than 24 percent alcohol, the flash point is to be determined by a Pensky-Martens Closed Cup Tester, using the test method specified in American Society of Testing and Materials (ASTM) Standard D–93–79 or D–93–80, or a Setaflash Closed Cup Tester, using the test method specified in ASTM Standard D–3278–78, or as determined by an equivalent test method approved by the Administrator under procedures set forth in 40 CFR 260.20 and 260.21 (see "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," 3rd Ed., as amended, EPA, OSWER, SW–846, Methods 1010 and 1020[12]). (Non-liquid wastes, compressed gases, and oxidizers may exhibit the characteristic of ignitability as described in 40 CFR 261.21 (a)(2–4).)

Corrosivity—For aqueous solutions, the pH is to be determined by a pH meter using either an EPA test method (i.e., SW–846, Method 9040 or an equivalent test method approved by the Administrator under procedures set forth in 40 CFR 260.20 and 260.21.) For liquids, steel corrosion is to be determined by the test method specified in National Association of Corrosion Engineers (NACE) Standard TM–01–69 as standardized in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," 3rd Ed., as amended (EPA, OSWER, SW–846, Method 1110), or an equivalent test method approved by the Administrator under procedures set forth in 40 CFR 260.20 and 260.21.

Reactivity—There are no specified test protocols for reactivity. 40 CFR 261.23 defines reactive wastes to include wastes that have any of the following properties:

(1) normally unstable and readily undergoes violent change without detonating;
(2) reacts violently with water;
(3) forms potentially explosive mixtures with water;
(4) generates dangerous quantities of toxic fumes, gases, or vapors when mixed with water;
(5) in the case of cyanide- or sulfide-bearing wastes, generates dangerous quantities of toxic fumes, gases, or vapors when exposed to acidic or alkaline conditions;
(6) explodes when subjected to a strong initiating force or if heated under confinement;
(7) explodes at standard temperature and pressure; or
(8) fits within the Department of Transportation's forbidden explosives, Class A explosives, or Class B explosives classifications.[13]

EPA has elected to rely on a descriptive definition for these reactivity properties because of inherent deficiencies associated with available methodologies for measuring such a varied class of effects, with the exception of the properties discussed in No. 5, above. The method used, as guidance but not required, to quantify the reactive cyanide and sulfide bearing wastes is provided in Chapter 7 of ''Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,'' 3rd Ed., as amended, EPA, OSWER, SW–846.

Toxicity Characteristic—The test method that may be used to determine whether a waste exhibits the toxicity characteristic (TC) is the Toxicity Characteristic Leaching Procedure (TCLP), as described in 40 CFR Part 261, Appendix II (SW–846, Method 1311). The TCLP was modified and revised in 55 *FR* 11798, March 29, 1990. Note that this revised TCLP is used (in most cases) for land disposal restriction compliance determinations as well. Differences between the TCLP and the previously required Extraction Procedure (EP) include improved analysis of the leaching of organic compounds, the elimination of constant pH adjustment, the addition of a milling or grinding requirement for solids (waste material solids must be milled to particles less than 9.5 mm in size), and other more detailed alterations.[14] Additionally, the TC rule added 25 organic compounds to the toxicity characteristic. The TCLP (Method 1311) recommends the use of a minimum sample size of 100 grams (solid and liquid phases as described in Section 7.2). *For mixed waste testing, sample sizes of less than 100 grams can be used, if the analyst can demonstrate that the test is still sufficiently sensitive to measure the constituents of interest at the regulatory levels specified in the TCLP and representative of the waste stream being tested*. Other variances to the published testing protocols are permissible (under 40 CFR 260.20–21), but must be approved prior to implementation by EPA. Use of a sample size of less than 100 grams is highly recommended for mixed wastes with concentrations of radionuclides that may present serious radiation exposure hazards. Additionally, Section 1.2 of the TCLP allows the option of performing a ''total constituent analysis'' on a hazardous waste or mixed waste sample, instead of the TCLP. Section 1.2 of Method 1311 states:

If a total analysis of the waste demonstrated that the individual analytes are not present in the waste, or that they are present, but at such low concentrations that the appropriate regulatory levels could not possibly be exceeded, the TCLP need not be run.

For homogenous samples, the use of total constituent analysis in this manner eliminates the need to grind or mill solid waste samples. The grinding or milling step in the TCLP has raised ALARA concerns for individuals who test mixed waste. The use of total constituent analysis, instead of the TCLP, may also minimize the generation of secondary mixed or radioactive waste through the use of smaller sample sizes and reduction, or elimination, of high dilution volume leaching procedures.

Flexibility in Mixed Waste Testing

Flexibility exists in the hazardous waste regulations for generators, TSDFs, and mixed waste permit writers to tailor mixed waste sampling and analysis programs to address radiation hazards. For example, upon the request of a generator, a person preparing a RCRA permit for a TSDF has the flexibility to minimize the frequency of mixed waste testing by specifying a low testing frequency in a facility's waste analysis plan. EPA believes, as stated in 55 FR 22669, June 1, 1990, that ''the frequency of testing is best determined on a case-by-case basis by the permit writer.''

EPA's hazardous waste regulations also allow a mixed waste facility the latitude to change or replace EPA's test methods (i.e., *Test Methods for Evaluating Solid Waste* (SW–846)) to address radiation exposure concerns. There are only fourteen sections of the hazardous waste regulations that require the use of specific test methods or appropriate methods found in SW–846 which are outlined in Appendix A.[15] However, any person can request EPA for an equivalent testing or analytical method that would replace the required EPA method (see 40 CFR 260.21).

In a recent amendment to the testing requirements, EPA added language to SW–846 that describes fourteen citations in the RCRA program (listed in Appendix A) where the use of SW–846 methods is mandatory (Update II, 60 FR 3089, January 13, 1995). In all other cases, the RCRA program functions under what we call the Performance Based Measurement System (PBMS) approach to monitoring. Language clarifying this approach was included in the final FR Notice which promulgated Update III (62 FR 32542, June 13, 1997) and in appropriate sections

(Disclaimer, Preface and Overview, and Chapter 2) of SW–846. Under PBMS, the regulation and/or permit focus is on the question(s) to be answered by the monitoring, the degree of confidence (otherwise known as the Data Quality Objective (DQO)) or the measurement quality objectives (MQO) that must be achieved by the permittee to have demonstrated compliance, and the specific data that must be gathered and documented by the permittee to demonstrate that the objectives were actually achieved. ''Any reliable method'' may be used to demonstrate that one can see the analytes of concern in the matrix of concern at the levels of concern. Additional reference documents on the characterization and testing methods are listed in Appendix C.

NRC regulations do not describe specific testing requirements for wastes to determine if a waste is radioactive. However, both NRC and Department of Transportation regulations contain requirements applicable to characterizing the radioactive content of the waste before shipment. For example, NRC's regulations in 10 CFR 20.2006 require that the waste manifest include, as completely as practicable, the radionuclide identity and quantity, and the total radioactivity. NRC regulations also require that generators determine the disposal Class of the radioactive waste, and outline waste form requirements that must be met before the waste is suitable for land disposal. These regulations are referenced in 10 CFR 20.2006, and are outlined in detail at 10 CFR 61.55 and 61.56. Mixed waste generators are reminded that both RCRA waste testing and NRC waste form requirements must be satisfied. Generators may also be required to amend their NRC or Agreement State licenses in order to perform the tests required under RCRA. In addition, if an NRC licensee uses an outside laboratory to test his or her waste, that laboratory may be required to possess an NRC or Agreement State license. It is the responsibility of the generator to determine if the outside laboratory possesses the proper license(s) prior to transferring the waste to the laboratory for testing.

Where radioactive wastes (or wastes suspected of being radioactive) are involved in testing, it has been suggested that the testing requirements of RCRA may run counter to the aims of the AEA. The AEA requirements that have raised inconsistency concerns with respect to RCRA testing procedures include ALARA, criticality, and security. Neither EPA nor NRC is aware of any specific instances where RCRA compliance has been inconsistent with the AEA. However, both agencies acknowledge the potential for an inconsistency to occur.[16] A licensee or applicant who suspects that an inconsistency may exist should contact both the AEA and RCRA regulatory agencies. These regulatory agencies may deliberate and consult on whether there is an unresolvable inconsistency and, if one exists, they may attempt to fashion the necessary relief from the particular RCRA provision that gives rise to the inconsistency. However, all other RCRA regulatory requirements would apply. That is, such a conclusion does not relieve hazardous waste facility owner/operators of the responsibility to ensure that the mixed waste is managed in accordance with all other applicable RCRA regulatory requirements. Owner/operators of mixed waste facilities are encouraged to address and document this potential situation and its resolution in the RCRA facility waste analysis plan which must be submitted with the Part B permit application, or addressed in a permit modification.

Both agencies also believe that the potential for inconsistencies can be reduced significantly by a better understanding of the RCRA requirements, a greater reliance on materials and process knowledge, the use of surrogate materials when possible, and the use of controlled atmosphere apparatuses for mixed waste testing. Where testing is conducted, the use of glove boxes and other controlled atmosphere apparatuses during the testing of the radioactive waste material lessens radiation exposure concerns significantly. These protective measures may also help to reconcile the required testing requirements (including milling) with concerns about maintaining exposures to radiation ALARA and complying with other AEA protective standards. If such protective measures do not exist, or do not adequately reduce individual exposure to radiation or address other factors of concern, relief may be available under Section 1006 of RCRA.

V. Determinations by Treatment, Storage, or Disposal Facility Owner/Operators and Certain Generators to Ensure Proper Waste Management

General Waste Analysis

Owner/operators of facilities that treat, store, or dispose of hazardous wastes must obtain a chemical and physical analysis of a representative sample of the waste (see 40 CFR 264.13 for permitted facilities, or 40 CFR 265.13 for interim status facilities).[17] The purpose of this analysis is to assure that owner/operators have sufficient information on the properties of the waste to be able to treat, store, or dispose of the waste in a safe and appropriate manner.

The waste analysis may include data developed by the generator, and existing, published, or documented data on the hazardous waste or on hazardous waste generated from similar processes. In some instances, however, information supplied by the generator may not fully satisfy the waste analysis requirement. For example, in order to treat a particular waste, one may need to know not only the chemical composition of the waste, but also its compatibility with the techniques and chemical reagents used at the treatment facility. Where such information is not otherwise available, the owner/operator will be responsible for gathering relevant data on the waste in order to ensure its proper management.

The analysis must be repeated only if the previous analyses are inaccurate or needs updating. EPA regulations at 40 CFR 264.13(a)(3) do require that, at a minimum, a waste must be re-analyzed if:

(1) The owner/operator is notified, or has reason to believe, that the process or operation generating the waste has changed [in a way such that the hazardous property or characteristics of the waste would change]; and (2) For off-site facilities, when the results of the verification analysis indicate that the [composition or characteristics of the] waste does not match the accompanying manifest or shipping paper.

The requirements and frequency of waste analysis for a given facility are described in the facility's waste analysis plan. As required by 40 CFR 264.13(b), the waste analysis plan must specify the parameters for which each hazardous waste will be analyzed; the rationale for selecting these parameters (i.e., how analysis for these parameters will provide sufficient information on the waste's properties); and the test methods that will be used to test for these parameters. The waste analysis plan also must specify the sampling method that will be used to obtain a representative sample of the waste to be analyzed; the frequency with which the initial analysis of the waste will be reviewed or repeated, to ensure that the analysis is accurate and up to date; and, for off-site facilities, the waste analyses to be supplied by the hazardous waste generators. Finally, the waste analysis plan must note any additional waste analysis requirements specific to the waste management method employed, such as the analysis of the waste feed to be burned in an incinerator.

The appropriate parameters for each waste analysis plan are determined on an individual basis as part of the permit application review process. To reduce the inherent hazards of sampling and analyzing radioactive material, and in particular, the potential risk to workers from exposure to radiation posed by duplicative testing of mixed wastes, redundant testing by the generator and off-site facilities should be avoided. In addition, waste analysis plans must include provisions to keep exposures to radiation ALARA, and incorporate relevant AEA-related requirements and regulations.

Analysis Required to Verify Off-site Shipments

The owner/operator of a facility that receives mixed waste from off-site must inspect and, *if necessary,* analyze each hazardous waste shipment received at the facility to verify that it matches the identity of the waste specified on the accompanying LDR notification or manifest (see 40 CFR 264.13 or 265.13(c)). This testing is known as verification testing. Such inspections and analysis will follow sampling and testing procedures set forth in the facility's waste analysis plan, which is kept at the facility.

It should also be emphasized that, where analysis is necessary, *RCRA regulations do not necessarily require the analysis of every movement of waste received at an off-site facility*. As explained above, the purpose of the waste analysis is to verify that the waste received at off-site facilities is correctly identified, and to provide enough information to ensure that it is properly managed by the facilities.

For example, if a facility receives a shipment of several sealed drums of mixed waste, a representative sample from only one drum may be adequate, if the owner/operator has reason to believe that the chemical composition of the waste is identical in every drum. In such a case, the drum containing the least amount of measurable radioactivity could be sampled to minimize radiation exposures (variations in radioactivity do not necessarily suggest different chemical composition). This procedure also would apply to a shipment of several types of waste. If the owner/operator has reason to believe that the drums in the shipment contain different wastes, then selecting a representative sample might involve drawing a sample from each drum or drawing a sample from one drum in each ‘‘set’’ of drums containing identical wastes. Once this waste analysis requirement has been satisfied, routine retesting of later shipments would not be required if the owner/operator can determine that the properties of the waste he or she manages will not change.

Fingerprint Analysis Versus Full Scale Analysis

Full scale analysis (i.e., detailed physical and chemical analysis) may be used to comply with the waste analysis plan, including verification of off-site shipments. However, for mixed waste, abbreviated analysis or ‘‘fingerprint analysis’’ may be more appropriate to meet general waste analysis requirements. The test procedure should be determined on a case-by-case basis.

Fingerprint analysis (which may involve monitoring pH, percent water, and cyanide content) is particularly recommended for mixed waste streams with high radiation levels that are received by an off-site TSDF for RCRA waste manifest verification purposes. It may be appropriate to use full scale analysis, instead of, or after, fingerprint analyses, if the facility suspects that the waste was not accurately characterized by the generator, information provided by a generator is incomplete, waste is received for the first time, or the generator changes a process or processes that produced the waste.

Generators Who Treat LDR Prohibited Waste In Tanks, Containers or Containment Buildings To Meet LDR Treatment Requirements

Hazardous waste generators may treat hazardous wastes in tanks or containers without obtaining a permit if the treatment is done in accordance with the accumulation timeframes and requirements in 40 CFR 262.34. However, generators who treat hazardous waste (including mixed wastes) to meet the EPA treatment standards for land disposal prohibited wastes must also prepare a waste analysis plan similar to that prepared by TSDFs.

The plan must be based on a detailed analysis of a representative sample of the LDR prohibited waste that will be treated. In addition, the plan should include all the information that is necessary to treat the waste, including the testing frequency (See 40 CFR 268.7(a)(5)).

