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Waste Isolation Pilot Plant Transuranic Wastes Experimental Characterization Program: Executive Summary

Martin A. Molecke



Sandia Laboratories

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ABSTRACT

A general overview of the Waste Isolation Pilot Plant transuranic wastes experimental characterization program is presented. Objectives and outstanding concerns of this program are discussed. Characteristics of transuranic wastes are also described. Concerns for the terminal isolation of such wastes in a deep bedded salt facility are divided into two phases, those during the short-term operational phase of the facility, and those potentially occurring in the long-term, after decommissioning of the repository. An inclusive summary covering individual studies, their importance to the Waste Isolation Pilot Plant, investigators, general milestones, and comments are presented.

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INTRODUCTION AND OVERVIEW

The Waste Isolation Pilot Plant (WIPP) will be a facility to demonstrate the environmentally safe and practical disposal of radioactive wastes in a deep underground salt bed. The proposed site for the WIPP is in the Los Medanos area of southeastern New Mexico, approximately 42 km (26 miles) east of the city of Carlsbad and about 66 km (41 miles) northeast of Carlsbad Caverns. A major portion of the wastes (solid form only) accepted for terminal isolation at the WIPP will be Department of Energy (DOE) defense-related transuranic (TRU) wastes, both contact-handled and remote-handled (surface dose rates < 200 mrem/hr and > 200 mrem/hr, respectively). These wastes contain relatively small quantities of plutonium plus other alpha-emitting radionuclide contaminants. Contact-handled TRU wastes contain virtually no fission products and, therefore, generate little heat and radiation external to their containers. These wastes are, however, potentially hazardous and must be effectively isolated from the biosphere. Remote-handled TRU wastes may exhibit much greater surface dose rates and thermal outputs of up to hundreds of watts per container.

The scope of the WIPP program also includes experiments using high-level waste (HLW, commercial and/or defense) and spent unprocessed fuel elements (SURF) (1). Such experiments will be conducted in the laboratory as well as in situ. It is planned that HLW emplaced in the WIPP for experiments will be retrieved at the end of the experimental program. Overall scope and details of the WIPP HLW experimental program are described elsewhere (2a, b).

The proposed WIPP repository will consist of two distinct phases: an operational phase (SHORT-TERM, 0 up to a maximum of about 50 years) consisting of excavation, waste emplacement, routine operations, and decommissioning; and, a passive phase of terminal isolation (LONG-TERM) following decommissioning and mine closure. During the operational phase, the WIPP is envisioned to function in two modes, pilot plant and full-scale repository for defense transuranic wastes. TRU wastes will be stored in a retrievable manner during the pilot plant phase, while monitoring plus engineering and storage operations are demonstrated. The pilot plant phase will continue until waste emplacement operations and confirmatory testing (e.g., confirmation of

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preceding laboratory experimental results and predictive models) on actual, non-simulated wastes have been technically and administratively judged to be acceptable and safe. This phase is tentatively estimated to last for five years, for retrievability restraints, beginning in early 1986, the current target date for acceptance of TRU wastes in the WIPP. Assuming a successful completion of the pilot phase, the WIPP will, with potential concurrence of the Nuclear Regulatory Commission, change to a full-scale TRU waste disposal mode with the need for waste retrieval eliminated. The capability for waste retrieval will, however, be demonstrated on an engineering scale before completion of the pilot plant phase.

The WIPP repository has been conceptually planned (3) to have adequate capacity for all DOE-generated contact-handled and remote-handled TRU wastes (in temporary pad storage and to be generated) into the beginning of the twenty-first century. The contact-handled TRU wastes will be placed in a salt bed horizon about 640 meters (2100 ft) below the surface of the earth. The remote-handled (i.e., shielded transport and handling) TRU wastes will be placed in an 800-meter (2600 ft) deep horizon. Details of the conceptual engineering design and waste emplacement (plus retrieval) procedures for both TRU wastes and HLW experiments are described elsewhere (3).

