# Stored Transuranic Waste Management Program at the Idaho National Engineering Laboratory

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## ABSTRACT

Since 1970, the Idaho National Engineering Laboratory (INEL) has provided interim storage capacity for transuranic (TRU)-contaminated wastes generated by activities supporting U.S. national defense needs. Approximately 60% of the nation's current inventory of TRU-contaminated waste is stored at the INEL, awaiting opening of the Waste Isolation Pilot Plant (WIPP), the designated federal repository for permanent disposal of defense-generated TRU waste. A number of activities are currently underway to enhancing current management capabilities, conducting projects that support local and national TRU management activities, and preparing for production-level waste retrieval, characterization, examination, certification, and shipment of untreated TRU waste to WIPP in April 1998. Implementation of treatment capability is planned in 2003 to achieve disposal of all stored TRU-contaminated waste by a target date of December 31, 2015, but no later than December 31, 2018.

## INTRODUCTION

Transuranic waste is defined[1] as material that has negligible economic value and is contaminated with alpha-emitting radionuclides with an atomic number greater than 92 and a half-life greater than 20 years, and in concentrations greater than 100 nCi/g. Since 1970, the INEL has placed approximately 60% of the nation's contact-handled (CH) TRU-contaminated waste in interim retrievable storage pending establishment of a permanent disposal repository. Approximately 65,000 $m^3$ of TRU-contaminated waste contained in about 129,000 drums and 11,000 boxes and bins are in storage at the INEL Radioactive Waste Management Complex (RWMC). These wastes are stored either in air-supported or pre-engineered metal buildings, or on earthen- or tarpaulin-covered asphalt pads. The total stored TRU mass is 823 kg with 500,000 Ci of activity.

This paper will discuss ongoing activities to: (1) enhance INEL TRU waste management capabilities, (2) conduct technical support projects supporting both local and national needs, (3) implementing full treatment of TRU-contaminated waste at INEL, and (4) identify future strategic direction.

## BACKGROUND

Since the early 1980s, the INEL has been on a path to evaluate and improve TRU waste management capabilities. Characterization of various aged waste was performed in 1980-1985 to support development of real-time radiography (RTR) as a nondestructive waste certification technique, address issues related to radiolytic production of hydrogen in waste drums, and

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support development of the waste certification process[2,3]. The INEL Stored Waste Examination Pilot Plant (SWEPP) was constructed and placed into operation in August 1985. The SWEPP facility provides capability to weigh and nondestructively examine the contents of waste containers for compliance with WIPP Waste Acceptance Criteria (WAC) without container opening, to perform nondestructive assay (NDA) for determining fissile material content and total TRU activity of a waste package, and to perform ultrasonic examination of drums to verify metal wall thickness to meet transportation requirements. The SWEPP facility was placed in operational standby in late 1989 due to delays in opening WIPP and promulgation of final WAC. In 1991, limited operations were initiated to support the WIPP Experimental Test Program and waste characterization activities.

The INEL Drum Venting Facility (DVF) was designed, constructed and placed into operation in May 1987. The purpose of this facility is to remotely puncture a drum and install a carbon composite filter to allow pressure equalization and aspiration of radiolytic-produced hydrogen. Drums destined for WIPP will be vented and the headspace gas sampled. Vented packages are also required for transportation if the Transuranic Package Transporter-II (TRUPACT-II) is used as the shipping container.

The INEL TRUPACT-II Loading Facility (TLF) was designed and constructed in October 1988. The facility was originally brought to operational status in November 1990 to provide shipments of TRU-contaminated waste to Argonne National Laboratory-West (ANL-W) to support preparation of experimental bins for the underground radioactive tests currently at WIPP. Currently, shipments are made for characterizing waste to support WIPP efforts to demonstrate compliance with regulations governing disposal of TRU mixed waste. Use of the TRUPACT-II was implemented in April 1992. Over 35 shipments using the TRUPACT-II have been completed to support characterization efforts.

## PROGRESS TOWARDS READINESS FOR DISPOSAL

For the past several years, the INEL has initiated projects to enhance operational capabilities to manage the stored TRU-contaminated waste, to evaluate and upgrade existing waste certification systems to meet new quality assurance objectives for waste characterization, and to conduct technical support activities that meet INEL, U.S. Department of Energy (DOE)-Carlsbad Area Office (CAO) National TRU Program (NTP), and WIPP needs.