VI. Determinations Under the Land Disposal Restrictions

Generators, as well as treatment facilities and land disposal facilities, that handle mixed waste may have to obtain or amend their radioactive materials licenses if they test or treat mixed waste under the LDRs. The following discussion assumes that generators and treatment and disposal facilities have satisfied the requirement to obtain, or amend, their radioactive materials licenses, as appropriate.

Waste knowledge may also be used to satisfy certain waste characterization requirements imposed by the LDRs for mixed wastes. The Hazardous and Solid Waste Amendments (HSWA) to RCRA (P.L. 98–616), enacted on November 8, 1984, established the LDR program. This Congressionally mandated program set deadlines (RCRA Sections 3004(d)-(g)) for EPA to evaluate all hazardous wastes and required EPA to set levels, or methods, of treatment which would substantially diminish the toxicity of the waste, or minimize the likelihood of migration of hazardous constituents from any RCRA waste. Beyond specified dates, prohibited wastes that do not meet the treatment standards before they are disposed of, are banned from land disposal unless they are disposed of in a so-called ‘‘no-migration’’ unit (i.e., a unit where the EPA Administrator has granted a petition which successfully demonstrated to a reasonable degree of certainty that there will be no migration of hazardous constituents from the disposal unit for as long as the wastes remain hazardous) (40 CFR 268.6). Certain categories of prohibited wastes also may be granted extensions of the effective dates of the land disposal prohibitions (i.e., case-by-case and national capacity variances (40 CFR 268.5 and Subpart C, respectively). However, these wastes are still restricted and, if disposed in landfills or surface impoundments, must be disposed of in units meeting the minimum technology requirements.[18]

The requirements of the LDR program apply to generators, transporters, and owner/operators of hazardous waste treatment, storage, and disposal facilities. Not all hazardous wastes are subject to 40 CFR Part 268. For instance, certain wastes that are identified or listed after November 8, 1984, such as newly identified mineral processing wastes for which land disposal prohibitions or treatment standards have not yet been promulgated, are not regulated under 40 CFR Part 268.[19]

Determinations by Generators

Under 40 CFR 268.7(a), generators must determine whether their waste is restricted from land disposal (or determine if they are subject to an exemption or variance from land disposal (40 CFR 268.1)) by testing their waste (or a leachate of the waste developed using the TCLP or, in certain cases, the Extraction Procedure Toxicity Test (EP), or by using waste or process knowledge). If the waste exhibits the characteristic of ignitability (and is not in the High Total Organic Constituents (TOC) Ignitable Liquids Subcategory or is not treated by the "CMBST" or "RORGS" treatment technology in 40 CFR 268.42, Table 1), corrosivity, reactivity and/or organic toxicity, the generator must also determine the underlying hazardous constituents (UHCs) in the waste. Two exceptions to this requirement are:

(1) if these wastes are treated in wastewater treatment systems subject to the Clean Water Act (CWA) or CWA equivalent; or,
(2) if they are injected into a Class I, nonhazardous Underground Injection Control well. A UHC is any constituent listed in 40 CFR 268.48, Table UTS Universal Treatment Standards, with the exceptions of nickel, zinc and vanadium, which can reasonably be expected to be present at the point of generation of the hazardous waste, at a concentration above the constituent-specific UTS treatment standard. Determining the presence of the UHCs may be made based on testing or knowledge of the waste. The UHCs must meet the UTS before the waste may be land disposed.

If a generator chooses to test the waste rather than use waste or process knowledge for hazardous waste that is not listed and exhibits a characteristic only, the generator must use the TCLP. The only exception is TC metals.

Until the "Phase IV" LDR rule is promulgated in the spring of 1998, generators who characterize their wastes as TC toxic only for metals may use the EP instead of the TCLP result to determine if their waste is land disposal restricted, because the TC wastes do not have final EPA treatment standards whereas, at this time, the EP metals do. If the EP result is negative, the waste will still be considered hazardous, but is not prohibited from land disposal. The TCLP generally yields similar results as the EP. However, in certain matrices the TCLP yields higher lead and arsenic concentrations than the EP. The rationale for using the EP instead of the TCLP for characteristic wastes is explained in 55 FR 3865, January 31, 1991. For further guidance on using the EP for the land disposal restriction determination, refer to the Figures 1 and 2, of this guidance.

If a waste is found to be land disposal restricted, generators must determine if the waste can be land disposed without further treatment. A prohibited waste may be land disposed if it meets applicable treatment standards (whether through treatment or simply as generated), or is subject to a variance from the applicable standards. As explained above, this determination can be made either based on knowledge of the waste or by testing the waste, or waste leachate using the TCLP.

Generators who determine that their listed waste meets the applicable treatment standards must certify to this determination and notify the treatment, storage, or land disposal facility that receives the waste (40 CFR 268.7(a)(3)). Notification to the receiving facility must be made with the initial shipment of waste and must include the following information:

- EPA Hazardous Waste Number;
- Certification that the waste delivered to a disposal facility meets the treatment standard, and that the information included in the notice is true, accurate, and complete;
- Waste constituents that will be monitored for compliance if monitoring will not include all regulated constituents, for wastes F001-F005, F039, D001, D002, and D012-D043;
- Whether the waste is a non-wastewater or wastewater;
- The subcategory of the waste (e.g., ''D003 reactive cyanide''), if applicable;
- Manifest number; and,
- Waste analysis data (if available).

If a generator determines that a waste that previously exhibited a characteristic is no longer hazardous, or is subject to an exclusion from the definition of hazardous waste, a onetime notification and certification must be place in the generator's files (40 CFR 268.7(a)(7) or 268.9).

Generators who determine that their waste does not meet the applicable treatment standards must ensure that this waste meets the applicable standards prior to disposal. These generators may treat (or store) their prohibited wastes on-site for 90 days or less in qualified tanks, containers (40 CFR 262.34), or containment buildings (40 CFR 268.50), and/or send their wastes off-site for treatment.[20] When prohibited listed wastes are sent off-site, generators must notify the treatment facility of the appropriate treatment standards (40 CFR 268.7(a)(2)). This notification must be made with the initial shipment of waste and must include the following information:

- EPA Hazardous Waste Number;
- Waste constituents that the treater will monitor if monitoring will not include all regulated constituents, for wastes F001–F005, F039, D001, D002, and D012–D043;
- Whether the waste is a non-wastewater or wastewater;
- The subcategory of the waste (e.g., ''D003 reactive cyanide''), if applicable;
- Manifest number; and,
- Specified information for hazardous debris.

Generators whose wastes are subject to an exemption such as a case-by-case extension under 40 CFR 268.5, an exemption under 40 CFR 268.6 (a no-migration variance), or a nationwide capacity variance under 40 CFR 268, Subpart C must also notify the land disposal facility of the exemption. In addition, records of all notices, certifications, demonstrations, waste analysis data, process knowledge determinations, and other documentation produced pursuant to 40 CFR Part 268 must be maintained by the generator for at least three years from the date when the initial waste shipment was sent to on-site or off-site treatment, storage, or disposal (40 CFR 268.7(a)(8)).

Determinations by Treaters and Disposers

Owner/operators of treatment facilities that receive wastes that do not meet the treatment standards are responsible for treating the wastes to the applicable treatment standards or by the specified technology(ies). In addition, the owner/operators of treatment facilities must determine whether the wastes meet the applicable treatment standards or prohibition levels by testing:

(1) The treatment residues, or an extract of such residues using the TCLP, for wastes with treatment standards expressed as concentrations in the waste extract (40 CFR 268.40); and
(2) The treated residues (not an extract of the treated residues) for wastes with treatment standards expressed as concentrations in the waste extract (40 CFR 268.40).

This testing should be done at the frequency established in the facility's waste analysis plan. Owner/operators of treatment facilities, however, do not need to test the treated residues or an extract of the residues if the treatment standard is a specified-technology (i.e., a technology specified in 40 CFR 268.40 or 268.45, Table 1.—Alternative Treatment Standards for Hazardous Debris).

Owner/operators of land disposal facilities under the LDRs are responsible for ensuring that only waste meeting the treatment standards (i.e., wastes not prohibited from disposal or wastes that are subject to an exemption or variance) is land disposed. Like a treatment facility, a disposal facility must test a treatment residue or an extract of the treatment residue, except where the treatment standard is a specified technology.

Owner/operators must periodically test wastes received at the facility for disposal (i.e., independent corroborative testing) as specified in the waste analysis plan to ensure the treatment has been successful and the waste meets EPA treatment standards, except where the treatment standard is expressed as a technology.[21] The results of any waste analyses are placed in a TSDF's operating records along with a copy of all certifications and notices (40 CFR 264.73 or 40 CFR 265.73).[22]

Mixed Waste Under the LDRs

As clarified in the Land Disposal Restrictions rule published on June 1, 1990 (see EPA's "Third Third rule," 55 FR 22669, June 1, 1990), the frequency of testing, such as corroborative testing for treatment and disposal facilities, should be determined on a case-by-case basis and specified in the RCRA permit. This flexibility is necessary because of the variability of waste types that may be encountered. Mixed waste is unique for its radioactive/hazardous composition and dual management requirements. Each sampling or analytical event involving mixed waste may result in an incremental exposure to radiation, and EPA's responsibility to protect human health and the environment must show due regard for minimizing this unique risk. These are factors which should be considered in implementing the flexible approach to determining testing frequency spelled out in the Third Third Rule language. This flexible approach encourages reduction in testing where there is little or no variation in the process that generates the waste, or in the treatment process that treats the waste, and an initial analysis of the waste is available. Also, the approach may apply to mixed wastes shipped to off-site facilities, where redundant testing is minimized by placing greater reliance on the characterization developed and certified by earlier generators and treatment facilities. On the other hand, where waste composition is not well-known, testing frequency may be increased. Waste analysis plan conditions in the permits of mixed waste facilities should reflect these principles.

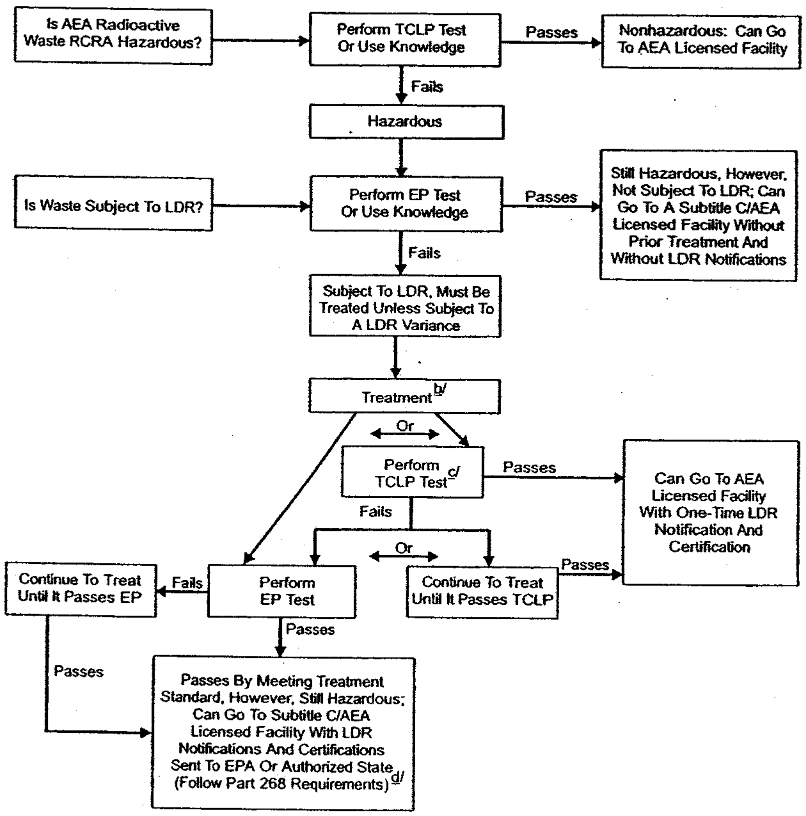
Revised Treatment Standards for Solvent Wastes

EPA promulgated revised treatment standards for wastewater and non-wastewater spent solvent wastes (F001–F005) in 57 FR 37194, August 18, 1992. The revision essentially converts the treatment standards for the organic spent solvent waste constituents (F001–F005) from TCLP based to total waste constituent concentration based. This conversion of the spent solvent treatment standards is particularly advantageous to mixed waste generators, since the entire waste stream or treatment residual must be analyzed (instead of a waste or treatment residual extract). This holds true for other mixed waste streams where the hazardous component is measured using a total waste analysis. As discussed in Section IV of this guidance, total constituent analysis has several advantages over the use of the TCLP for high activity waste streams.

EPA and NRC are aware of potential hazards attributable to testing hazardous waste. Moreover, EPA and NRC recognize that the radioactive component of mixed waste may pose additional hazards to laboratory personnel, inspectors, and others who may be exposed during sampling and analysis. All sampling should be conducted in accordance with procedures that minimize exposure to radiation and ensure personnel safety. Further, testing should be conducted in laboratories licensed by NRC or the appropriate NRC Agreement State authority. EPA and NRC believe that a combination of common sense, modified sampling procedures, and cooperation between State and Federal regulatory agencies will minimize any hazards associated with sampling and testing mixed waste.

Note: Section V, ''Determinations under the Land Disposal Restrictions (LDRs)'' and the following flow charts represent a brief summary of the Land Disposal Restriction Regulations. They are not meant to be a complete or detailed description of all applicable LDR regulations. For more information concerning the specific requirements, consult the **Federal Registers** cited in the document and the Code of Federal Regulations, Title 40 Parts 124, and 260 through 271.

FIGURE ONE: TESTING REQUIREMENTS
FOR CHARACTERISTIC LEAD AND ARSENIC NONWASTEWATERS ONLY[a/]



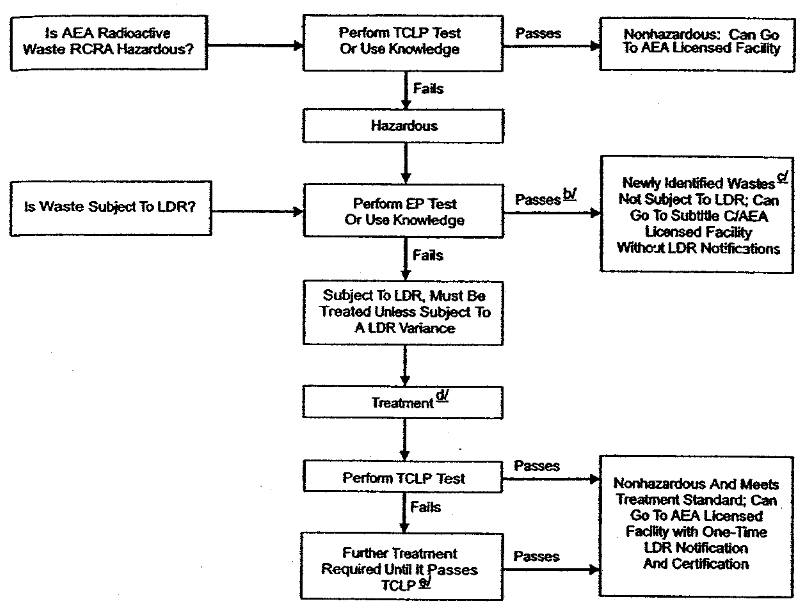
a/ Logic tree assumes the waste also contains AEA regulated radioactive waste.

b/ If the treatment standard is expressed as a specified technology, no further testing is required. However, the mixed waste must go to a Subtitle C/AEA licensed facility with LDR notifications and certifications.

c/ TCLP generally yields higher concentrations than EP for lead and arsenic in certain matrices.

d/ If the waste meets the treatment standard and passes the TCLP, it can go to an AEA licensed facility with one-time LDR notification and certification.