Aside from safe handling and waste emplacement operations, a determination and demonstration of the long-term safety for the isolation of radioactive wastes in the WIPP will require many chemical, physical, and geochemical experiments on the waste forms, the salt bed storage environment, and their possible interactions. The purpose of this TRU waste characterization program is to describe and focus relevant current and future experiments directly applicable to the terminal isolation conditions of TRU wastes in the WIPP, not to present results obtained from temporary, near-surface storage of similar wastes.

The emphasis in this document is on programs of a chemical, waste characterization, materials and metallurgical nature. An overview of related, supporting programs will also be presented. An overview of the WIPP TRU waste characterization program is presented in Tables 4, 5, 6, and 7. These tables include descriptions of major concerns for both the operational phase and the long-term, waste degradation plus gas generation studies, why they are of importance to the WIPP program, who the investigators are, etc.

The majority of such studies are now in progress (or in the planning stage) at various DOE, industrial, and university research laboratories. Most of the laboratory programs will be complete before the first waste is accepted at the WIPP. Some monitoring, demonstrations, and experimental validations with actual TRU wastes are planned in the WIPP to substantiate, beyond any reasonable level of doubt, that terminal isolation of long-lived radioactive wastes in a bedded salt facility is indeed environmentally safe and acceptable.

OBJECTIVES

The principal objectives of this experimental characterization program, with the overall goal as stated above, are:

1. To define the perceived hazards or concerns for terminal isolation of TRU wastes in the WIPP bedded salt facility.
2. To quantify (experimentally) waste behavior plus degradation and interactions with the geologic environment; to obtain data sufficient to determine kinetics and mechanisms of occurring interactions, permitting the formulation of predictive, analytical models for such interactions valid for hundreds to thousands of years of geological isolation.
3. To conduct "accelerated aging" experiments, both in the laboratory and in situ to help validate long-term predictive, analytical models.
4. To determine the consequences of waste-repository interactions; to supply measured parameters for ongoing consequence and safety assessment studies.
5. To validate and support waste acceptance criteria for the types and quantities of wastes and waste packages to be transported to and safely isolated in the WIPP.
6. To investigate the potential effects on the WIPP salt repository and its attendant waste containment integrity following such conceivable events as flooding or fracturing of the facility after decommissioning.

For the attainment of the above objectives, data measured in the WIPP TRU waste characterization program will be combined with applicable existing knowledge obtained from:

- (a) Idaho National Engineering Laboratory (INEL) experience with temporary pad storage of TRU wastes (4);

- (b) shallow trench burial of TRU wastes at Los Alamos Scientific Laboratory (LASL) (5) and from experimentation thereon (6);
- (c) operating experience and testing at the Asse II salt mine pilot plant for the disposal of radioactive wastes in the Federal Republic of Germany (7,8,9);
- (d) various United States, European, and Japanese laboratories working in waste management (10, 11).

WASTE DESCRIPTIONS

The existing unprocessed varieties of DOE defense-related TRU wastes are listed in Table 1. Approximately 3.4×10^4 M³ (1.2×10^6 ft³) of these wastes are temporarily stored on surface pads at INEL (as of 1977). These are among the first wastes, presumably, which will be transported to the WIPP for terminal isolation. The DOE has charged Sandia Laboratories with the technical responsibility for determining whether such existing, non-homogeneous types of waste are acceptable for safe, long-term isolation in the WIPP. A significant percentage of the studies in this waste characterization program apply directly to answering this question.

In July, 1979, the Waste Acceptance Criteria Steering Committee (WACSC) will evaluate all available data, interpretations, and recommendations from this study, as well as all applicable similar laboratory work, and then recommend for DOE approval a WIPP TRU Waste Acceptance Criteria document. This criteria document will guide waste generators and shippers as to whether various waste types are acceptable without processing or whether they must be processed (i.e., incinerated and encapsulated) to meet the criteria.

Table 2 is a listing of potential, homogeneous waste matrices which may be used to stabilize processing residues. Table 3 describes some of the physical characteristics of existing DOE TRU wastes.