Facility Enhancements. In 1989, two Line-Item Construction Projects (LICP), consisting of several subprojects, were initiated to enhance the existing facility infrastructure and increase operational capability to support waste storage, retrieval, and characterization needs. Figure 1 provides an overview of key construction activities.

Construction has been completed on eight new storage buildings. A Type I Storage Module was constructed over the existing DVF and primarily supports activities performed prior to waste examination at SWEPP. These activities include a warming area for waste containers, drum venting operations, and an aspiration area used to store vented drums for up to eight weeks to aspirate hydrogen. This storage module is a 3790 $m^2$ pre-engineered metal building, 1340 $m^2$ of which is heated to support container warming and aspiration operations.

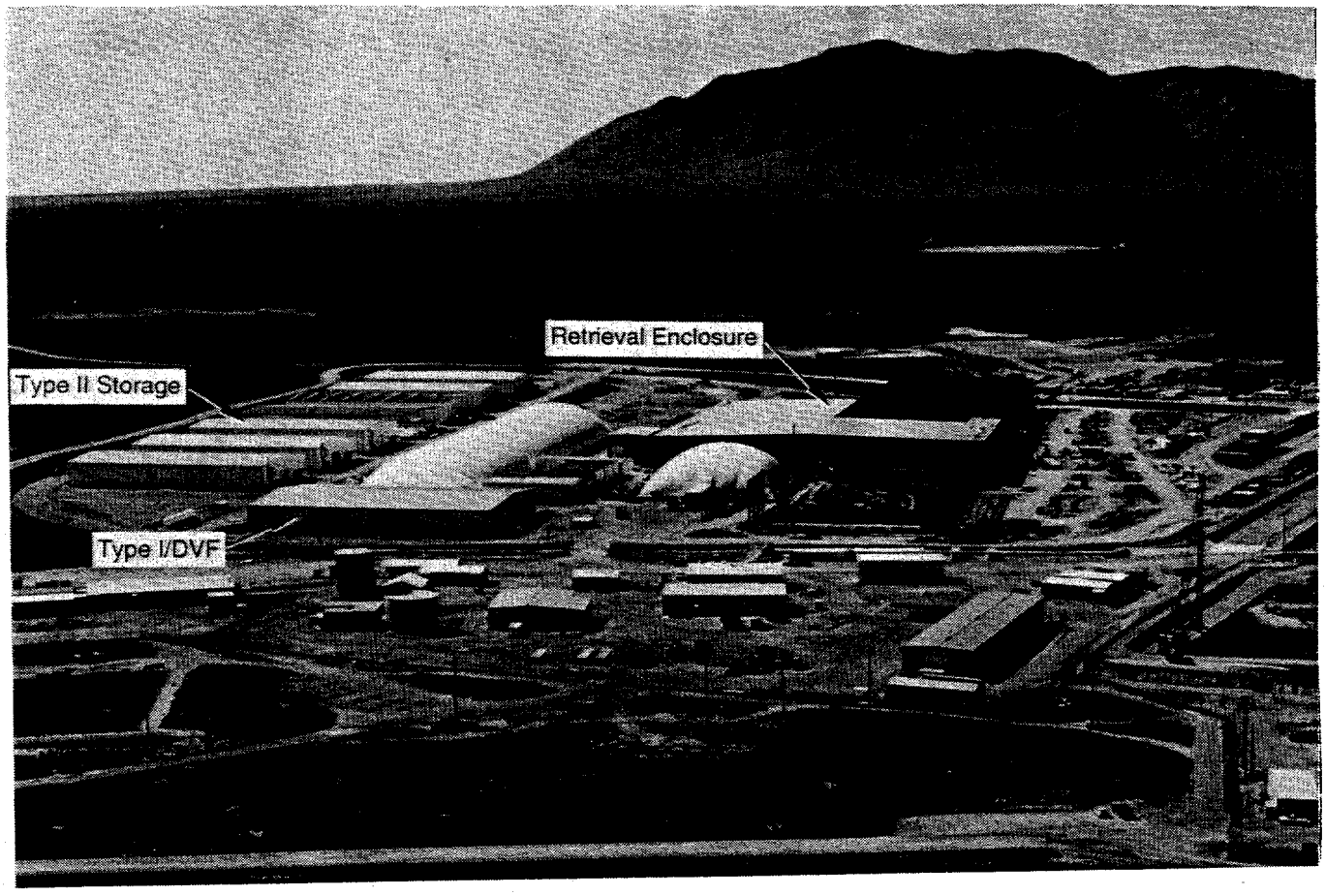


Figure 1. Overview of Key Construction Activities.