FIGURE TWO: TESTING REQUIREMENTS
FOR ALL OTHER CHARACTERISTIC METALS[a/]



a/ Logic tree assumes the waste also contains AEA regulated radioactive waste.

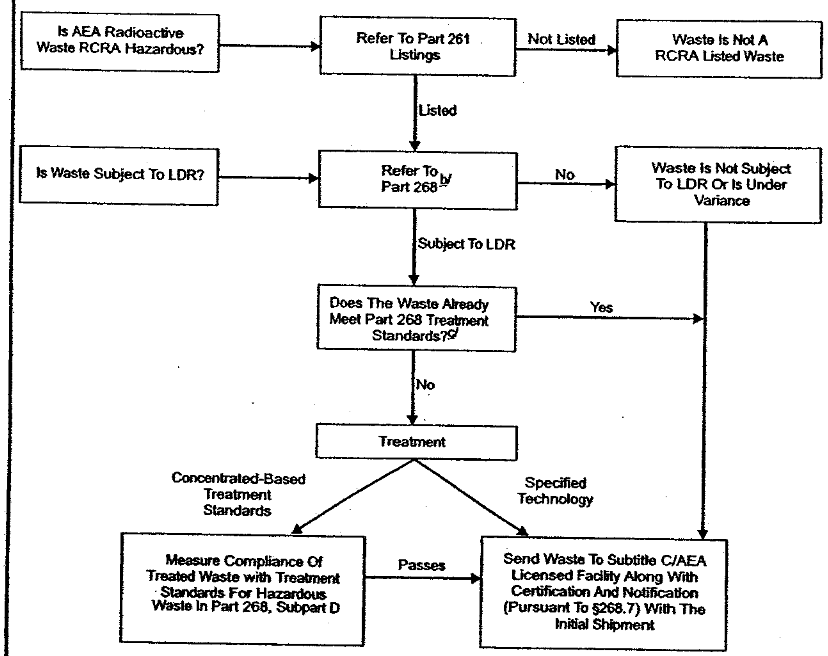
b/ This should be rare, since the two tests usually yield similar results.

c/ Wastes exhibiting the toxicity characteristic but not the EP are newly identified wastes and, therefore, are not subject to the land disposal restrictions at this time.

d/ If the treatment standard is expressed as a specified technology, no further testing is required. However, the mixed waste must go to a Subtitle C/AEA licensed facility with LDR notifications and certifications.

e/ Selenium is the one exception because it has a treatment standard slightly above the characteristic level.

FIGURE THREE: TESTING REQUIREMENTS FOR RCRA LISTED HAZARDOUS WASTES ONLY[a/]

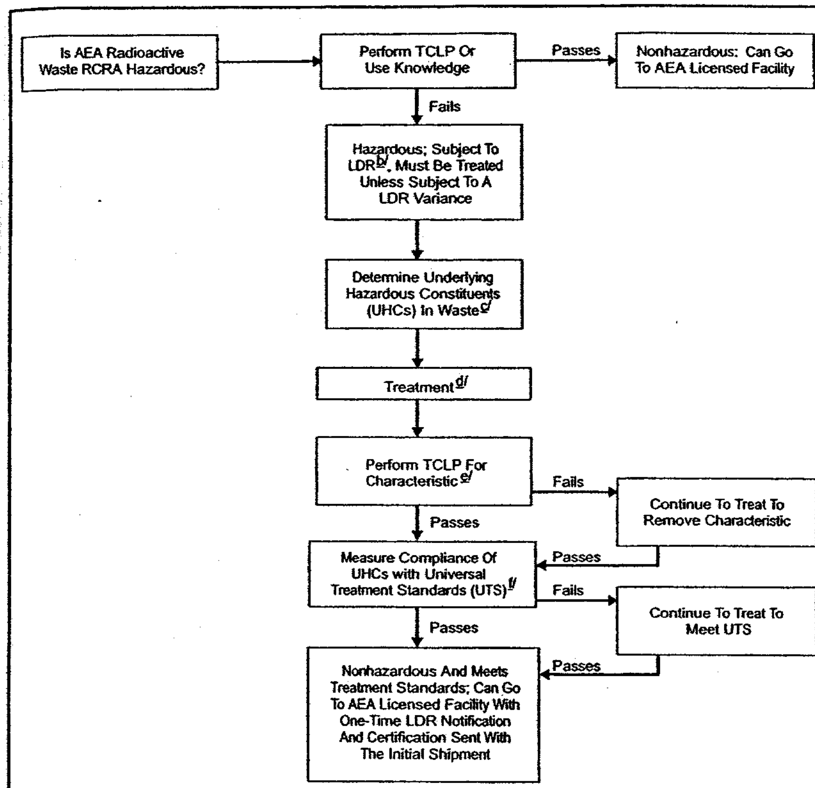


a/ Logic tree assumes the waste also contains AEA regulated radioactive waste.

b/ Refer to §268.1 to determine if LDR is applicable to waste. If so, test using TCLP or use process knowledge to determine if waste is restricted (§268.7).

c/ Test using TCLP or use process knowledge.

FIGURE FOUR: ORGANIC TOXICITY CHARACTERISTIC (TC) WASTES AND PESTICIDE WASTES[a/]



a/ Logic tree assumes the waste also contains AEA regulated radioactive waste.

b/ Restriction applies to TC organic and pesticide wastes managed in non-CWA/non-CWA equivalent/ non-Class I SDWA systems only.

c/ Testing or knowledge of waste may be used. A UHC is any constituent listed in §268.48 Table UTS, except zinc, that can reasonable be expected to be present at the point of generation of the hazardous waste, at a concentration above the constituent-specific UTS treatment standard.

d/ If the treatment standard is expressed as a specified technology, no further testing is required. However, the mixed waste must go to a Subtitle C/AEA facility with LDR notifications and certifications.

e/ Refer to the table "Treatment Standards for Hazardous Wastes" in 40 CFR Part 268, Subpart D.

f/ Compliance should be measured based on the appropriate testing protocols (see SW-846).

Appendix A—RCRA Regulations That Require Specific EPA Test Methods

The use of an SW–846 method is mandatory for the following nine Resource Conservation and Recovery Act (RCRA) applications contained in 40 CFR Parts 260 through 270:

- Section 260.22(d)(1)(I)—Submission of data in support of petitions to exclude a waste produced at a particular facility (i.e., delisting petitions);
- Section 261.22(a)(1) and (2)—Evaluations of waste against the corrosivity characteristic;
- Section 261.24(a)—Leaching procedure for evaluation of waste against the toxicity characteristic;
- Section 261.35(b)(2)(iii)(A)—Evaluation of rinsates from wood preserving cleaning processes;
- Sections 264.190(a), 264.314(c), 265.190(a), and 265.314(d)—Evaluation of waste to determine if free liquid is a component of the waste;
- Sections 264.1034(d)(1)(iii) and 265.1034(d)(1)(iii)—Evaluation of organic emissions from process vents;
- Sections 264.1063(d)(2) and 265.1063(d)(2)—Evaluation of organic emissions from equipment leaks;
- Section 266.106(a)—Evaluation of metals from boilers and furnaces;
- Sections 266.112(b)(1) and (2)(I)—Certain analyses in support of exclusion from the definition of a hazardous waste for a residue which was derived from burning hazardous waste in boilers and industrial furnaces;
- Sections 268.7(a), 268.40(a), (b), and (f), 268.41(a), 268.43(a)—Leaching procedure for evaluation of waste to determine compliance with land disposal treatment standards;
- Sections §270.19(c)(1)(iii) and (iv), and 270.62(b)(2)(I)(C) and (D)—Analysis and approximate quantification of the hazardous constituents identified in the waste prior to conducting a trial burn in support of an application for a hazardous waste incineration permit; and
- Sections 270.22(a)(2)(ii)(B) and 270.66(c)(2)(I) and (ii)—Analysis conducted in support of a destruction and removal efficiency (DRE) trial burn waiver for boilers and industrial furnaces burning low risk wastes, and analysis and approximate quantification conducted for a trial burn in support of an application for a permit to burn hazardous waste in a boiler and industrial furnace.

Appendix B.—States and Territories with Mixed Waste Authorization [As of June 30, 1997].

State/territory	FR date	Effective date	FR cite
Colorado	10/24/86	11/7/86	51 FR 37729.
Tennessee	6/12/87	8/11/87	52 FR 22443.
S. Carolina	7/15/87	9/13/87	52 FR 26476.
Washington	9/22/87	11/23/87	52 FR 35556.
Georgia	7/28/88	9/26/88	53 FR 28383.
Nebraska	10/4/88	12/3/88	53 FR 38950.
Kentucky	10/20/88	12/19/88	53 FR 41164.
Utah	2/21/89	3/7/89	54 FR 7417.
Minnesota	4/24/89	6/23/89	54 FR 16361.
Ohio	6/28/89	6/30/89	54 FR 27170.
Guam	8/11/89	10/10/89	54 FR 32973.
N. Carolina	9/22/89	11/21/89	54 FR 38993.
Michigan	11/24/89	12/26/89	54 FR 48608.
Texas	3/1/90	3/15/90	55 FR 7318.
New York	3/6/90	5/7/90	55 FR 7896.
Idaho	3/26/90	4/9/90	55 FR 11015.
Illinois	3/1/90	4/30/90	55 FR 7320.
Arkansas	3/27/90	5/29/90	55 FR 11192.
Oregon	3/30/90	5/29/90	55 FR 11909.
Kansas	4/24/90	6/25/90	55 FR 17273.
N. Dakota	6/25/90	8/24/90	55 FR 25836.
New Mexico	7/11/90	7/25/90	55 FR 28397.
Oklahoma	9/26/90	11/27/90	55 FR 39274.
Connecticut	12/17/90	12/31/90	55 FR 51707.
Florida	12/14/90	2/12/91	55 FR 51416.
Mississippi	3/29/91	5/28/91	56 FR 13079.
S. Dakota	4/17/91	6/17/91	56 FR 15503.
Indiana	7/30/91	9/30/91	56 FR 41959.
Louisiana	8/26/91	10/26/91	56 FR 41959.
Wisconsin	4/24/92	4/24/92	57 FR 15092.
Nevada	4/29/92	6/29/92	57 FR 18083.
California	7/23/92	8/1/92	57 FR 32725.
Arizona	11/23/92	1/22/93	57 FR 54932.
Missouri	1/11/93	3/12/93	58 FR 3497.
Alabama	3/17/93	5/17/93	58 FR 14319.
Vermont	6/7/93	8/6/93	58 FR 31911.
Montana	1/19/94	3/21/94	59 FR 2752.
New Hampshire	11/14/94	1/13/95	59 FR 56397.
Wyoming	10/04/95	10/18/95	60 FR 51925.
Delaware	8/8/96	10/7/96	61 FR 41345.
Total: 39 States and 1 Territory.			

Appendix C: Testing Reference Documents

The following references provide information on approved methods for testing hazardous waste samples:

American Public Health Association, *Standard Methods for the Examination of Water and Wastewater, 17th Edition.* 1989. Available from the Water Pollution Control Federation, Washington, D.C., #S0037.

U.S. Environmental Protection Agency, *Design and Development of a Hazardous Waste Reactivity Testing Protocol.* EPA Document No. 600/2–84–057, February 1984.

U.S. Environmental Protection Agency, *Methods for Chemical Analysis of Water and Waste.* EPA–6001114–79–020. Washington, D.C., 1983.

U.S. Environmental Protection Agency, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.* SW–846. Third Edition (1986) as amended. Available from the Government Printing Office, by subscription, 955–001–00000–1, or from the National Technical Information Service, PB88–239–223. Washington, D.C., January, 1995.

U.S. Environmental Protection Agency, *The New Toxicity Characteristic Rule: Information and Tips for Generators.* Office of Solid Waste, 530/SW–90–028, April, 1990.

U.S. Environmental Protection Agency, ORD, and U.S. Department of Energy, *Characterizing Heterogenous Wastes: Methods and Recommendations.* EPA/600/R-92/033, February 1992.

U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. ‘‘Joint EPA/NRC Guidance on the Definition and Identification of Commercial Mixed Low-Level Radioactive and Hazardous Waste,’’ Directive No. 9432–00–2, October 4, 1989.

Appendix D: List of Regulations

Environmental Protection Agency General Regulations for Hazardous Waste Management, 40 CFR Part 260.

Environmental Protection Agency Regulations for Identifying Hazardous Waste, 40 CFR Part 261.

Environmental Protection Agency Regulations for Hazardous Waste Generators, 40 CFR Part 262.

Environmental Protection Agency Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, 40 CFR Part 264.

Environmental Protection Agency Interim Status Standards for Owners and Operators of Hazardous Waste Facilities, 40 CFR Part 265.

Environmental Protection Agency Regulations on Land Disposal Restrictions, 40 CFR Part 268.

Nuclear Regulatory Commission Regulations—Standards for Protection Against Radiation, 10 CFR Part 20.

Nuclear Regulatory Commission Regulations—Rules of General Applicability to Domestic Licensing of Byproduct Material, 10 CFR Part 30.

Nuclear Regulatory Commission Regulations—Domestic Licensing of Source Material, 10 CFR Part 40.

Nuclear Regulatory Commission Regulations—Domestic Licensing of Production and Utilization Facilities, 10 CFR Part 50.

Nuclear Regulatory Commission Regulations—Licensing Requirements for Land Disposal of Radioactive Waste, 10 CFR Part 61.

Nuclear Regulatory Commission Regulations—Domestic Licensing of Special Nuclear Material, 10 CFR Part 70.

[FR Doc. 97–30528 Filed 11–19–97; 8:45 am]

FOOTNOTES

[1] See 42 U S.C. §6903 (41), added by the Federal Facility Compliance Act of 1992 (FFCA).

[2] See revised *Guidance on the Definition and Identification of Commercial Low-Level Radioactive and Hazardous Waste and Answers to Anticipated Questions,* October 4, 1989.

[3] The RCRA base hazardous waste program is the RCRA program initially made available for final authorization and includes Federal regulations up to July 26, 1982. However, authorized States have revised their programs to keep pace with Federal program changes that have taken place after 1982 in accordance with EPA regulation.

[4] Refer to Appendix A for specific EPA regulations pertaining to (1)–(4).

[5] ALARA, codified in 10 CFR Part 20, refers to the practice of maintaining all radiation exposures, to workers and the general public, as low as is reasonably achievable.