TABLE 1

EXISTING DOE DEFENSE-RELATED TRANSURANIC WASTES

- A. Absorbent Papers and Rags (Dry and Moist)
Protective Clothing, Wood, Other Cellulosics
Plastics, Rubbers
- B. Ion Exchange Resins
Processing Sludges
Salt Cake
Incinerator Ashes
Above, Cement Stabilized
- C. Spent Machinery, Tools
Process Vessels
Contaminated Building Materials, Rubble
Scrap Laboratory Equipment, Glass
Contaminated Concrete and Asphalt
- D. Contaminated Soils from Burial Trenches

TABLE 2

POTENTIAL TRU WASTE MATRICES

Glasses
Ceramics
Concrete
Asphalt (Bitumen)
Resins, Polymers

TABLE 3

PHYSICAL CHARACTERISTICS OF DOE TRU WASTES

Packaging:

Mild steel drums, 210 liter (55 gal) DOT 17C
Fiberglass reinforced plywood box, 4 x 4 x 7 ft, DOT 7A
Metal bins, approx. 4 x 5 x 6 ft, DOT 7A
Others acceptable

Surface Dose Rates:

Average < 10 mrem/hr
If > 200 mrem/hr, remote handling required

Actinide Contamination Limits:

(weapons grade Pu equiv.; $^{238,239,240}\text{Pu}$, $^{233,235}\text{U}$)
Average \leq 10g/drum
Maximum 200g/210 liter drum
350g/M³ in DOT 7A boxes
200g weapons grade Pu = 15 Ci (alpha) \approx 4 x 10⁵ nCi/g of waste

Thermal Power Output: (Contact-Handled TRU)

Negligible to approx. 0.1 watt/ft³, 3.5 watt/M³

The existing waste forms in Table 1, part A, present several potential concerns or problems: these inhomogeneous materials are combustible and are subject to radiolytic, thermal, and bacterial degradation mechanisms which yield gases, water, and residual organic products. These products may also serve to enhance radionuclide migration. Waste forms in Table 1, part B, contain significant amounts of sorbed water which will, in time, be released. Cement stabilized processing sludges from Rocky Flats Plant, for example, can contain up to about 70 wt.% of water. Spent ion exchange resins (organic) are also potentially degradable. Incinerator ashes from processing are in a highly dispersible form (via air currents or aqueous mobilization) if not further encapsulated. Salt cake from chemical processing (nitrate salts) is very soluble, has a moderate water content, generates gases, and can be quite corrosive to waste packaging materials.

The contaminated waste materials in Table 1, parts C and D, are not amenable to simple processing. Most of the contamination on these wastes is on the surface, being more amenable to leaching. Metallic waste materials can corrode, potentially yielding significant quantities of gas. These wastes appear, however, more stable for isolation than the combustible, organic varieties.

The waste matrices listed in Table 2 have been tested or utilized for encapsulating low- and intermediate-level wastes. Such homogeneous matrices generally have a low leachability and are more readily characterized. Glass encapsulation of TRU incinerator ash is under development at the Rocky Flats Plant (12). Reaction of clays with contaminated salt cake to form a ceramic matrix is being studied at Rockwell Hanford (13). Encapsulation of TRU incinerator ashes in concrete is being evaluated at Savannah River Laboratory for compatibility with WIPP waste acceptance criteria (14). Concerns regarding concrete relate to radiolytic and thermal degradation of the free and bound water which yields gas and water. Asphalt (bitumen) encapsulation of radioactive salts and residues (low-level, non-TRU, predominantly) has been used and studied extensively in Europe for approximately ten years (15,16). Concerns regarding bituminization include flammability, microbial degradation (17), enhanced migration capacity of leached radionuclides due to organic degradation byproducts, and alpha radiolysis producing gas.