Seven Type II Storage Modules have been constructed to support waste storage operations. The modules were designed to comply with Resource Conservation and Recovery Act (RCRA) requirements for permitted storage. The modules are approximately 2675 $m^2$ and will contain about 16,000 drums or 2000 waste boxes. The modules are pre-engineered metal buildings with Type K concrete floors and 6-inch berms to meet RCRA containment requirements. The modules are unheated and include a forced-air ventilation system. Two storage modules are currently operational and are receiving waste from air-supported buildings to meet a 1992 Consent Order with the State of Idaho on storage of TRU-contaminated mixed waste. The remaining five modules will be operational by March 1996. The storage modules will be operated in accordance with the RWMC RCRA Part B permit issued by the State of Idaho in November 1995. One storage module will be used only for storage of environmental-remediation-derived waste from activities being performed at the RWMC on pre-1970 buried TRU-contaminated waste.

An Operations Control Building (OCB) was constructed and placed into operation in April 1995. The OCB is a single story pre-engineered metal building approximately 2230 $m^2$. The OCB provides main access control to the RWMC, a changing area for operations personnel, office space for managerial and technical staff, a personnel training area, and conference rooms. The OCB will also serve as the Emergency Control Center for ensuring rapid and efficient response to abnormal operating situations.

Several site improvement projects have been completed to support new facilities. These improvements have included upgrades to the power supply line to meet anticipated power demands, providing fire and potable water to new facilities, a new sewer system and treatment lagoon, and a new communications/alarm system to support the additional facilities.

A Retrieval Enclosure (RE) is currently being constructed over TRU-contaminated wastes stored on asphalt pads under earthen- or tarpaulin-cover. The purpose of the RE is to reduce weather-related degradation of stored waste containers by providing an enclosure over the storage pads to allow year-around retrieval of waste containers and to provide the necessary utilities and systems to retrieve stored waste. The RE, which is weather-tight, has a nominal free span of 366 m by 61 m for one pad, and 146 m by 49 m for the second pad. The total area enclosed is about 29,170 $m^2$. The retrieval work area will be defined by two moveable partitions or shrouds to provide ventilation control and maintain a negative pressure with respect to outside pressure. Ventilation system exhaust air is filtered by a baghouse and High-Efficiency Particulate Air (HEPA) filtration system. The shrouds support selected utilities needed in the retrieval area such as ventilation ducts, lighting, and electrical connections. Heating of the active work space is provided for year-around operation. A dry-pipe fire protection system is used. An oil-free breathing air distribution system is provided to support off-normal retrieval activities, such as retrieval of a breached container. Equipment used to support retrieval operations will include a mobile vacuum system for cleaning off soil overburden on waste containers, forklifts, an excavator called T-Rex with interchangeable end-effectors for removal of soil overburden and retrieving waste containers, and an isolation unit for use when dealing with contaminated containers. Construction of the RE will be completed by July 1996.

A Waste Characterization Facility has been designed to provide an isolated and controlled environment for opening, examining, and sampling the contents of waste containers. These activities will be performed to meet RCRA characterization requirements specified by final WIPP disposal criteria and for storage by the RWMC RCRA Part B permit. Features of the WCF include capabilities for opening drums and boxes in a glovebox environment, coring capability for sampling sludges and other solidified process residues, remote waste sorting, and repackaging capability. Other functions that WCF could perform include repackaging waste that does not meet WIPP WAC into a form that can be shipped to WIPP for disposal, providing characterization of waste forms that will be treated, and providing limited-scale treatment (e.g., solidification, amalgamation) of certain waste forms. Title II design of the WCF was completed April 1994. Initiation of construction has been deferred until decisions concerning privatization of characterization and treatment services are completed.

System Upgrades. Upgrades to several key existing systems are being made to either improve the operational capability, improve efficiencies, or implement new requirements defined in the TRU Waste Characterization Quality Assurance Program Plan (QAPP)[4].