[6] For a more detailed discussion on process knowledge, see Section 1.5 in ‘‘Waste Analysis at Facilities That Generate, Treat, Store, and Dispose of Hazardous Wastes’’ OSWER 9938.4–03, April 1994.

[7] The ‘‘mixture’’ and ‘‘derived-from’’ rules were vacated and remanded due to EPA's failure to provide adequate notice and opportunity for comment before their 1980 promulgation, in *Shell Oil* v. *EPA,* No. 80–1532 (D.C. Cir. Dec. 6, 1991). At the Court's suggestion, EPA reinstated the ‘‘mixture’’ and ‘‘derived-from’’ rules as interim final until the rules are revised through new EPA rulemaking. The ‘‘mixture’’ and ‘‘derived from’’ rules adopted by those States with authorized RCRA programs were not affected by the court case or the subsequent reinstatement by EPA. For further information, see 57 *FR* 49278, October 30, 1992, and 60 *FR* 66344, December 21, 1995.

[8] Generators who also treat their waste are subject to the requirements for treatment facilities unless they treat waste in accumulation tanks,

containers, or containment buildings, for 90 days or less in accordance with 40 CFR 262.34(a). Treatment facilities must periodically test the treated waste residue from prohibited wastes to determine whether it meets the best demonstrated available technology (BDAT) treatment standards and may not rely on materials and process knowledge to make this determination (40 CFR 268.7(b)). This testing must be conducted according to the frequency specified in the facility's waste analysis plan (refer to Section IV of this guidance for a detailed discussion of treatment, storage, and disposal facility requirements).

[9] This definition of surrogate should not be confused with the definition of surrogate for the purposes of sampling and analysis quality control in Section 1.1.8 of "*Evaluating Solid Waste—Volume IA: Laboratory Test Methods Manual Physical/Chemical Methods.*"

[10] Note that characteristic only wastes (which are neither wastewater mixtures or RCRA listed hazardous wastes when generated) may be treated so that they no longer exhibit any of the four characteristics of a hazardous waste. However, these wastes may still be subject to the requirements of 40 CFR Part 268, even if they no longer exhibit a hazardous characteristic at the point of land disposal. After treatment this waste must not exhibit any RCRA hazardous waste characteristic *and* must meet applicable treatment standards before it can be considered a non-hazardous waste (see 57 *FR* 37263, August 18, 1992, and 58 *FR* 29869, May 24, 1993).

[11] Note that hazardous and mixed waste samples analyzed for waste characteristics or composition, and samples undergoing treatability studies may be exempt from all or part of the RCRA regulations if they are managed in accordance with 40 CFR 261.4 (d), (e) or (f).

[12] EPA incorporated by reference into the RCRA regulations (58 *FR* 46040, August 31, 1993), a third edition (and its updates) of "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods." The updates can be found in 60 *FR* 3089, January 13, 1995 (update II), 59 *FR* 458, January 4, 1994 (update IIA), 60 *FR* 17001, April 4, 1995 (update IIB), and 62 *FR* 32452, June 13, 1996 (update III). Hazardous and mixed waste

generators and management facilities should verify that the analytical method that they use to analyze hazardous waste has not been superseded in the third edition.

[13] When evaluating test protocols for explosive mixed waste, consideration should be given to the likelihood for dispersing radioactivity during detonation. Using process knowledge or a surrogate material would, in most instances, be appropriate for these wastes.

[14] Note that when using the TCLP, if any liquid fraction of the waste positively determines that hazardous constituents in the waste are above regulatory levels, then it is not necessary to analyze the remaining fractions of the waste. Extraction using the zero headspace extraction vessel (ZHE) is not required, furthermore, if the analysis of an extract obtained using a bottle extractor demonstrates that the concentration of a volatile compound exceeds the specified regulatory levels. The use of a bottle extractor, however, may not be used to demonstrate that the concentration of a volatile compound is below regulatory levels (40 CFR Part 261 Appendix II Sections 1.3 and .4).

[15] With the exception of the fourteen areas (see Appendix D) where test methods are required by hazardous waste regulation, use of EPA's *Test Methods for the Evaluation of Solid Waste* (SW–846) is not required, and should be viewed as guidance on acceptable sampling and analysis methods.

[16] An inconsistency occurs when compliance with one statute or set of regulations would necessarily cause non-compliance with the other. It may stem from a variety of considerations, including those related to occupational exposure, criticality, and other safeguards.

[17] A representative sample is defined in 40 CFR 260.10 as "a sample of a universe or whole (e.g., waste pile, lagoon, ground water) which can be expected to exhibit the average properties of the universe or whole." For further guidance see Chapter 9 of the EPA's testing guidance entitled *Test Methods for Evaluating Solid Waste* or SW–846.

[18] A prohibited waste may not be land disposed unless it meets the treatment standards established by EPA. These standards are usually based on the performance of the BDAT. A waste that is subject to an extension, such as a national capacity variance, does not need to comply with the BDAT treatment standards, but is ''restricted'' and if it is going to be disposed in a landfill or surface impoundment, it can only be disposed of in a unit that meets the minimum technology requirements (MTRs). An exception exists for interim status surface impoundments which may continue receiving newly identified and restricted wastes for four years from the date of promulgation of the listings or characteristics before being retrofitted to meet the MTRs (RCRA Section 3005(j)(6)), so long as the only hazardous wastes in the impoundment are newly identified or listed.

[19] The treatment standards for mineral processing wastes and certain additional newly listed waste streams were proposed in 61 *FR* 2338, January 25, 1996, and a second supplemental proposed rule signed April 18, 1997.

[20] Non-wastewater residues (e.g., slag) that result from high temperature metals recovery that are excluded from the definition of hazardous waste by meeting the conditions of 40 CFR 261.3(c)(2)(ii)(C), and hazardous debris that is excluded from the definition of hazardous waste in 40 CFR 261.3(f) have reduced LDR notification requirements. Specifically, these wastes, and characteristic hazardous wastes that are rendered non-hazardous, do not require a notification and certification accompanying each shipment. Instead, they may be sent to an AEA-licensed facility with a one-time notification and certification sent to the EPA Region or authorized State.

[21] Note that verification testing is a means to verify that the wastes received match the waste description on the manifest, which is required under 40 CFR 264.13 and 40 CFR 265.13(c). The main objective of corroborative testing is to provide an independent verification that a waste meets the LDR treatment standard.

[22] Land disposal facilities must maintain a copy of all LDR notices and certifications transmitted from generators and treaters (40 CFR 268.7(c)).

ACRONYMS/ABBREVIATIONS USED IN THIS GUIDANCE

AEA	Atomic Energy Act.
ALARA	As Low As Is Reasonably Achievable.
BDAT	Best Demonstrated Available Technology.
CFR	Code of Federal Regulations.
EP	Extraction Procedure (toxicity test).
EPA	Environmental Protection Agency.
FR	Federal Register.
HSWA	Hazardous and Solid Waste Amendments.
LDR	Land Disposal Restrictions.
NRC	Nuclear Regulatory Commission.
OSWER	Office of Solid Waste and Emergency Response.
RCRA	Resource Conservation and Recovery Act.
SW–846	Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods.
TC	Toxicity Characteristic.
TCLP	Toxicity Characteristic Leaching Procedure.
TSDF	Treatment, Storage or Disposal Facility.
WAP	Waste Analysis Plan.

Excerpts from U.S. Senate Report 108-105 and Bill S.1424

U.S. Senate Energy & Water Report 108-105

"Waste Analysis Requirements for the Waste Isolation Pilot Plant.—The Committee recognizes that the WIPP facility is central to the cleanup of the nuclear weapons complex and that waste should be emplaced as quickly and safely as possible—for reasons of reducing clean-up costs, public safety, and with the growing threat of radiological terrorism, for national security. Current law and regulation regarding the sampling and analysis of waste destined for WIPP produces substantial health and safety risks to workers with little if any corresponding public benefit. Both the New Mexico Environmental Evaluation Group, an independent WIPP oversight group, and the National Academy of Sciences have strongly suggested that waste destined for disposal at WIPP should not undergo hazardous waste sampling and analysis. To this end, the Committee believes that eliminating dangerous and excessive waste confirmation requirements that offer little if any benefit to the health and safety of the public will serve the national interests inherent in the safe and expeditious cleanup of the nuclear weapons complex. For these reasons, the Committee has included language in section 310 that requires that waste characterization be limited to determining that the waste is not ignitable, corrosive, or reactive. This confirmation will be performed using radiography or visual examination of a representative subpopulation of the waste. The language further directs the Secretary of Energy to seek a modification to the WIPP Hazardous Waste Facility Permit to implement the provisions of this bill by December 31, 2003. The Committee recommendation includes $1,000,000 for regulatory and technical assistance to the State of New Mexico to amend the existing WIPP Hazardous Waste Permit to comply with the provisions of the bill."

U.S. Senate Bill S.1424

Title: An original bill making appropriations for energy and water development for the fiscal year ending September 30, 2004, and for other purposes.
Sponsor: Sen Domenici, Pete V. [NM] (introduced 7/17/2003)
Cosponsors: (none)

"SEC. 310. (a) The Secretary of Energy is directed to file a permit modification to the Waste Analysis Plan (WAP) and associated provisions contained in the Hazardous Waste Facility Permit for the Waste Isolation Pilot Plant (WIPP). For purposes of determining compliance of the modifications to the WAP with the hazardous waste analysis requirements of the Solid Waste Disposal Act (42 U.S.C. 6901 et seq.), or other applicable laws waste confirmation for all waste received for storage and disposal shall be limited to (1) confirmation that the waste contains no ignitable, corrosive, or reactive waste through the use of either radiography or visual examination of a statistically representative subpopulation of the waste; and (2) review of the Waste Stream Profile Form to verify that the waste contains no ignitable, corrosive, or reactive waste and that assigned Environmental Protection Agency hazardous waste numbers are allowed for storage and disposal by the WIPP Hazardous Waste Facility Permit.

(b) Compliance with the disposal room performance standards of the WAP shall be demonstrated exclusively by monitoring airborne volatile organic compounds in underground disposal rooms in which waste has been emplaced until panel closure."

Peer Review Criteria, Findings, and Recommendation of the Review Panel

The findings of the Review Panel (RP) with respect to the review criteria are as follows:

Criterion 1

Is the elimination of the waste confirmation requirements mentioned in U.S. Senate Report 108-105 and Bill S. 1424 supported by the recommendations of the National Research Council (NRC) report "Improving Operations and Long-Term Safety of the Waste Isolation Pilot Plant"?

Finding 1 of the RP

The NRC committee was formed to respond to specific issues identified by the U.S. Department of Energy (DOE) and was disbanded in 2001. Consequently, the RP had no other choice but to rely exclusively upon the text of the NRC (2001) report.

The DOE has been exploring the waste characterization requirements necessary to satisfy the U.S. Environmental Protection Agency (EPA) and the requirements necessary to satisfy the New Mexico Environment Department (NMED). The EPA regulates the long-term repository containment of radionuclides. The following characterization requirements are needed to comply with EPA regulations:

1. Acceptable Knowledge (AK) and Non-Destructive Assay requirements listed in Appendix A of *Contact-Handled Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*; and

2. Radiography results for ferrous and non-ferrous metals; cellulose; rubber; plastics; and liquids.

The NMED focuses on the containment of materials regulated by Resource Conservation and Recovery Act (RCRA). Characterization requirements of NMED are as follows:

1. AK
2. Headspace gas
3. Solids sampling and analysis

4. Real-Time Radiography/Visual Examination (RTR/VE)
5. Compliance with Waste Acceptance Criteria as described in the Attachments B to the WIPP Hazardous Waste Facility Permit (HWFP)

Characterization requirements in compliance with transportation regulations are:

1. AK
2. RTR/VE
3. Headspace gas flammables analysis
4. Payload container surface dose measurements
5. Fissile material quantity measurements for payload containers
6. Radionuclide description for at least 95% of the activity in each shipment

In complying with transportation regulations, DOE determines when characterization activities beyond the initial AK would need to be used. For some wastes, AK contains sufficient information to comply with transportation regulations.

The U.S. Senate Bill S. 1424 states that waste confirmation for all waste received for storage and disposal shall be limited to:

1. confirmation that the waste contains no ignitable, corrosive, or reactive waste through the use of either radiography or visual examination of a statistically representative sub-population of the waste; and

2. review of the Waste Stream Profile Form to verify that the waste contains no ignitable, corrosive, or reactive waste and that assigned Environmental Protection Agency hazardous waste numbers are allowed for storage and disposal by the WIPP Hazardous Waste Facility Permit.

Reference is made to the 2001 NRC Report under the heading "Waste Characterization and Packaging Requirements",

Pages 77-78:

"__Finding:__ The committee found inadequate legal or safety bases for some of the National TRU Program requirements and specifications.

That is, some waste characterization specifications have no basis in law, the safe conduct of operations to emplace waste in WIPP, or long-term performance requirements [...]. The National TRU Program waste characterization procedures involve significant resources (e.g., expenditures of several billion dollars) and potential for exposure of workers to radiation and other hazards. Insofar as some of this waste characterization may be unnecessary, such characterization is inconsistent with economic efficiency and the ALARA principle that guides radiation protection practices [...]. The committee regards the 30+ years of waste emplacement operations and related worker safety issues at WIPP as posing no significant needs for waste characterization information, because no use of characterization data is made in any handling, shipping, or emplacement operations."

Page 78:

"***Recommendation:*** *DOE should eliminate self-imposed waste characterization requirements that lack a legal or safety basis. One way to justify a reduction in waste characterization requirements is through implementation of joint U.S. Nuclear Regulatory Commission (USNRC)-U.S. Environmental Protection Agency (EPA) guidance (62 Federal Register 62079;[...]), which appears to the committee to provide appropriate guidelines for implementation and integration of Resource Conservation and Recovery Act (RCRA) requirements for mixed TRU waste. Implementation of this regulatory guidance could significantly reduce the testing protocols and associated radiation exposure of personnel. Another way to justify a reduction is to identify the origins of all waste characterization requirements and to eliminate those requirements that lack a technical or safety basis. Such reductions may require modifications to existing permits granted by external regulating authorities such as the EPA and New Mexico Environment Department."*

Pages 78-80:

"***Rationale:*** *.... The committee sought to identify the connection between the National TRU Program procedures and the various regulatory, legal, and technical requirements that the procedures* *should be devised to meet. The committee views these requirements in a hierarchy, at the top of which are legal and safety requirements, with regulatory specifications at the next tier, procedures proposed by DOE to meet regulatory requirements at the third tier, and the DOE protocols for these procedures at the fourth tier.*

"The approach used by the committee was to focus on six primary National TRU Program procedures representative of high-level requirements that drive operational activities in waste characterization and repackaging [...]:

1. *determination that the TRU waste is of defense origin;*
2. *sampling and analysis of homogeneous waste;*
3. *headspace gas sampling and analysis;*
4. *radioassay of the plutonium content;*
5. *real-time radiography; and*
6. *visual examination.*

".... A review of these six procedures revealed that one may be interpreted too strictly by DOE and three are without a technical or legal foundation:

"Procedure 1: Determination that the TRU waste is of defense origin. WIPP is limited to defense-related waste as stipulated in the Land Withdrawal Act, with defense activities defined in the Nuclear Waste Policy Act of 1982. The committee notes that this definition includes the words 'in whole or in part', which can be interpreted to include mixtures of defense and nondefense waste, although DOE does not appear to take advantage of this (see DOE, 1997a; Nordhaus, 1996). That is, waste such as plutonium-238 (^{238}Pu)-contaminated scrap from a facility used for both defense and nondefense missions at Los Alamos National Laboratory would appear to qualify as defense waste under the definition, without the need for waste segregation restrictions.