The Rocky Flats Plant was selected recently (18) by the DOE as lead contractor for coordinating TRU waste technology, development, and operational activities. Coordination of the ongoing WIPP TRU programs with the Rocky Flats national TRU waste program has been initiated.

It is not the purpose of this discussion to focus on the perceived negative aspects of existing waste matrices, nor to exhibit a bias toward some matrices while favoring others. The purpose of this program is to determine the validity of the specified concerns, and whether the postulated effects have a significant impact on long-term containment integrity of the repository or on short-term operational safety.

Experimental data from all segments of the WIPP TRU waste programs provide source terms for analytical modeling and risk/safety assessment studies. Analysis of these laboratory and in situ studies will help place perceived concerns in perspective.

AREAS OF MAJOR CONCERN AND INSUFFICIENT DATA

Areas of insufficient technical knowledge necessary for completing WIPP waste acceptance criteria (WIPP WAC), providing a technical base for possible NRC licensing of the WIPP, and for evaluating long-term concerns of facility containment integrity and associated environmental safety are summarized in Table 4. The gas generation issue and associated consequences are further expanded in Table 5.

TABLE 4

AREAS OF MAJOR CONCERN AND INSUFFICIENT DATA

1. Generation of Gases from TRU Wastes and Containers
2. Consequences of Gas Generization - Pressurization
3. Permeability of WIPP Rocksalt - Gas Dissipation
4. Potential Leaching of Wastes - Radionuclide Migration
5. Combustibility of Wastes - Mine Fire
effects on mine design, operation
propagation rates, initiating mechanisms
production of respirables
6. Formulation of WIPP TRU Waste Acceptance Criteria

TABLE 5

GAS GENERATION FROM TRU WASTES

Mechanisms of Waste Degradation, Gas Production:

1. Radiolytic - organic and contained water content
2. Thermal and Catalyzed Pyrolytic - organic matrices, water vapor release
3. Chemical Corrosion - metals, oxygen and water rate controlling
4. Bacterial - organic matrices: gas production, conversion, consumption

Primary Gases Produced:

H_2 , CO, CO₂, CH₄, H₂O

Concerns of Gas Generation:

Long-term: pressurization of repository
breach in containment integrity

Operational Phase:

flammable, explosive, toxic concentrations of gases
fuel for fire, with initiating event
particulate contamination carrier
effects on mine design, operation

Areas of WIPP Study:

kinetics, species, total extent of generation
predictive, analytical modeling of generation
methods, techniques for reducing generation
permeability studies on gas dissipation
WIPP WAC to limit gas generation

EXPERIMENTAL STUDIES SUMMARY

Long-term concerns are the principal impetus for the WIPP TRU waste experimental programs. Many of the existing TRU waste forms can generate gases from their slow but continuous degradation. Continued production without commensurate permeation into the surrounding media could pressurize the decommissioned facility. Significant pressurization could possibly violate the integrity of the containment providing a means for mobilization or dispersal of radioactive materials via aqueous or airborne pathways. The major recommendation of the ERDA working group to assess the adequacy of research and development in support of completing WIPP waste acceptance criteria (19) was: "The highest priority should be placed on determining the permeability of WIPP bedded salt to gases generated in the mine." Preliminary results of these permeability measurements (20), using realistic simulation of lithostatic pressure confinement in the laboratory, indicate that the rocksalt has insufficient permeability to dissipate all generated gases in an acceptable time.

Leaching of wastes, followed by aqueous-brine transport of radionuclides, may occur with water originating within the waste itself (i.e., dewatering) or from potential hydrologic flow or intrusion (i.e., drilling). Chemical and physical interactions occurring among the waste form plus packaging materials, the geologic environment, and degradation products may possibly alter radionuclide migration and dispersal. The same ERDA working group (19) identified radionuclide migration studies as another area of high priority due to its impact on long-term environmental safety.