The DVF is currently being modified to alleviate operational constraints imposed to ensure organic emissions do not exceed allowable limits, and to improve efficiencies and reduce costs associated with performing drum headspace gas analysis to determine the concentration of volatile organic compounds (VOCs) to meet WIPP WAC and transportation requirements. A VOC recovery unit consisting of an activated carbon absorption system has been installed to

reduce organic emissions. A headspace gas sampling system has been designed and installed to automatically collect a gas sample during remote venting operations. A Fourier transform infrared (FTIR) spectrometer, developed to reduce waste characterization analytical costs for determining drum headspace VOCs, will provide automated analysis of samples from each drum. A Residual Gas Analyzer has also been installed to determine hydrogen and methane concentrations in the headspace gas sample. The results of these analyses will be used to determine compliance with VOC concentration limits imposed by final WIPP WAC and the presence of flammable gases exceeding allowable facility safety or transportation limits.

Upgrades to the existing SWEPP NDA systems have been ongoing for several years. In 1993, use of high-resolution passive gamma spectroscopy was implemented to support passive-active neutron (PAN) assay measurements. Addition of the gamma spectroscopy system was necessary to determine the relative mass ratios of various isotopes contained in the nuclear source material in the waste. Although the primary contaminant is weapons-grade plutonium, other isotopes such as U-235 and AM-241 have been identified and must be accurately reported to meet waste characterization and transportation criteria. Current efforts are focused on upgrading hardware and software to improve data collection, data analysis, and operation. The PAN system electronics are being replaced with state-of-the-art electronics, such as shift registers. The improved shift register electronics will allow higher count rate data collection needed for wastes containing high ($\alpha$, n) reactions. Software modifications are being developed to integrate the PAN and gamma spectroscopy systems to provide quantities of isotopes that must be reported, self-diagnostic checks to flag data inconsistencies and reduce manual review of data, and more user-friendly software for technicians operating the system.

Technical Support Projects. Several key technical support projects are being performed to implement new TRU Waste Characterization QAPP requirements to support future production-level waste examination and certification activities and ongoing NTP projects.

The Waste Certification Program is currently undergoing revision to ensure all aspects of the TRU Waste Characterization QAPP have been addressed and incorporated. Logic diagrams or process flow sheets depicting the cradle-to-grave waste management process have been developed, and activities and data that must be performed or collected to meet QAPP and final WIPP WAC have been built into the flow sheets. These flow sheets will form the basis for determining tasks that must be completed to effectively implement all requirements that allow certification and shipment of waste to WIPP.

Evaluation of SWEPP NDA system performance and demonstrating compliance with TRU Waste Characterization QAPP requirements are among the most challenging and difficult aspects of future efforts to certify waste for shipment to WIPP. Calibration drums representing several major stored waste streams have been developed, nuclear sources fabricated to meet stringent quality assurance requirements are being procured, and programs are underway to demonstrate NDA system compliance with precision, accuracy, and minimum detectable concentration quality assurance objectives. Total uncertainty, which is the propagated uncertainty of all corrections and factors used by the NDA system during assay, is being performed on a waste form basis. Because of the wide variation in stored TRU-contaminated waste forms and the resulting affect on NDA system response, it is not economically practical to fabricate calibration standards to experimentally assess total uncertainty. Two approaches have been developed to address total uncertainty. One approach

uses a neutron transport and temporal response calculational method based on the Monte Carlo Neutron Photon (MCNP) code. Total uncertainty evaluations have been completed for graphite molds, and are underway for combustible, glass, and sludge waste forms. For solidified process waste forms, such as sludges, a statistical sampling method is being developed. During coring and sampling of sludge waste forms for RCRA analysis, representative samples will also be collected for destructive radiochemical analysis to quantify radioisotopes in the waste. The results from radiochemical analysis and the SWEPP NDA measurements for each of the drums sampled will be used to complete the total measurement uncertainty evaluation.

The Gas Generation Test Program consists of performing controlled tests with actual containers of CH-TRU waste to collect data and quantify the gas generation properties of the waste under simulated transportation thermal conditions. These tests will be performed due to concerns that hydrogen and methane concentrations in shipping containers destined for permanent storage could exceed their flammability limits. Waste to be tested will be placed in one of five heated enclosures which simulate temperature increases due to decay heating, warmed to 57°C - 63°C, and held until steady state is attained. An offgas collection system is attached to the carbon composite vent filter installed in the waste drum so that total gas flow may be measured, and samples can be directed to a process mass spectrometer for analysis. The mass spectrometer measures the concentrations of hydrogen and methane in the offgas at frequent intervals during the test. Figure 2 is an internal view of the gas generation test assemblies. The Gas Generation Test assembly is in the final stages of performance testing now, and will be operational in February 1996. The Gas Generation Test Program will also support the Matrix Depletion Program by measuring the concentrations of hydrogen and methane to verify that the rate of gas generation decreases as gas producing matrices (e.g., combustibles, organic sludges) are depleted.