"Procedure 2: Sampling and analysis of homogeneous waste. DOE has written, There is no regulatory requirement to conduct homogeneous waste sampling and analysis, however, in an effort to meet the

intent of 40 CFR 264.13, WIPP has imposed additional characterization requirements on the waste generators (Nelson, 1999[...], p. 2). No operational decisions are made based on these data; that is, the results of the sampling and analysis do not affect how waste is handled, so it is not clear what justifies the additional radiation exposure risk and cost of this procedure. In the committee's view, this sampling and analysis applied only to homogeneous waste is unnecessary: If acceptable knowledge documentation [...] provides sufficient characterization information for heterogeneous waste, the committee can identify no technical reason why acceptable knowledge should not also be adequate for homogeneous waste.

"Procedure 3: Headspace gas sampling and analysis. DOE informed the committee that there is no regulatory requirement to conduct headspace gas sampling and analysis, however, in an effort to meet the intent of 40 CFR 264.13, WIPP has imposed additional characterization requirements on the waste generators (Nelson, 1999[...], p. 3). The headspace gas sampling and analysis was developed as a means of checking on conformance with USNRC and the U.S. Department of Transportation (DOT) requirements [...]; however, these requirements can be met by other means [...].

"Procedure 6: Visual examination. Visual examination is done on a fraction of the waste containers to confirm the real-time radiography and acceptable knowledge waste characterization information (Nelson, 1999[...], p. 5). However, there is no requirement for verification of real-time radiography results. An alternative way to confirm these results without operator exposure would be to use standardized test drums. The visual examination confirmation is a self-imposed procedure that yields no benefit but results in increased risk of exposure and cost."

Furthermore the NRC (2001) suggested that a DOE study (1999) confirms that sampling and analysis of homogeneous waste (which frequently requires drilling into a radioactive waste container using a large drill to obtain a core sample), headspace gas sampling and analysis (which requires workers to establish a pathway into a radioactive waste container to attach a sample line, frequently done with a large needle), and visual examination (which requires workers to open a radioactive waste container and physically sort through its contents), are based on terms negotiated in a permit and not on a required regulation or legal mandate.

Page 80:

"....The committee sees no utility in the information that these procedures provide. Any speculative benefits of acquiring this information must be weighed against the risks and costs. The committee's judgment is that the collection of these data from superfluous procedures increases, rather than decreases, the risk and safety of the overall TRU waste operations." [The RP notes that the second term 'safety' in the quoted phrase conveys the opposite meaning from the first term 'risk'. Upon reading the complete text of the cited report, the RP concludes that the cited phrase should be read 'to reduce risk' rather than 'reduce risk and safety.']

"These superfluous characterization and intrusive procedures also represent a conflict with the ALARA principle. The issue of how to handle conflict between regulatory requirements for waste characterization information and ALARA is beyond the scope of the committee's statement of task. At issue, however, is whether the present TRU waste management program results in significantly more worker radiation exposure than is justified to satisfy safety and nonnegotiabie regulatory requirements."

Based on the careful evaluation of the NRC (2001) report, the RP concludes that the elimination of the waste confirmation requirements mentioned in U.S. Senate Report 108-105 and Bill S. 1424 is supported by the NRC.

Criterion 2

Is the elimination of the waste confirmation requirements mentioned in U.S. Senate Report 108-105 and Bill S. 1424 supported by various statements and other publications of the New Mexico Environmental Evaluation Group?

Finding 2 of the RP

As the Senate language was based on the statements and other publications of Environmental Evaluation Group (EEG), the RP had to rely upon the existing materials prepared by the EEG.

Responding to a question of the NRC (EEG 2003, page 2, #5): "What WIPP waste characterization requirements, if any, has DOE imposed that go beyond EPA, NMED, and transportation requirements?", the EEG response was:

"*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.*"

Silva (2002b, page 1) provided EEG's views to a committee of NRC by stating:

"*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' ...."

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, 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."

Silva (2002b, page 8) has also stated that:

"We see no technical reason why it is necessary to analyze for metals and chemicals at all. [...] 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 $\geq 5x10^5$ 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." [The RP does not understand this statement as it appears inconsistent with the above paragraph.]

"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."

In May 2002, based on the results of an EEG Report (Channell and Neill 1999), Silva (May 2002a, page 5) stated that:

"With respect to waste characterization for non-radiological constituents such as VOCs, the EEG's analyses indicate that the non-radiological risks are substantively less than the radiological risks[...]. The analyses suggest that these constituents do not require the same level of sampling characterization. Furthermore, it has been suggested that additional waste characterization of the non-radiological constituents may increase radiological risks to workers. The EEG recommends that the DOE analyze the efficacy of AK for RH TRU in the absence of confirmatory testing. However, until the data are generated and evaluated, the DOE should not deviate from the characterization process used for CH TRU. The DOE also needs to address the documents identified by the EEG which raise questions about AK at the generator/storage sites."

Furthermore, Channell and Walker (2000 page 60) of EEG concluded that:

"Even if VOC emissions are much higher than expected, the Confirmatory VOC Monitoring Plan at WIPP would detect concentrations that are three orders of magnitude below allowable Permit limits. Any hazardous emissions from pre-Permit wastes would likely be reported and acted on long before Permit limits were reached."

It appears that EEG agrees that the current characterization requirements are excessive. It appears that EEG also agrees that monitoring VOCs in underground disposal rooms is sufficient. The RP was unable to identify more details on views of EEG regarding the elimination of the waste confirmation requirements mentioned in U.S. Senate Report 108-105 and Bill S. 1424.

Criterion 3

Based on the information presented to the Review Panel, is the permit modification listed under Section 310 of U.S. Senate Bill S. 1424 technically defensible?

Finding 3 of the RP

In assessing the need for various characterization tests, the RP first evaluated the regulatory requirements. Regulations promulgated in implementing requirements of RCRA provide guidance on compliance with RCRA. Briefly, each generator is required to perform specific tasks as follows:

1. If the process used by the waste generator does not use or produce any of the classes covered under RCRA, then the waste is not covered under RCRA. Many organizations use the process knowledge to demonstrate exception from RCRA.

2. The generator performs specific tests as provided in the regulations, and can demonstrate a lack of presence of listed waste or passage of specific characteristic wastes.

3. The generator has also the option to request a delisting of the waste even if the process knowledge or the tests indicate coverage under RCRA. The delisting process is intended to remove those waste streams that pose insignificant risks from unnecessary and costly compliance with RCRA requirements.

4. If the process knowledge or various tests demonstrate that the waste is legally covered under RCRA and the waste is not delisted, the generator must treat the waste prior to its disposal. This latter requirement is referred to as Land Disposal Restrictions (LDR) and is intended to ensure the long-term safety of Disposal facilities permitted under RCRA.

For transuranic (TRU) waste, WIPP Managers have chosen to accept the fact that TRU waste includes RCRA constituents. As stated above, the consequence of such a decision is compliance with the requirements of LDR. However, the Waste Isolation Pilot Plant/Land Withdrawal Act exempts the WIPP from the coverage of LDR. Consequently, it appears that the WIPP managers would have to comply only with those RCRA requirements that are unrelated to LDR. These include those tests that would be required for the safety of operations. The safety-related requirements are those that are also covered by the transportation requirements—notably corrosivity, reactivity, and ignitability/flammability.

Acceptable knowledge can be one way in which compliance with the legal requirements is confirmed. EPA provides guidance in this regard. In particular, EPA (1994) provides guidance regarding waste analysis at facilities that generate, treat, store, and dispose of hazardous waste. Although EPA views representative sampling and laboratory analysis as the preferred method, acceptable knowledge is considered to be a viable alternative to meet waste analysis requirements. EPA (1994, page 1-11) indicates that:

"... generators and TSDFs also can meet waste analysis requirements by applying acceptable knowledge. Acceptable knowledge can be used to meet all or part of the waste analysis requirements."

Moreover, on pages 1-13 to 1-14 of EPA (1994) it is stated that:

"... there are situations where it may be appropriate to apply acceptable knowledge, including:
• Hazardous constituents in wastes from specific processes are well documented, such as with the F-listed and K-listed wastes.
• Wastes are discarded unused commercial chemical products, reagents or chemicals of known physical, and chemical constituents. Several of these fall into the P-listed and U-listed categories...
• Health and safety risks to personnel would not justify sampling and analysis (e.g., radioactive mixed waste).
• Physical nature of the waste does not lend itself to taking a laboratory sample."

The RP finds itself in agreement with the NRC (2001, page 77) that:

"... *some waste characterization specifications have no basis in law, the safe conduct of operations to emplace waste in WIPP, or long-term performance requirements.*"

The NRC (2001, page 80) identifies three tests as having no legal foundation and

"... sees no utility in the information that these procedures provide. Any speculative benefits of acquiring this information must be weighed against the risks and costs. The committee's judgment is that the collection of these data from superfluous procedures increases, rather than decreases, the risk and safety of the overall TRU waste operations." [The RP notes that the second term 'safety' in the quoted phrase conveys the opposite meaning from the first term 'risk'. Upon reading the complete text of the cited report, the RP concludes that the cited phrase should be read 'to reduce risk' rather than 'reduce risk and safety.']

In addition to NRC (2001) report, the RP evaluated a more recent relevant NRC (2002) report. The latter report adopts the conclusions of the NRC (2001) report, and provides the following recommendation (NRC 2002, page 49):

"The committee acknowledges that DOE must consider many non-technical factors in composing its characterization plan. However, DOE should propose only characterization activities that have a technical, health and safety, or regulatory basis."

As no evidence was provided that the views of the EEG—as presented in its statements and reports—had been subjected to independent peer review, the RP used the EEG information cautiously.

DOE has already agreed with the NRC recommendation to eliminate self-imposed waste characterization requirements that lack a legal or safety basis (NRC 2001, page 113). DOE has developed and begun the implementation of a strategy to systematically improve the Waste Analysis Plan by reducing the frequency of waste characterization and implementing methods that make characterization simpler, less expensive—and above all—safer. On August 8, 2000, the New Mexico Environment Department approved two packages of Class 2 modifications to the WIPP's Hazardous Waste Facility Permit that include:

1. The "miscertification rate" of TRU waste was revised to apply to the waste summary category group instead of each waste stream. This could result in a ten-fold reduction in the number of drums that must be opened for VE.

2. The solids sampling requirements for analysis of VOCs have been revised to allow use of one subsample instead of three subsamples. This could avoid a cost of approximately ten million dollars that the Idaho National Engineering and Environmental Laboratory would have had to spend in re-analyzing the samples.

3. The number of headspace gas samples required has been reduced for two types of waste streams to a statistically-selected number of drums, instead of 100% sampling. The two types of waste streams now eligible for statistical headspace gas sampling are: wastes that have been thermally processed; and homogeneous wastes with "acceptable knowledge" that demonstrate no volatile organic compounds have been present in the waste.

Approval of these modifications could result in significant cost savings associated with waste characterization and will reduce radiation exposures to workers.

Additionally, several modifications have been prepared and submitted that specifically address safety issues associated with TRU waste handling and disposal. One such modification, submitted in October 2000, will allow generators to remove from consideration for VE any containers that pose a safety concern. For example, if a generator determines that opening a container with a high fissile gram content is a safety hazard, that container can be ruled ineligible for VE and another container selected.

Based on the information presented to the Review Panel, the permit modification listed under Section 310 of U.S. Senate Bill S. 1424 is technically defensible. There is no reason to perform waste confirmation tests that:

1. provide insignificant health and safety benefits to the U.S. population; and
2. pose serious radiological and occupational health and safety risks for the workers performing these tests.

RECOMMENDATION

The RP recommends that the Mayor of Carlsbad make available this report to the U.S. Senate Committee for Energy and Water.

References

ASME/RSI (The American Society of Mechanical Engineers/Institute for Regulatory Science). Assessment of technologies supported by the U.S. Department of Energy; results of the peer review for fiscal year 1997, CRTD Vol. 47. New York: ASME; 1997.

ASME/RSI (The American Society of Mechanical Engineers/Institute for Regulatory Science). Assessment of technologies supported by the U.S. Department of Energy; results of the peer review for fiscal year 1998, CRTD Vol. 50. New York: ASME; 1998.

ASME/RSI (The American Society of Mechanical Engineers/Institute for Regulatory Science). Assessment of technologies supported by the U.S. Department of Energy; results of the peer review for fiscal year 1999, CRTD Vol. 56. New York: ASME; 1999.

ASME/RSI (The American Society of Mechanical Engineers/Institute for Regulatory Science). Assessment of technologies supported by the U.S. Department of Energy; results of the peer review for fiscal year 2000, CRTD Vol. 61. New York: ASME; 2000.

ASME/RSI (The American Society of Mechanical Engineers/Institute for Regulatory Science). Strategy for remediation of groundwater contamination at the Nevada Test Site; technical peer review report; report of the review panel, CRTD Vol. 62. New York: ASME; 2001a.

ASME/RSI (The American Society of Mechanical Engineers/Institute for Regulatory Science). Requirements for disposal of remote-handled transuranic wastes at the waste isolation pilot plant; technical peer review report; report of the review panel, CRTD Vol. 63. New York: ASME; 2001b.

ASME/RSI (The American Society of Mechanical Engineers/Institute for Regulatory Science). Assessment of technologies supported by the U.S. Department of Energy; results of the peer review for fiscal year 2001, CRTD Vol. 64. New York: ASME; 2001c.

ASME/RSI (The American Society of Mechanical Engineers/Institute for Regulatory Science). Waste isolation pilot plant initial report for polychlorinated biphenyl disposal authorization; technical peer review report; report of the review panel, CRTD Vol. 65. New York: ASME; 2002a.

ASME/RSI (The American Society of Mechanical Engineers/Institute for Regulatory Science). Airborne release fractions; technical peer review report; report of the review panel, CRTD Vol. 68. New York: ASME; 2002b.

ASME/RSI (The American Society of Mechanical Engineers/Institute for Regulatory Science). The beryllium oxide manufacturing process; technical peer review report; report of the review panel, CRTD Vol. 69. New York: ASME; 2002c.

ASME/RSI (The American Society of Mechanical Engineers/Institute for Regulatory Science). Assessment of technologies supported by the U.S. Department of Energy; results of the peer review for fiscal year 2002; CRTD Vol. 70. New York: ASME; 2002d.