Laboratory experiments utilizing WIPP in situ conditions of temperature (from 25°C to 70°C), confining pressures (1 to 150 atmospheres), and geochemistry are in progress to quantify the potential extent, kinetics, and mechanisms of the listed concerns and to develop means for their control, if necessary. The conditions of 25°C and 1 atmosphere represent ambient conditions during the operational (short-term) phase of the WIPP. The temperature of 70°C represents the maximum credible condition obtained (approximately 200 years after decommissioning) if heat generating wastes are stored on the lower (800 m) horizon of the facility. The

pressure of 150 atmospheres results from the rock overburden (approximately 2100 psi and 2100 ft down) upon cavity closure.

Experience and data gathered for many years of TRU waste burial in near-surface trenches may have little bearing on conditions extant in terminal, deep geologic isolation. For instance, gases generated in trench-buried wastes simply escape and, therefore, have not previously been of significant concern. A summary of the laboratory experiments addressing the long-term concerns follows in Table 6.

TABLE 6

WIPP TRU WASTES EXPERIMENTAL SUMMARY: LONG-TERM CONCERNS

<u>Program-Experiment</u>	<u>Importance to WIPP</u>	<u>Investigators and Comments</u>
Radiolytic Degradation of Existing TRU Waste Forms: <ol style="list-style-type: none"> rate & extent of gas, water, & organic byproduct formation function of waste matrix, temperature, pressure, alpha doping; mechanism 	Quantify, support WAC for organic wastes, concrete. Quantify gas generation capacity. Support safety and consequence assessments. Evaluate concentrations of toxic, radioactive, flammable, explosive gases.	(a) LASL(CMB-1, H-7); high priority; 3 yr study 4 MY/yr effort; existing organic waste matrices. (b) SRL (Bibler); concrete matrix; complete 6/79; evaluate techniques, procedures to reduce gas production.
Thermal & Catalyzed Pyrolytic Degradation of Waste Matrices: <ol style="list-style-type: none"> as above. function of temperature, pressure, mine catalysts, etc. kinetics and mechanism 	Quantify, support WAC for organic wastes, concrete. Evaluate gas and water release, as above.	(a) LASL(CMB-1, H-7); high priority; complete 6/78. (b) SRL (Bibler) concrete matrix; complete 6/79.
Chemical Degradation, Corrosion: <ol style="list-style-type: none"> as above function of temperature, pressure, dry salt or saturated brine materials, metallurgical integrity 	As above. Evaluate waste container integrity as physical barrier for handling retrieval and storage operations. Evaluate anti-corrosion coatings.	(a) Sandia (Braithwaite) high priority, 1.5 MY/yr effort start 8/76, complete 6/79. (b) LASL (CMB-1, H-7); in conjunction with radiolytic and thermal studies above.
Bacterial Degradation of Organic Waste Matrices: <ol style="list-style-type: none"> production, conversion of gases enhancement of radionuclide migration via chelate formation concentration of fissile nuclides change in oxidation state of actinides 	Determine restrictions to organic wastes for WAC due to bacterial action, if significant. Evaluate significance of enhanced radionuclide migration.	(a) Univ. of N.M. (Caldwell, Biology Dept.), prime experimenter; start 5/78. complete 1980; major output FY78,79. (b) ZoBell (Scripps), consultant (c) LASL (H-9, Barnhart); field sampling of trench buried TRU wastes, in support of UNM study.

TABLE 6 (Continued)