NTP Support Projects. Since 1990, the INEL has been actively involved with DOE-CAO efforts to demonstrate WIPP compliance with disposal standards and supporting NTP Office objectives. Key technical support projects have included: (1) development of the TRU Waste Characterization QAPP and Performance Demonstration Programs (PDPs) supporting characterization of TRU and TRU-mixed wastes, (2) characterization of stored TRU-contaminated waste to support WIPP data needs for regulatory compliance documents, (3) development of advanced waste characterization methods to reduce waste generator/storage site costs, (4) development of a method to determine internal waste package VOC concentrations without intrusive sampling, (5) developing a system-wide computer simulation model to support national strategic planning efforts, and (6) developing a program to reduce the impact of current transportation wattage restrictions on transportation by analyzing and modeling depletion of gas-producing waste matrices.

Data quality objectives have been developed to provide a uniform and complete suite of requirements that must be met prior to disposing of TRU waste at WIPP. The objectives, which are compiled in the TRU Waste Characterization QAPP, support ongoing efforts at WIPP to demonstrate compliance with regulations governing transportation and disposal of TRU waste. The QAPP has been reviewed by the external DOE agencies that have regulatory authority over WIPP. The intent of the QAPP is to provide generator/storage sites with a single document that identifies characterization requirements that will provide data of known quality to meet various regulatory compliance needs. Additionally, specific guidance for