ASME/RSI (The American Society of Mechanical Engineers/Institute for Regulatory Science). Radionuclide transport in the environment; technical peer review report; report of the review panel; CRTD Vol. 71. New York: ASME; 2002e.

ASME/RSI (The American Society of Mechanical Engineers/Institute for Regulatory Science). Review of selected nuclear safety programs at Savannah River Site; technical peer review report; report of the review panel, CRTD Vol. 72. New York: ASME; 2003a.

ASME/RSI (The American Society of Mechanical Engineers/Institute for Regulatory Science). Hanford Site 100 B/C Risk Assessment Pilot Project; technical peer review report; report of the review panel, CRTD Vol. 73. New York: ASME; 2003b.

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

DOE/AA (Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980). Public Law 96-164; 1979.

DOE (U.S. Department of Energy). Carlsbad area office interim guidance on ensuring that waste qualifies for disposal at the Waste Isolation Pilot Plant. Carlsbad, NM: DOE; (February 13) 1997a.

DOE (U.S. Department of Energy). Waste Isolation Pilot Plant disposal phase final supplemental environmental impact statement, vol. I, DOE/EIS-0026-S-2. Carlsbad, NM: DOE; 1997b.

DOE (U.S. Department of Energy). Findings and recommendations of the transuranic waste characterization task force, final report. Carlsbad, NM: DOE; (August 9) 1999.

EEG (Environmental Evaluation Group). EEG response to National Research Council committee's questions on transuranic waste characterization, December 6, 2002. Albuquerque, NM: EEG; (January 3) 2003.

EPA (U.S. Environmental Protection Agency). Environmental radiation protection standards for the management and disposal of spent nuclear fuel, high-level and transuranic radioactive wastes; final rule, 40 CFR 191. Fed. Reg. 58:66398-66416; 1993.

EPA (U.S. Environmental Protection Agency). Waste analysis at facilities that generate, treat, store and dispose of hazardous waste. A guidance manual. Washington, DC: EPA; 1994.

EPA (U.S. Environmental Protection Agency). Criteria for certification and re-certification of the waste isolation pilot plant's compliance with the disposal regulations: Certification decision; Final rule, 40 CFR 194. Fed. Reg. 61:27354-27406; 1996a.

EPA (U.S. Environmental Protection Agency). Test methods for evaluating solid waste, SW-846. Washington, DC: EPA Office of Solid Waste and Emergency Response; 1996b.

EPA (U.S. Environmental Protection Agency); USNRC (U.S. Nuclear Regulatory Commission). Joint USNRC/EPA guidance on the testing requirements for mixed waste. Fed. Reg. 62:62079-62094; 1997.

EPA (U.S. Environmental Protection Agency). Criteria for certification and recertification of the Waste Isolation Pilot Plant's compliance with the disposal certification decision regulations, 40 CFR 194. Fed. Reg. 63:27354-27406; 1998.

EPA (U.S. Environmental Protection Agency). Standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, 40 CFR 260 through 265, 268, and 270. Code of Federal Regulations. Washington, DC: Government Printing Press; 2000.

EPA (U.S. Environmental Protection Agency). 40 CFR Part 194, Criteria for the certification and recertification of the Waste Isolation Pilot Plant's compliance with the disposal regulations; alternative provisions; proposed rule. Fed. Reg. 67(154):51930-51946. Washington, DC: Government Printing Press; (August 9) 2002.

Gilbert, R.O. Statistical methods for environmental pollution monitoring. New York, NY: Van Nostrand Reinhold; 1987.

Moghissi, A.A. Classification of scientific information. Technol. J. Franklin Inst. 333A:1-2; 1996.

Nelson, R. E-mail correspondence to committee containing attachment of summaries of regulatory drivers for certain characterization activities. Carlsbad, NM: DOE; (May 11) 1999.

NMED (New Mexico Environment Department). New Mexico hazardous waste regulations. Title 20 New Mexico Administrative Code, Chapter 4, Part 1 (20 NMAC 4.1), subparts I through VI, subpart VIII, and subpart IX. Santa Fe, NM: NMED; 1997.

NMED (New Mexico Environment Department). WIPP permit number, NM4890139088-TSDF. Santa Fe, NM: NMED; 1999.

Nordhaus, R. Department of Energy memorandum. Interpretation of the term “Atomic Energy Defense Activities” as used in the Waste Isolation Pilot Plant Land Withdrawal Act. Washington, DC: DOE; (September 9) 1996.

NRC (National Research Council). Disposal of radioactive wastes on land. Washington, DC: National Academy Press; 1957.

NRC (National Research Council). A study of the isolation system for geologic disposal of radioactive wastes. Washington, DC: National Academy Press; 1983.

NRC (National Research Council). Review of scientific and technical criteria for Waste Isolation Pilot Plant (WIPP). Washington, DC: National Academy Press; 1984.

NRC (National Research Council). Improving operations and long-term safety of the Waste Isolation Pilot Plant, interim report. Washington, DC: National Academy Press; 2000.

NRC (National Research Council). Improving operations and long-term safety of the Waste Isolation Pilot Plant, final report. Washington, DC: National Academy Press; 2001.

NRC (National Research Council). Characterization of remote-handled transuranic waste for the Waste Isolation Pilot Plant: Final Report. Washington, DC: National Academy Press; 2002.

RCRA (Resource Conservation and Recovery ACT). Public law 94-580; 1976.

RSI (Institute for Regulatory Science). Peer review report; water quality program of department of natural resources of the commonwealth of Virginia. Alexandria, VA and Columbia, MD: RSI; 1998.

RSI (Institute for Regulatory Science). Technical peer review report; assessment of water quality studies in the vicinity of the Washington Aqueduct. Columbia, MD: RSI; 2002.

RSI (Institute for Regulatory Science). Assessment of desirability of the formation of a center of excellence on hazardous materials management in Carlsbad, New Mexico. Columbia, MD: RSI; 2003.

Silva, M. EEG's Statement before the Governor's WIPP Task Force, 5/21/02. Albuquerque, NM: Environmental Evaluation Group; (May 21) 2002a.

Silva, M. EEG Views on Wipp Characterization and transportation requirements. A statement provided to NAS/NRC WIPP COMMITTEE. Carlsbad, NM, October 29, 2002. Albuquerque, NM: Environmental Evaluation Group; (October 29) 2002b.

WIPP/LWA (Waste Isolation Pilot Plant Land Withdrawal Act) Public Law 102-579; 1992.

Biographical Summaries

Erich W. Bretthauer is currently President of the Bryce Meadows Development Corporation. He held the position of research professor at the University of Nevada-Las Vegas from January 1993 to March 1995. In that capacity, he served as Executive Director of Nevada Industry, Science Engineering & Technology, a public-private partnership which developed programs to enhance the scientific infrastructure of the state of Nevada. He was Assistant Administrator for Research and Development at the U.S. Environmental Protection Agency (EPA) from March 1990 until January 1993. In that capacity, he managed the Research and Development activities of a large and multi-disciplinary agency. Erich Bretthauer rose through the ranks of the EPA and served in a number of capacities ranging from a bench scientist to policy manager at national and international levels. He directed the EPA's emergency and long-term monitoring program after the accident at Three Mile Island, as well as its bioremediation program in Prince William Sound after the Valdez oil spill. He also directed the EPA's ecological research program from 1983-1986 and was Director of EPA's Environmental Monitoring Systems Laboratory in Las Vegas from 1986-1990. He is a member of Sigma Xi; the American Chemical Society; the American Association for the Advancement of Science; and the American Water Works Association; and has served on the Federal Advisory Committee to the Civil Engineering Research Foundation. Erich Bretthauer is the author and coauthor of numerous papers, reports, and other publications. He received his B.S. and M.S. in chemistry from the University of Nevada, Reno, NV.

Melvin W. Carter is currently an International Radiation Protection Consultant and Neely Professor Emeritus at Georgia Institute of Technology in Atlanta, GA. His fields of interest include: pollutant pathways in the environment and their kinetics; policy formulation in environmental protection and radiological protection; and procedures and methods for environmental surveillance. His other fields of interest are: the management of radioactive wastes; radiological engineering evaluations for criteria and standards; and the transportation of radioactive materials. He has provided consulting services to a large number of national and international organizations. He served as the Director of the Office of Interdisciplinary Programs at Georgia Tech, which included the Bioengineering Center and Environmental Resources Center. He was also Professor of Nuclear Engineering and Health Physics at Georgia Tech. He developed and taught graduate and undergraduate courses, which included: Nuclear Technology and the Environment; Radiation Protection in Nuclear Facilities; and Introduction to Bioengineering. He also taught Radiological Health Physics Practices. He was the Director of the National Environmental Research Center of the U.S. Environmental Protection Agency in Las Vegas, NV and the Southeastern Radiological Health Laboratory of the U.S. Public Health Service in Montgomery, AL. He performed research on radioactive water decontamination and waste disposal, and participated in investigative work on the accumulation of radioactivity in bottom sediments of the Clinch and Tennessee rivers. Melvin Carter is a member of the National Academy of Engineering, and has served on a number of committees, boards, and panels of the National Research Council. He is past President of the Health Physics Society, and past President of the International Radiation Protection Association. He served as Chair or a member of a number of scientific committees, and has been a member of the Board of Directors of the National Council on Radiation Protection and Measurements. He served as a presidential appointee as one of the nine-member Nuclear Waste Technical Review Board. He was inducted into Georgia Tech's Engineering Hall of Fame. Melvin Carter has published over 100 works, including several books. Melvin Carter received a B.S. degree in Civil Engineering, as well as a M.S. degree in Public Health Engineering from Georgia tech, and a Ph.D. in Radiological and Environmental Engineering, with a minor in Chemistry, from the University of Florida in Gainesville, FL.

Alan S. Corson is a consultant in hazardous waste issues. He has over 25 years of experience in a number of environmental issues, notably those related to the regulations and management of hazardous waste. Subsequent to his retirement from the U.S. Environmental Protection Agency (EPA), he served in an advisory role to Jacobs Engineering Group and to the Versar Corporation for both government and private sector clients regarding hazardous waste management programs. During his employment at the EPA, he worked at the Office of Solid Waste where he was responsible for regulatory programs and establishing national standards for generators and transporters of hazardous waste; development of sampling and analytic methods for evaluating solid/hazardous waste including the quality assurance/quality control program; and development and management of programs to establish risk assessment of hazardous waste management practices. Alan Corson was instrumental in the development of the original regulatory program defining standards for solid waste and hazardous waste, and setting national standards for recycling hazardous waste. He also initiated, developed, and managed the original program for restricting hazardous wastes from land disposal management options. The framework developed under this program is currently in-place and used for all evaluations in the land-ban program. Alan Corson served as the EPA Office of Solid Waste representative on many intra- and inter-agency workgroups including PCBs, Reportable Quantities, chlorinated solvents, and transportation of hazardous materials. He developed a guide for effective management of infectious wastes—a predecessor to the current regulatory program for medical wastes; characteristics and listings of hazardous waste; and many regulatory options papers for presentation. Alan Corson managed the preparation of numerous regulatory packages for all aspects of the program implementing the Resource Conservation and Recovery Act (RCRA). He has spoken widely and has taught numerous courses on RCRA and its various regulations. He served on numerous national and international panels including review panels of the American Society of Mechanical Engineers. He received a B.S. in Electrical Engineering and an M.S. in Engineering Management from the Drexel Institute of Technology in Philadelphia, PA.

Ernest L. Daman is Chairman Emeritus of Foster Wheeler Development Corporation where he previously served as Director of Research and Chairman of the Board. He also held the position of Senior Vice President at the parent company, FWC. He is a Past President of American Society of Mechanical Engineers and was elected to the National Academy of Engineering. Ernest Daman is a Fellow of the Institute of Energy (England) and the American Association for the Advancement of Science, and Past Chairman of the American Association of Engineering Societies. He served on several American Society of Mechanical Engineers committees as member or chairman. Ernest Daman is the author of numerous papers and holds 18 patents. He was responsible for the design and development of a combined steam gas turbine plant, fluidized bed combustion, fast breeder reactor components, supercritical steam generators, environmental control processes, and advanced high-efficiency power generation systems. Ernest Daman received his B.M.E. degree from the Polytechnic Institute of Brooklyn.

Nathan H. Hurt is a consultant in management and engineering with Technical and Management Consulting. He provides services to industrial firms and government agencies involved in environmental clean-up and waste management—both chemical and radioactive. He has extensive experience in the areas of executive management; plant management; engineering management; project management; marketing; and sales. He specializes in the areas of: uranium enrichment/production; engineering; development and marketing; plant management of rubber chemicals; petrochemicals; and thermoplastics. He also specializes in the engineering management of synthetic rubber and lattices; vinyl monomers and copolymers; polyesters; U.S. Department of Energy (DOE) weapons plants; quality assurance management; and operational readiness review. Nathan Hurt has been involved with the decommissioning of nuclear facilities. He was the Corporate Sponsor or Program Manager for seven decommissioning contracts at the DOE Complexes in Oak Ridge, TN; and Pinellas, FL. Previously, Nathan Hurt worked for Sharp and Associates, Inc. as the Director and Project Manager at the Oak Ridge Office. He was Vice President and Director of Oak Ridge Operations for IDM Environmental Corp., where he was responsible for the marketing and sales of decontamination, decommissioning, and waste management. He served as Project Manager for the laboratory quality assurance program at Westinghouse Hanford; DOE's Rocky Flats Plant—plant-wide identification of electrical equipment. He managed a study for a waste treatment and storage facility at the Portsmouth Area Uranium Enrichment Facility which included incineration and compaction of low-level radioactive wastes. He also worked for The Goodyear Tire and Rubber Company, including Goodyear Atomic, as Director of Research and Development, and President, where he was responsible for the operation of the Portsmouth Area Uranium Enrichment Facility. Nathan Hurt is a past President of, the American Society of Mechanical Engineers. He has been a member of: the American Association of Engineering Societies' Board of Governors; the American Institute of Chemical Engineers; and the Institute of Nuclear Materials Management. He is also a member of Tau Beta Pi Honorary Engineering Society; Pi Tau Sigma Honorary Mechanical Engineering Society; and was a member of The Nuclear Engineering Advisory Board of Worcester Polytechnic Institute. Nathan Hurt received a B.S. degree in Mechanical Engineering from the University of Colorado and has done Graduate, Technical, and Management course work at Pennsylvania State University. He is a registered Professional Engineer in Ohio.