<u>Program-Experiment</u>	<u>Importance to WIPP</u>	<u>Investigators and Comments</u>
<p>Total Gas Generation, Synergism of Multiple Modes:</p> <ol style="list-style-type: none"> laboratory testing development of analytical predictive models in-situ monitoring 	<p>WAC decision point. Relates to predicting, preventing long-term repository over-pressurization. Control and measurement of gases during operational phase. Direct relationship to salt permeability (to gas) study.</p>	<p>(a) LASL, as integral part of radiolytic, thermal/pyrolytic, chemical and bacterial studies. (b) Sandia, for consequence and safety assessment studies, chemical degradation study, evaluation and input to DOE WACSC</p>
<p>Salt Bed Permeability to Gases:</p> <ol style="list-style-type: none"> measure WIPP rock salt permeability to H₂, He, air, etc.; laboratory & in-situ function of lithostatic pressure, temperature: time 	<p>Crucial to WAC decisions. Important to long-term geologic containment integrity. Assess consequences of gas release or pressurization. Highest priority.</p>	<p>(a) Sandia (Wayland), program tech coordination. (b) SLL; single crystal permeability; completed 2/78. (c) Terra Tek; scoping study for H₂, N₂ & brine permeability, function of temperature & confining pressure (d) Sandia (5156); detailed study, triaxial compression/rocksalt healing, mechanistic modeling study.</p>
<p>Leachability of TRU Wastes:</p> <ol style="list-style-type: none"> existing homogeneous waste forms homogeneous, developmental matrices WIPP specific environment 	<p>Provide source term data to migration modeling; input to risk assessment study. Basic evaluation of waste matrix durability.</p>	<p>(a) Sandia (Braithwaite); homogeneous waste forms study; i MY/yr; lead group for procedures (b) LASL (CMB-1, H-7); scoping study of existing wastes, as offshoot of chemical degradation study; (c) Mound Lab or LASL; contractor to be chosen for lab, field studies on existing wastes.</p>

TABLE 6 (Continued)

<u>Program-Experiment</u>	<u>Importance to WIPP</u>	<u>Investigators and Comments</u>
<p>Radionuclide Migration and Geochemistry:</p> <ol style="list-style-type: none"> 1. distribution coefficient retardation studies 2. mechanistic & kinetic studies 3. transport enhancement 4. leachant-carrier chemistry effects 5. secondary barriers(getter) development 6. radionuclide migration modeling 	<p>Determine effects of various chemical parameters on radionuclide migration or sorption. Assess extent and consequences of radionuclide migration. Model migration for predictive migration.</p>	<p>(a) Sandia (Lambert), geochemistry tech. coordinator. (b) Sandia (5824), Kd measurements, mechanisms, complexes and getters. (c) ANL, actinide oxidation state speciation, microfracture effects on sorption. (d) UNM, complexation by organic and inorganic ligands, effects on migration.</p>
<p>Criticality Control:</p> <ol style="list-style-type: none"> 1. define potential mechanisms for fissile element concentration 2. determine feasibility of such mechanisms 3. develop calculational model for evaluating credibility of a criticality incident 4. assess consequences of an underground criticality 	<p>Criticality would involve leaching and reconcentration of fissile nuclides. Calculations should evaluate consequences in conjunction with long-term safety assessment.</p>	<p>(a) Sandia - determine scenarios for reconcentration: geometrical, physical chemical; (b)UNM (Brooking): evaluate viability of geochemical processes for reconcentration. (c) LASL (D. Smith); develop calculation model - codes for evaluation, assessments.</p>

Short-term operational safety concerns for the WIPP TRU waste include: combustibility of waste forms and packaging; dispersal of particulate radioactivity; waste package degradation by various mechanisms yielding flammable, explosive, or toxic gases; and physical integrity concerns such as corrosion of waste containers with attendant effect on waste handling, storage, or retrieval operations. Criticality control of the emplacement of TRU wastes in the WIPP, in all conceivable storage configurations, is a short-term concern which has been effectively eliminated via calculations.

The worst conceivable operational accident in the WIPP consists of an underground fire propagating among multiple waste packages. This is one concern which can be eliminated or have its probability (and consequences) greatly reduced by means of engineering and fire safety preventative operations. Alternate solutions include administrative control via limitation on acceptable quantities of combustibles (by means of waste acceptance criteria) or by processing-incinerating the wastes and encapsulating in a non-combustible matrix.

A summary of the experiments or programs addressing these concerns, primary investigators, and importance to the WIPP follows in Table 7.