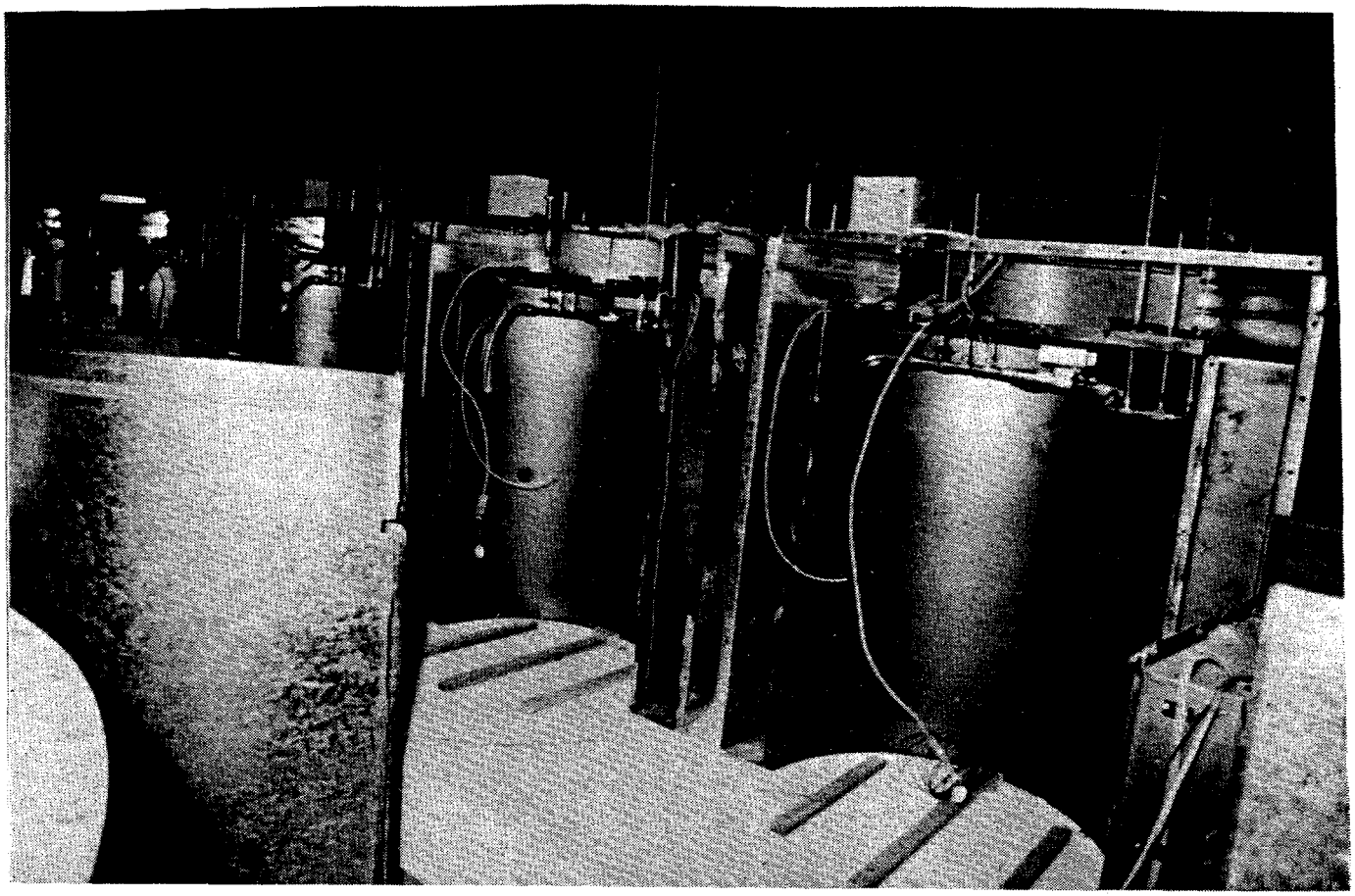

Figure 2. Internal View of Gas Generation Test Assemblies.

sampling and analysis methods to be used during TRU waste characterization processes was developed and documented in a guidance manual[5]. Several PDPs have been developed to provide an independent method for evaluating and ensuring a waste generator/storage site method for characterizing TRU waste meets quality assurance objectives established in the QAPP. To date, three PDP programs have been developed for DOE-CAO: (1) analysis of VOCs and gases[6], (2) nondestructive assay[7], and (3) RCRA constituent analysis of solidified wastes[8]. Waste generator/storage site implementation of these requirements is a key step in achieving authorization to dispose of TRU waste at WIPP.

Since 1991, the INEL has been actively retrieving and characterizing accessible stored TRU waste forms to supply information primarily supporting development of the No-Migration Petition for WIPP. Characterization activities, at a minimum, include headspace gas sampling, weighing, RTR, and radioassay. Intrusive sampling, completed to meet visual examination, inner bag sampling or collection of sludge samples for RCRA analysis, is performed at the ANL-W Waste Characterization Area (WCA). The WCA provides capability to open and examine waste drums and collect samples in a glovebox environment. Wastes are transported to ANL-W using the TRUPACT-II shipping container. Analysis of

sludge samples for RCRA constituents is being performed by Oak Ridge National Laboratory. Quality Assurance Project Plans have been prepared to implement the requirements of the TRU Waste Characterization QAPP. By January 1996, 595 drums have been characterized and the results reported to DOE-CAO.

FTIR spectroscopy was evaluated as an alternative approach to analyzing headspace gas from TRU waste containers. Current practices involve collection of the gas sample in a SUMMA™ canister followed by analysis of the gas at the INEL Environmental Chemistry Laboratory using gas chromatography/mass spectrometry. Use of the FTIR method offered a simple, rapid analysis that could be performed at the location the sample was collected. Significant cost savings could be realized over the conventional sampling approach. A two-phase study[9] was completed over about three years to evaluate FTIR capability to simultaneously quantitate the 29 VOCs required by the QAPP and then evaluate application of the FTIR on actual TRU waste drum headspace gas samples. Results of this effort have been successful, with FTIR meeting the TRU waste characterization requirements of $\pm$30% accuracy and $\pm$25% precision. As previously noted, this system is being installed on the Drum Venting system to support venting, sampling, and analysis needs.

A test program[10] has been completed to demonstrate that VOC concentrations in the void space of each layer of confinement in vented waste drums can be estimated using the measured drum headspace gas and a model incorporating theoretical diffusion and permeation transport principles. The conditional No-Migration Determination for WIPP requires that gas sampling of all layers of confinement within a container for flammable and nonflammable volatile hazardous constituents be performed unless DOE demonstrates this sampling is not necessary. A VOC transport model was developed and experiments completed to measure VOC concentrations in laboratory-scale simulated waste drums and actual waste drums. Both transient and steady-state modeling were completed. Results of this test program provided information that has demonstrated that headspace gas sampling of inner layers of confinement is not necessary to characterize VOC concentrations in the void volumes of drums and to safely manage waste at WIPP. This provides a significant reduction in costs by not opening and sampling inner bags of waste. A position paper has been prepared and submitted to DOE for regulatory compliance discussions.