Michael C. (M.C.) Kirkland is an independent consultant who led a team that performed a Congressionally-mandated External Independent Review of the $1.3 billion Spallation Neutron Source Project at Oak Ridge. He assisted in the planning and review of a management assessment at a U.S. Department of Energy (DOE) Site that involved the restart of a plutonium facility. He participated in planning, procurement, and review activities in the environmental remediation area that included decommissioning activities at a shut down nuclear test reactor; designed and installed a ground water cleanup technology. M.C. Kirkland managed several environmental and construction projects that employed many soil investigative techniques including significant work with cone penetrometers. Additionally, he provided consulting services to a large environmental remediation services company regarding Dense Non-Aqueous Phase Liquid locating and removal techniques. During his tenure at the SRS, M.C. Kirkland was a Technical Advisor, Project Manager, and Director of the Project Engineering Division. He evaluated nuclear and mixed waste conditions and aspects of high level wastes and spent nuclear fuel; determined material inventories; performed pollution prevention and environmental health and safety evaluations for a proposed waste treatment facility; served as technical advisor to a study administered by the Savannah River Operations Office; and developed integrated schedules defined for this project. M.C. Kirkland was director of the Project Engineering Division and managed the SRS design and construction program. He has been involved with waste management and environmental projects; cutting-edge technology programs; and worked with lasers and magnetic containment. He served as Director of the Waste and Fuel Cycle Technology Office, and planned and coordinated the programs of the DOE National High Level Waste Technology Office; the SR Fuel Cycle Technology Program; and the Commercial Interim Spent Fuel Management Program. M.C. Kirkland holds a B.S. in Mechanical Engineering from the University of South Carolina. He is registered as a Professional Engineer in South Carolina.

Betty R. Love is currently Executive Vice President of the Institute for Regulatory Science. In that capacity, she is responsible for the management of day-to-day operations of the Institute, and for administration of several projects. She is the Administrative Manager of a large-scale peer review program in collaboration with the American Society of Mechanical Engineers for a number of organizations including the U.S. Department of Energy. Her current research activities center around the development and implementation of a systematic approach to stakeholder participation, notably in scientific meetings. Previously, Betty Love was Director, Department of Training and Information within the Office of Environmental Health and Safety of Temple University in Philadelphia, PA. During that period she was instrumental in the development of a "Handbook of Environmental Health and Safety". She also developed and implemented a large-scale training program not only for the faculty and staff of the University but also for others. Betty Love is currently Managing Editor of *Technology.* She has published several papers in peer-reviewed journals; has edited a number of compendia; and is the primary author of *Manual for Public and Stakeholder Participation*. Betty Love received a B.S. degree in Business Administration from Virginia State University in Petersburg, VA, and an M.S. degree in Developmental Clinical Psychology from Antioch College in Yellow Springs, OH.

Robert E. Luna is currently a private consultant involved in the packaging and transportation of a wide variety of radioactive materials at national and international levels. His current interests range from risk assessment related to packaging and transportation of radioactive materials, to nuclear weapon accident phenomenology. Previously, he was Senior Manager for the Waste Legacy Program Development Office at Sandia National Laboratory. In that capacity, he was responsible for business development for the mining industry; Department of Defense environmental cleanup needs; U.S. Nuclear Regulatory Commission transportation technology; and application of environmental remediation technology to various U.S. Department of Energy sites. In addition, he was involved in the study of nuclear weapon safety, transportation risk assessment, and cask sabotage source terms. Prior to that position, he managed a number of programs dealing with environmental characterization and monitoring technology, and while at Sandia National

Laboratory, he was involved in the development of the Environmental Impact Statement for the Pantex Plant in Amarillo, TX. For nearly 20 years, Robert Luna was involved with increasing responsibility in various aspects of radioactive and hazardous material package design and transportation, including: package design and testing; structural and thermal analysis; material development; and information management. He led the development of RADTRAN risk assessment code; managed the development of regulatory guide NUREG 0170; and led national efforts related to the risk assessment of packaging and transportation of high level waste/spent nuclear fuel at Sandia. Robert Luna represented the U.S. Department of Energy at the International Atomic Energy Agency in the development of the document regulations for the transportation of radioactive materials and related topics. He managed and contributed to experiments which defined sabotage threat and the potential impact of the sabotage of spent nuclear fuel transportation casks, including: threat evaluation, source-term development, and damage evaluation. He was involved in the development of generation, transport, and the fate of aerosols resulting from nuclear weapons accidents, including mishaps during the stages of assembly, disassembly, deployment, and storage. Robert Luna is a Fellow of the American Society of Mechanical Engineers; a member of the American Nuclear Society; and a member of ANSI N14 Management Committee for Nuclear Material Packaging. He is on the Editorial Board of the *International Journal of Radioactive Material Transportation.* He was past Chair of the Bernalillo County Air Quality Control Board. He received the Department of Energy Award of Excellence for "Significant Contributions to the Nuclear Weapons Program in Plutonium Safety Issues". He is the author or coauthor of more than 100 publications. Robert Luna holds a B.S. degree in Mechanical Engineering from Rutgers University; an M.S. degree in Mechanical Engineering and a Ph.D. in Aerospace and Mechanical Sciences from Princeton University; and Master of Management degree from the Anderson Schools of Management, University of New Mexico. He is a registered Professional Engineer in New Mexico.

Peter Maggiore is currently Principal Scientist with Portage Environmental, in San Antonio, TX. There, he is a corporate resource regarding regulatory analysis, environmental compliance, and scientific matters. In addition, Peter Maggiore has responsibilities in the areas of quality assurance/quality control and business development. Prior to his current position, he served as Cabinet Secretary of the New Mexico Environment Department, reporting to the governor regarding all environmental matters. In his capacity as Secretary of Environment Department, he was responsible for drafting legislation, preparing regulations; enforcing regulations, and otherwise overseeing environmental protection in New Mexico. In addition, on numerous occasions he provided expert testimony at New Mexico and U.S. legislative and other hearings; and interacted with officials of the U.S. Environmental Protection Agency and other federal environmental officials. During his tenure, New Mexico Environment Department, he signed the RCRA B permit for the Waste Isolation Pilot Plant and was responsible for the enactment five major environmental laws. Prior to his appointment as Secretary, Peter Maggiore served at leading positions at the Environment Department. In addition he has extensive industrial experience. His academic experience includes appointments at the University of New Mexico and the University of Maine. He is a member of the National Water Well Association; New Mexico Hazardous Waste Management Society; New Mexico Geological Society; Albuquerque Geological Society; American Institute of Professional Geologists; and the Environmental Council of States. Peter Maggiore received a B.S. degree in Geology from the State University of New York at Stony Brook; and an M.S. degree in Geology from the University of New Mexico.

A. Alan Moghissi is currently President of the Institute for Regulatory Science (RSI), a non-profit organization dedicated to the idea that societal decisions must be based on best available scientific information. The activities of the Institute include research, scientific assessment, and science education at all levels—particularly the education of minorities. Previously, Alan Moghissi was Associate Vice President for Environmental Health and Safety at Temple University in Philadelphia, PA and Assistant Vice President for Environmental Health and Safety the University of Maryland at Baltimore. In both positions, he established an environmental health and safety program and resolved a number of relevant existing problems in those institutions. As a charter member of the U.S. Environmental Protection Agency (EPA), he served in a number of capacities, including Director of the Bioenvironmental/Radiological Research Division; Principal Science Advisor for Radiation and Hazardous

Materials; and Manager of the Health and Environmental Risk Analysis Program. Alan Moghissi has been affiliated with a number of universities. He was a visiting professor at Georgia Tech and the University of Virginia, and was also affiliated with the University of Nevada and the Catholic University of America. Alan Moghissi's research has dealt with diverse subjects ranging from measurement of pollutants to biological effects of environmental agents. A major segment of his research has been on scientific information upon which laws, regulations, and judicial decisions are based—notably risk assessment. He has published nearly 400 papers, including several books. He is the Editor-in-Chief of *Technology: A Journal of Science Serving Legislative, Regulatory*, and *Judicial Systems*, which traces its roots to the *Journal of the Franklin Institute*—one of America's oldest continuously published journals of science and technology. Alan Moghissi is a member of the editorial board of several other scientific journals and is active in a number of civic, academic, and scientific organizations. He has served on a number of national and international committees and panels. He is a member of a number of professional societies. He is a fellow at the American Society of Mechanical Engineers and is past chair of its Environmental Engineering Division. He is also an academic councilor of the Russian Academy of Engineering. Alan Moghissi received his education at the University of Zurich, Switzerland, and Technical University of Karlsruhe in Germany, where he received a doctorate degree in physical chemistry.

Lawrence C. Mohr, Jr., is currently Professor of Medicine, Biometry, and Epidemiology; and Director of the Environmental Biosciences Program at the Medical University of South Carolina. His areas of research and special interest include internal medicine and pulmonary disease—specifically diseases of the chest and respiratory system. An area of particular interest to Lawrence Mohr is environmental medicine, including molecular epidemiology and biomarker applications. He has been involved in studies related to environmental lung disease; pathophysiology; prevention and treatment of high altitude illness; high altitude physiology; risk assessment of environmental hazards and clinical epidemiology. Other areas of considerate interest to Lawrence Mohr are assessment of clinical outcomes; health policy analysis; and international health. This latter area includes: global epidemiology; medical relief operations; and health care in Central and Eastern Europe, as well as medical history—the impact of illness on world leaders. Previously, he held academic appointments as a Teaching Fellow in Medicine at the Uniformed Services University of the Health Sciences in Bethesda, MD. He was Associate Clinical Professor of Medicine and Emergency Medicine at George Washington University, Washington, DC. While in these institutions, he was a staff member of the Medical Support Group for the President of the United States. Lawrence Mohr was on the Medical Staff of Walter Reed Army Medical Center—where he completed his Internship and Residency in Internal Medicine—as well as George Washington University Hospital, both in Washington, DC. He has held Visiting Professorships at various universities. He served as Visiting Chief Resident at Presbyterian Hospital and Visiting Professor at the School of Nursing, both at Columbia University. Additionally, Lawrence Mohr was Visiting Professor of: William Beaumont Army Medical Center, Tulane University, University of Cincinnati, New York University, Brown University, East Carolina University, and the Mayo Clinic. Lawrence Mohr is a Fellow of the American College of Physicians and the American College of Chest Physicians. He is a member of several professional societies including: the American Federation for Medical Research; the Society for Risk Analysis; and the Wilderness Medical Society. Previously, he was on the Scientific Advisory Board for the Consortium in Environmental Risk Evaluation and the Savannah River Health Information System. He has authored or coauthored more than 60 articles, books, or technical publications. He received an A.B. degree in Chemistry as well as an M.D. degree, both from the University of North Carolina, Chapel Hill. Lawrence Mohr, Jr., is certified by the American Board of Internal Medicine.

John E. Moore is currently a Hydrogeologist at the Office of Water of the U.S. Environmental Protection Agency in Denver, CO. He is also an Adjunct Professor at Metro State College in Denver, CO, and a consulting hydrologist. His recent activities have included serving as a technical advisor, and planning geologic and hydrogeologic projects nationally and internationally. Prior to his current positions, he was Senior Hydrogeologist at Environmental Strategies Corporation, where he performed site investigations for property transfer, and aquifer remediation. He was a Technical Advisor at the U.S. Environmental Protection Agency in Washington, DC, where he conducted field investigations and prepared data for congressional hearings on the extent of groundwater contamination at U.S. Department of Energy facilities and military sites. Earlier, he was Deputy Assistant Chief Hydrologist at the U.S. Geological Survey in Reston, VA. While there, he was responsible for the Water Resources Division's publication program, and presented technical short courses to U.S. Geological Survey district and regional offices. Earlier in his career, he was head of the Southwest Florida U.S. Geological Survey Office; Ground Water Specialist and head of hydrologic studies at the U.S. Geological Survey regional office in Denver, CO; and an assistant in hydrogeologic studies at the Nevada Test Site. John Moore is past President of the International Association of Hydrogeologists and of the American Institute of Hydrology. He is a Fellow of the Geological Society of America, and a member of the American Geophysical Union. He is an honorary Life Member of the International Association of Hydrogeologists, where he is also Chair of the Education and Training Commission. John Moore is on the Editorial Board of *Environmental Geology and Hydrology and Hydrogeology*. He is author or coauthor of over 70 publications. He received a B.A. degree in Geology from Ohio Wesleyan University in Delaware, OH, and an M.S. degree and a Ph.D. in Geology from the University of Illinois, Urbana, IL. He is a registered Professional Geologist in the state of Wyoming, and is certified as a Professional Hydrogeologist by the American Institute of Hydrology.

Goetz K. Oertel's career in engineering, physics, chemistry, astronomy, and technical program management spans more than 40 years. He consults for industrial, academic, and governmental organizations in North and South America. As President and CEO of the Association of Universities for Research Astronomy, a nonprofit corporation, he engineered the initiation and completion of two 8-m aperture optical telescopes, and oversaw the Space Telescope Science Institute from before launch, through repair of the "Hubble flaw", to its successful operation. He initiated the conceptional phase of the Next Generation Space Telescope that will succeed Hubble as well as the Advanced Solar Telescope, and he oversaw the completion of ambitious ground-based astronomy facilities. He held technical and management positions in the U.S. Department of Energy, including Director of Defense Waste Management; Acting Manager of the Savannah River Operations Office; Deputy Manager of Albuquerque Operations Office; and Deputy Assistant Secretary for Safety, Health, and Quality Assurance. He had primary responsibility for the congressionally-mandated Defense Waste Management Plan, and for managing the related technology development, operations, and projects. He led the initiation of the Defense Waste Processing Facility, and saw it and the Waste Isolation Pilot Plant through technical, managerial, stakeholder, and political challenges. He was National Aeronautics and Space Administration Space Science Chief and Program Manager, and Aerospace Engineer at Langley. He was a Fellow in the White House with the President's Science Advisor and the Office of Management and Budget's Space and Energy branch. He chaired the Westinghouse West Valley Corporation Technical Advisory Group for high-level nuclear waste vitrification and management before, during, and after that project's successful vitrification campaign. He is a member of the American Physical Society, Sigma Xi, and other professional organizations. He is a Fellow of the American Association for the Advancement of Science. He is Chair or member of boards and committees of the National Research Council; George Mason University; the American Society of Mechanical Engineers; International University Exchange; and Westinghouse West Valley Corporation. He is a founding member of the Editorial Board for "Data Science", the new international on-line journal of Codata. He published numerous peer-reviewed papers and was awarded two patents. Trained as electrical engineer and physicist, he received a Vordiplom in Physics and Chemistry from the University of Kiel while on German industrial and governmental scholarships, and a Ph.D. in Physics from University of Maryland at College Park under a Fulbright scholarship.