TABLE 7

WIPP TRU WASTES EXPERIMENTAL SUMMARY: SHORT-TERM CONCERNS

<u>Program</u>	<u>Importance to WIPP</u>	<u>Investigators and Comments</u>
Combustibility of Wastes: 1. initiating mechanism studies 2. products of fire, respirables 3. fire propagation studies 4. engineering and procedural control, fire safety and prevention	Fire is most severe, credible mine accident during operational phase. Fire prevention engineering, design, and operations are potential solutions. Effects of fire important to mine ventilation system design.	Sandia (Milloy), INEL full-scale fire tests on FRP plywood boxes, FY78. Study resolution by fire protection engineers at Sandia
Physical Integrity of Waste Containers: 1. corrosion studies of metal waste containers 2. coatings testing for metal drums and FRP boxes 3. Adequacy of mechanical design to anticipated loadings	Corrosion concerns, physical lifetime expectancy driven by retrieval requirements; estimated 5-year proviso for retrievability. Mechanical design, strength necessary for waste handling and mine emplacement operations	Sandia (Braithwaite), materials, metallurgy testing program for corrosion resistance of metals, protective coatings, expected completion by end of FY78. Related Studies: INEL--Initial Drum Retrieval Program Early Waste Retrieval Program; Mound--Acceptable TRU Packaging Study for Interim Storage and Terminal Isolation

TABLE 7 (Continued)

WIPP TRU WASTES EXPERIMENTAL SUMMARY: SHORT-TERM CONCERNS

<u>Program</u>	<u>Importance to WIPP</u>	<u>Investigators and Comments</u>
Waste Form and Package Degradation: 1. measure rates of gas generation (flammable, explosive or toxic) from degradation/radiolytic, thermal/pyrolytic, chemical or bacterial 2. similar to long-term concern studies	Accumulated gas in waste containers can be initiating event or source term for fire. Release of gases relevant to operational phase safety assessment.	LASL, SRL, Sandia, UNM: refer to long-term concern studies.
Criticality Control: 1. Calculate worst case loading, geometry of TRU wastes in repository	Calculations necessary to insure that criticality incident is not credible for emplaced wastes.	LASL (D.Smith) - calculations completed; criticality is not a credible hazard for TRU wastes as emplaced.

CONCLUSIONS

The WIPP will be the first deep geologic pilot plant or repository for the terminal isolation of TRU wastes in this country. As such, it may establish precedents and technical bases which carry over to subsequent commercial repositories now envisioned or planned by the Department of Energy, the Office of Nuclear Waste Isolation, or others. The described TRU waste characterization programs are necessary to support WIPP waste acceptance criteria and to allow comprehensive and credible risk and safety assessment studies for both the short-term operational safety and long-term environmental safety.

Completion of these programs will allow specification of waste acceptance criteria based on technical data. These criteria will impact the decision on processing (i.e., incineration and encapsulation) of large segments of existing DOE TRU wastes. Incineration (or slagging, digestion, etc.) and encapsulation of most combustible organic wastes would lead to reductions in dispersibility and terminal storage volumes, and significantly reduce susceptibility to degradation and resultant gas generation. Processing may also become desirable as impacts of transportation of such wastes to a repository are considered and as future performance criteria evolve.

ACKNOWLEDGMENTS

The required experimental WIPP TRU waste characterization programs were the subject of an Energy Research and Development Administration (ERDA) working group established in May, 1977, at the request of the Deputy Director of ERDA's Division of Waste Management, Production, and Reprocessing. The charter of this working group was to assess the TRU waste research and development programs supporting completion of TRU waste acceptance criteria for the Waste Isolation Pilot Plant. This ERDA (now Department of Energy) working group functioned essentially as a peer review group, and its output (unpublished, September 1977) was particularly valuable to me for filling identified gaps in programs and reestablishing experimental priorities, as described in an earlier (June 1977) rough draft of this program document. Suggestions and comments received from members of this working group were greatly appreciated.

I would also like to sincerely acknowledge the many comments, suggestions, contributions, and support concerning this program received from numerous members of the Sandia WIPP project staff as well as from other Sandia technical staff members.

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