A National TRU Waste Model was developed by INEL to support NTP planning efforts. The model, developed using commercially available personal computer software, is a decision-making tool for evaluating the preparation and flow of CH-TRU waste from eight major storage sites to WIPP. The model is designed to predict the course and results of hypothetical actions, understand observed or projected events, identify inefficiencies and problem areas, evaluate alternative management approaches, improve understanding of variables that influence waste flow to WIPP, and support development of an integrated complex-wide plan for achieving disposal of TRU waste. This simulation model forms the core of a larger system being developed by INEL, Sandia National Laboratory, and the NTP to address other management aspects such as budgeting and remote-handled waste. Results of these efforts will be assimilated into a complex-wide National TRU Waste Program Management Plan by September 1996.

The Matrix Depletion Program[11] is a cooperative effort between the INEL, Los Alamos National Laboratory (LANL), and Rocky Flats Environmental Technology Site (RFETS) for DOE-CAO. The objective of this program is to investigate the phenomenon of matrix

depletion as it affects the generation of radiolytic-produced gases over time, and to develop age-dependent gas generation values. The expected outcome of this program is the development of data that will support an application to the Nuclear Regulatory Commission for lower effective gas generation values and corresponding higher thermal wattage limits for wastes shipped in the TRUPACT-II. This will increase the amount of untreated waste that can be shipped to WIPP without repackaging or treatment. Radioactive tests containing various waste matrices are expected to begin at LANL in February 1996 to provide quantitative gas generation data and development of bounding effective gas generation rates. Predictive modeling will be completed for actual TRU waste drums, followed by sampling of this waste by INEL and RFETS, for determination of actual hydrogen content to verify experimentally-derived time-dependent gas generation rates are bounding. This program is expected to be completed in February 1998.

Procurement of Treatment Services. In 1992, efforts were initiated to evaluate the feasibility of procuring treatment services needed for TRU-contaminated waste from the private sector as an alternative to design, construction, and operation of a DOE-funded LICP. Results of these studies have indicated that significant cost savings could be achieved for DOE, and completion of waste disposal could be accomplished eight years earlier. The INEL has issued a Request for Proposal (RFP) for treatment services. It is expected that award of the contract will be completed in September 1996. Treatment of all TRU-contaminated waste will commence by March 2003. Until that time, untreated waste will be shipped to WIPP for disposal.

## FUTURE STRATEGIC DIRECTION

In October 1995, a settlement agreement was reached between DOE, the State of Idaho, and the Department of the Navy concerning future receipt of spent nuclear fuel at the INEL. This agreement will result in significant impacts to the future management program for INEL stored TRU waste. Although the stored TRU waste program was moving in a direction consistent with the general terms of the agreement, the establishment of specific dates and volumes of waste to be removed from the State of Idaho will result in acceleration of planned activities. Key agreement conditions affecting management of stored TRU waste include: (1) the first shipment of TRU waste out of the State to WIPP or another designated facility must be accomplished by April 30, 1999; (2) by December 31, 2002, 3100 $m^3$ of waste (15,000 drum equivalents) must be shipped out of the State; (3) after January 1, 2003, a running three-year average of 2000 $m^3$/yr must be shipped out of the State; (4) a mixed waste treatment facility contract must be established by June 1, 1997, construction completed by December 31, 2002, and operational by March 31, 2003; and (5) shipment of TRU out of the State must be completed by a target date of December 31, 2015, but not later than December 31, 2018. Failure to comply with these conditions could affect the receipt of DOE spent fuel at the INEL.

As originally planned, production-level waste examination and certification operations will be initiated in the summer of 1997 to begin building a backlog of certified waste for shipment to WIPP in April 1998. Receipt of final WIPP WAC is assumed by December 1996. Alternatives for achieving shipment of 15,000 drums by December 31, 2002, are currently being evaluated.

## SUMMARY

Historically, the INEL has proactively and successfully enhanced management capabilities for stored TRU waste. These capabilities include facility, operational, and technical development and support activities. Initiation of shipment of INEL stored TRU waste to WIPP will begin once WIPP is opened and authorization to ship is received.

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