Harold W. Olsen is a Research Professor in the Division of Engineering and the Department of Geology and Geological Engineering at the Colorado School of Mines. He is also a Scientist Emeritus of the U.S. Geological Survey. His experience includes research regarding geological and environmental hazards, including landslides; subsidence; expansive soils; and subsurface contamination. This research involves interrelationships between the geologic characteristics of unconsolidated earth materials and their geomechanical and hydrologic properties. It also includes the development and application of new experimental capabilities for geotechnical measurements on undisturbed core samples that provide experimental control on the chemistry and degree of saturation of soil pore fluids, and on arbitrary stress and strain paths. Recently Harold Olsen has been working on a National Aeronautics and Space

Administration contract through the University of Colorado entitled *Identification and Mapping of Expansive Clay Soils in the Western U.S. Using Field Spectrometry and AVIRIS Data*; and a National Science Foundation grant entitled *The Importance of Osmosis in the Volumetric Behavior of Earth Materials.* Formerly, he was a Research Civil Engineer at the U.S. Geological Survey Engineering Geology Branch and Earthquake and Landslide Hazards Branch. His projects included the investigation of physicochemical and physical phenomena that can increase the vulnerability of ground to failure with time, and that can be used to strengthen and stabilize weak or failed ground. These phenomena include chemical causes of groundwater movement, and chemical and saturation effects on the permeability, compressibility, and strength of argillaceous materials. Harold Olsen conducted reviews of geotechnical aspects of Preliminary Safety Analysis Reports concerning proposed nuclear reactor sites for the Atomic Energy Commission. He also has worked as a Geotechnical Consultant in U.S. Geological Survey Technical Assistance Programs in Peru, Indonesia, and Bangladesh. He is an expert on soil properties and behavior, and the application of geotechnical data to studies of terrestrial and marine environments. Harold Olsen has been Editor-In-Chief of the American Society of Civil Engineers' Journal *Geotechnical and Geoenvironmental Engineering,* and a member of the American Society of Civil Engineers' Geo-Institute Awards Committee. His current professional society activities include membership in the: American Society of Civil Engineers' Geo-Institute Technical Publications Committee; American Society of Civil Engineers' Committee on Engineering Geology; American Society for Testing and Materials Committee D-18 on Soil and Rock for Engineering Purposes; and Highway Research Board Committee A2L03 on the Physicochemical Properties of Soils. He has authored or coauthored over 100 papers, reports, and conference contributions. Harold W. Olsen received S.B., S.M., and Sc.D. degrees in Civil Engineering from the Massachusetts Institute of Technology in Cambridge, MA. He is a certified Professional Hydrologist (Groundwater).

Wren Prather-Stroud is Manager of Western Operations of the Institute for Regulatory Science (RSI). In that capacity, she manages the day-to-day operation of the RSI office in Carlsbad, NM, and interacts with RSI clients in various western states—notably New Mexico and

Nevada. Her current activities include assisting in the development of the RSI stakeholder participation approach; stakeholder information workshops; and other activities related to public participation in technical aspects of societal decisions. Previous to her current position, Wren Prather-Stroud was employed at Westinghouse where she was responsible for the preparation of various reports; feature articles for the U.S. Department of Energy (DOE) and DOE contractor publications; interaction with DOE contractors; and special writing assignments. For example, she prepared responses to eight recommendations included in a report of the National Research Council. Wren Prather-Stroud was also involved in the study of shipping TRU waste to the Waste Isolation Pilot Plant by rail, and chaired the WIPP Rail Working Group. Wren Prather-Stroud is an accomplished Master sculptor working with bronze and clay, and her sculptures are featured in numerous public and private locations in New Mexico and other states. She received a Bachelor of Arts degree in English from the University of Denver, with a minor in Advertising & Public Relations.

Fritz A. Seiler is currently President of Sigma Five Consulting—a company devoted to the application of computer technology to solve environmental problems. He has over 30 years experience in research involving physics and risk assessment, with a broad background in nuclear physics, health physics, toxicology, uncertainty analysis, and risk management. He was a faculty member at the University of Basel, Switzerland where he conducted research in nuclear physics, including: experimental and theoretical studies reactions between light nuclei (fusion reaction) and studies on neutron interactions; neutron activation analysis; prompt gamma measurements; and similar topics. In addition, he accepted an appointment as Staff Officer for Nuclear-Biological-Chemical (NBC) Warfare Defense on the Swiss Army Command. In this capacity, he assessed and minimized NBC risks to military and civilian populations. Subsequently, he assumed an additional appointment as Commanding Officer of the Swiss Army's 37 radiation laboratories coordinating sampling; data collection; risk evaluation; and risk management. Subsequent to immigration to the United States, Fritz Seiler joined the Lovelace Inhalation Toxicology Research Institute. In that capacity, he was involved in risk assessment of chemical and radiological agents, cost-risk-benefit analysis emphasizing economics, and uncertainty analysis. He was also involved in the study of nuclear radiation dosimetry;

environmental dispersion; chemical and radiological materials transport; and new sampling methods. He performed a wide variety of measurements, data evaluation, and statistics, as well as theoretical modeling and systems simulation. Later, he joined IT corporation and continued and expanded his previous activities. For a one year period, Dr. Seiler was a Vice President with the Institute for Regulatory Science—a not-for-profit organization involved with the application of best available science, including peer review to societal decisions. Dr. Seiler is Fellow of the American Physical Society and has been designated Distinguished Technical Associate of IT Corporation. He is a member of the Society of Risk Analysis; the Health Physics Society; the American Nuclear Society, (Member of NCRP Liaison Committee); and the American National Standards Institute. He has published more than 120 scientific papers in the areas of physics, risk assessment, and risk management. Fritz Seiler received a Baccalaureate in Economics from the Basel School of Economics, and a Ph.D. in Physics from the University of Basel, Switzerland.

Sorin R. Straja is currently Vice President for Science and Technology of the Institute for Regulatory Science. He has over 20 years of expertise in mathematical modeling and software development as applied in chemical engineering and risk assessment. Previously, he served as Assistant Professor of Biostatistics with Temple University, Philadelphia; as Director of the Department of Occupational Health and Safety of Temple University, Philadelphia; and as a chemist with University of Maryland at Baltimore. Sorin Straja has extensive experience in the chemical industry where he worked as a senior R&D consultant with the Chemical and Biochemical Energetics Institute, and as a plant manager with Chemicals Enterprise Dudesti and Plastics Processing Bucharest from Romania. He was an Assistant/Adjunct Professor of Chemical Engineering with the Polytechnic Institute Bucharest. Sorin Straja is the author of two books and 44 scientific papers published in internationally recognized and peer-reviewed journals. He was an editor of *Environment International,* and currently is a contributing editor of *Technology.* Sorin Straja received a Certificate of Appreciation for Teaching from Temple University, the "Nicolae Teclu" Prize of the Romanian Academy, and a Certificate of Appreciation from U.S. Department of Agriculture for significant volunteer contributions. He is a Fellow of the Global

Association of Risk Professionals, and a member of the American Chemical Society, American Institute of Chemical Engineers, Society for Risk Analysis, and New York Academy of Sciences. Sorin Straja holds a M.S. in Industrial Chemistry and a Ph.D. in Chemical Engineering both from Polytechnic Institute Bucharest.

Bruce M. Thomson is a Professor in the Department of Civil Engineering at the University of New Mexico. His interests cover a wide area of environmental systems, including: disposal of hazardous materials in arid ecosystems; treatment of radioactive wastewater; development of barriers for containment of contaminated sites; and in-situ immobilization of inorganic contaminants. He has been an instructor and Graduate Fellow at Rice University's Department of Environmental Science and Engineering; Environmental Engineer for the U.S. Environmental Protection Agency; and Visiting Professor at the Tyndall Air Force Base Headquarters Engineering and Services Center. He has taught courses in waste management, and has supervised graduate students in the areas of hazardous and radioactive waste management, and environmental restoration. Bruce Thomson is a member of: the American Chemical Society; the Water Pollution Control Federation; the Association of Groundwater Scientists and Engineers; the Association of Environmental Engineering Professors; and the American Society of Civil Engineers. He has been appointed to several committees, including: the National Research Council's Subcommittee on Mixed Waste Forms; the New Mexico State Underground Storage Tank Committee; and the New Mexico Mining Commission. He is author or coauthor of over 100 papers—including those in peer-reviewed journals—reports, and other publications. He is a coeditor of a book on the disposal of hazardous materials in desert ecosystems. Bruce Thomson received a B.S. degree in Civil Engineering from the University of California; and M.S. and Ph.D. degrees in Environmental Science and Engineering from Rice University. He is a registered Professional Engineer in New Mexico.

Charles O. Velzy is a consultant in the field of waste treatment and disposal. Previously, he held increasingly responsible positions with the environmental consulting engineering firm, Charles R. Velzy Associates, Inc., becoming President in 1976. In 1987, when Velzy Associates merged with Roy F. Weston, Inc., Charles Velzy became Vice

President of Weston, a position which he held until retiring in 1992. He has over 35 years of experience as an environmental engineering consultant specializing in: the analysis of waste management problems; design of wastewater treatment and waste disposal systems; and design of new, retrofit of existing, testing, and permitting of waste combustion facilities. He has authored or co-authored over 80 publications—primarily in the field of solid waste management. He has served on the Science Advisory Board of the U.S. Environmental Protection Agency; as President of the American Society of Mechanical Engineers (ASME); Chair of the ASME Peer Review Committee; and as Treasurer of the American Academy of Environmental Engineers (AAEE). He has served on numerous committees of the ASME, the AAEE, the American National Standards Institute, and the American Society for Testing and Materials. He is a registered professional engineer in New York and eleven other states. Charles Velzy received B.S. degrees in Mechanical and Civil Engineering, and an M.S. in Sanitary Engineering from the University of Illinois in Urbana, IL.

Roger P. Whitfield is a consultant in the areas of strategic planning, business development, environmental program planning, environmental and safety reviews, and procurement assistance. He was Deputy Assistant Secretary for Environmental Restoration in the U.S. Department of Energy's Office of Environmental Management. In that capacity he was responsible for remediation of sites used in the U.S. Department of Energy's nuclear weapons program; the Uranium Mill Tailings Program; the Formerly Utilized Sites Program; and the decontamination and dismantlement of the facilities. He also served as Project Manager; Director of the Environmental Division; and Assistant Manager for Health, Safety and Environment at the U.S. Department of Energy's Savannah River Site. At the National Aeronautics and Space Administration he was Program Manager for the design and test center located at the launch center; systems checkout engineer at Kennedy Space Center; project engineer; and performed design, fabrication, testing, and quality assurance of rocket engines. During Roger Whitfield's tenure as Deputy Assistant Secretary he received the Presidential Rank Award and the Federal Environmental Engineer of the Year Award. Also, during this period he was awarded the University of Alabama Mechanical Engineering Department Distinguished Fellow Award and the Engineering

Department Distinguished Fellow Award. He has published numerous papers in trade journals. He received a BSME degree from the University of Alabama in Tuscaloosa, AL, along with the Machinery Magazine Design Award and an MBA degree from Florida State University in Tallahassee, FL.

Richard Wilson is currently emeritus Mallinckrodt Research Professor of Physics at Harvard University in Cambridge, MA. He is also an affiliate of the Center for Middle Eastern Studies; the Harvard Center for Risk Analysis; and of the Program on Science and International affairs at the Kennedy School of Government. He used the principle of detailed balance to measure the spin of the pi-zero meson and studied nucleon-nucleon scattering at the Harvard Cyclotron Laboratory. He was involved in converting the Harvard University Cyclotron from nuclear physics use to medical treatment. He was the first to analyze elastic scattering data in terms of the electric and magnetic form factors. He studied nucleon structure by electron-proton scattering and muon proton scattering. He was a participant in the Cambridge Electron Accelerator "by-pass" program, which demonstrated an unusually large cross-section for producing hadrons. Richard Wilson closely followed the Russian and Ukrainian radiation accidents at Chernobyl in the Ukraine, and the accidents at the Techa River and the Mayak production complex in the Ural Mountains. He performed research on the risk assessment of chemical carcinogens. Richard Wilson is Chairman of the visiting committee of the radiation medicine department at Massachusetts General Hospital. He is Chairman of an International Advisory Committee to the newly formed Sakharov College of Radioecology in Minsk, Belarus, and serves as a member of the Board of Directors of the Andrey Sakhorov Foundation of New York and Moscow. He was the first Chairman of the Harvard Cyclotron Operating Committee and is still a member. He is a Fellow of the American Physical Society, Chaired its committee to study the radiological consequences of severe nuclear power accidents, and received its "Forum Award". Richard Wilson chaired an advisory committee for the Minister of Economic Affairs of the Republic of China. He is a founder/member of the Society of Risk Analysis, as well as the recipient of its Distinguished Service Award. He is a member of the American Nuclear Society and the Society of Toxicology. He served as the Director of the NE Regional Center of the National Institute of Global Environmental

Change. He has held various positions as a Visiting Professor, Scholar, and Scientist and served on numerous government advisory committees in many different agencies and countries. Richard Wilson is the author or coauthor of more than 800 published papers. He is the editor of the English translation of the Russian Journal, *Radiation and Risk,* which is published by the Russian Medical Research Laboratory in Obninsk and is mainly about the effects of Chernobyl. Richard Wilson holds a B.A. degree; an M.A. degree and a Ph.D. degree; all in Physics and all from Christ Church, Oxford University, Oxford, England.

Acronyms

AEA	Atomic Energy Act
AK	Acceptable Knowledge
ALARA	As Low As Reasonably Achievable
ASME	American Society of Mechanical Engineers
BAS	Best Available Science
BDAT	Best Demonstrated Available Technology
CAR	Commission on Assessment and Reviews
CCA	Compliance Certification Application
CFR	Code of Federal Regulations
CH	Contact-Handled
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EEG	Environmental Evaluation Group
EP	Extraction Procedure
EPA	U.S. Environmental Protection Agency
FR	Federal Register
FTIRS	Fourier Transform Infrared System
GC	Gas Chromathography
HPLC	High Pressure Liquid Chromatography
HSWA	Hazardous and Solid Waste Amendments
HWFP	Hazardous Waste Facility Permit
INEEL	Idaho National Engineering and Environmental Laboratory
LDR	Land Disposal Restrictions
MS	Mass Spectrometry
NAS	U.S. National Academy of Sciences
NDA	Non-Destructive Assay
NMED	New Mexico Environment~~al~~ Department
NRC	National Research Council
NUREG	Nuclear Regulatory Guidelines
OSWER	Office of Solid Waste and Emergency Response
PA	Performance Assessment
PAN	Passive/Active Neutron
PCB	Polychlorinated Biphenyl
PREPP	Process Experimental Pilot Plant
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RH	Remote-Handled

RP	Review Panel
RSI	Institute for Regulatory Science
RTR	Real-Time Radiography
SGS	Segmented Gamma Scans
SPC	Statistical Process Control
SVOC	semi-volatile organic compound
SW–846	Test Methods for Evaluating Solid Wastes, Physical/ Chemical Methods
SWB	Standard Waste Box
TC	Toxicity Characteristic
TCLP	Toxicity Characteristic Leaching Procedure
TDOP	Ten-Drum Overpack
TIC	Tentatively Identified Compound
TRU	Transuranic
TRUDOCK	Waste handling area of WIPP
TRUPACT-II	Transuranic Package Transporter, Model 2
TSDF	Permit Treatment, Storage and Disposal Facility
TSDF-WAC	Permit Treatment, Storage and Disposal Facility Waste Acceptance Criteria
UCL	Upper Confidence Limit
USNRC	U.S. Nuclear Regulatory Commission
VE	Visual Examination
VOC	Volatile Organic Compound
WAC	Waste Acceptance Criteria
WAP	Waste Analysis Plan
WHB	Waste Handling Building
WIPP	Waste Isolation Pilot Plant
WIPP/LWA	Waste Isolation Pilot Plant/Land Withdrawal Act
WSPF	Waste Stream Profile Form