MANAGEMENT AND DISPOSAL

OF HANFORD SOLID TRANSURANIC WASTE

J. F. Albaugh
J. D. Anderson
D. R. Groth
Rockwell International
Rockwell Hanford Operations
Richland, Washington 99352

ABSTRACT

Solid radioactive waste has been generated at the Hanford Site since 1944. Prior to 1970, this waste was disposed of through shallow land burial. Since 1970, solid waste suspected of containing transuranically contaminated materials has been stored such that it can be readily retrieved for future processing and/or shipment to a geologic repository. This paper presents a brief description of past, present, and future solid transuranic waste activities at Hanford.

INTRODUCTION

Since the start of operations in 1944, approximately 300,000 m^3 (approximately 10 million ft^3) of radioactively contaminated dry solids have been buried or stored at Hanford. Initially, all solid radioactive waste was directly buried in trenches. Since May 1970, waste containing or suspected of containing transuranic (TRU) radionuclides has been packaged, segregated from low-level wastes, and placed in special burial trenches to permit recovery. Current plans are to dispose of the retrievably stored TRU wastes in a geologic repository and to leave the pre-1970 wastes where they were previously disposed.

DEFINITION OF TRU

Prior to September 30, 1982, wastes were considered TRU if they contained, or were suspected of containing, TRU radionuclides in concentrations greater than 10 nCi/g (0.37 MBq/kg) of waste matrix. Since that date, TRU wastes have been defined as those having TRU radionuclide concentrations greater than 100 nCi/g (3.7 MBq/kg) of waste matrix. These quantitative limits were not routinely measurable for dry, solid waste because assay systems capable of these detection limits were not available. The wastes have therefore been segregated primarily on the basis of their point of origin.

PAST AND CURRENT PRACTICES

Solid waste materials consist of items such as failed process equipment including pumps, columns, and tanks; laboratory wastes and room trash including paper, plastics, glassware, and cloth; and decontamination and decommissioning rubble including concrete, piping, and soils. Historically, virtually all of the radioactive wastes were buried near the area where they were generated, with no consideration for eventual retrieval. Since May 1, 1970, most of the radioactive wastes contaminated or potentially contaminated with TRU radionuclides have been packaged and stored in the 200-West Area for retrieval.

Geohydrology and Monitoring

The Hanford Site has climatic and geological features which make the site well suited for burial and storage operations. Hanford is located in an arid environment having an average annual precipitation of approximately 15 cm (6 in.), which varies between approximately 8 cm (3 in.) and 28 cm (11 in.). Direct precipitation over the Hanford Site largely evaporates, leaving a small amount for plant uptake and runoff.

The majority of the burial grounds where TRU wastes are buried or stored are underlaid by approximately 50 m of low permeability dry sand and gravel, which has a large capacity for ion exchange. In the event water infiltration should occur, radionuclides would be retained in the soil column. Water movement between the waste storage site and the water table, however, is essentially nonexistent. Due to the low rainfall and resultant lack of driving force for moving radionuclides through the soil column, no groundwater monitoring wells are specifically provided to monitor solid waste burial sites. Groundwater monitoring wells located in close proximity to solid waste burial sites, however, have not detected radionuclides which could be attributed to migration from solid wastes.

Pre-1970 Buried TRU Solid Waste Sites

Eleven pre-1970 burial sites are now considered to be TRU waste sites based upon the 1982 definition of TRU waste. Pre-1970 wastes were packaged in fiberboard boxes, wooden containers, steel boxes, or concrete containers, placed in the ground in "V" shaped trenches, and covered with approximately 1.3 m of soil overburden. In addition to "V" trench disposal, a small amount of waste was disposed of in underground caissons. The pre-1970 caissons were used for disposal of small containers exhibiting high beta/gamma activity. Once the waste was buried, whether in "V" trenches or caissons, it was assumed that the packages provided no long-term containment.

(HEPA) filters, and exhausters designed to provide a downdraft through the inlet chutes into the caisson while the caissons are being charged.

Packages of RH-TRU waste are brought to the caisson site in a truck-mounted shielding cask. The cask is positioned over the caisson and a gate valve on the bottom of the cask is opened, allowing the waste package to fall freely into the caisson.

Each waste shipment is accompanied by a Solid Waste Burial Record form which physically describes the type and number of containers, the type and amount of TRU radionuclides contained, and the container radiation level.[1] The completed Solid Waste Burial Record is maintained as the primary record of the stored TRU wastes. The data are then entered into a computerized data base management system used to prepare all of the required reports and to interact with other national data bases, specifically the Integrated Data Base and the Solid Waste Information Management System. A new and very flexible data base system has recently been adapted to prepare reports and perform analyses of virtually any combination of parameters without the need for elaborate programming.

In order to assure that the retrievable storage sites are properly maintained, routine monitoring and surveillance is performed at least annually in a manner similar to that performed at the pre-1970 sites.

TRU INVENTORIES

There are approximately 92,100 m^3 (Table I) of TRU waste buried under an area of approximately 17 ha in the 11 pre-1970 solid TRU burial sites. This represents approximately 54% of the volume buried at all the U.S. Department of Energy (DOE) sites. This volume contains approximately 350 kg of TRU radionuclides, representing approximately 48% of the TRU elements buried at all DOE sites.[2]

At the end of December 1983, there were 12,800 m^3 (Table I) of CH-TRU waste and 21.8 m^3 of RH-TRU waste in retrievable storage at Hanford. This represents approximately 17% of the CH-TRU waste volume and 3% of the RH-TRU waste volume in retrievable storage at all DOE sites. This volume contains 345 kg of CH-TRU radionuclides and 5.4 kg RH-TRU radionuclides, representing approximately 28% of the CH-TRU elements and 71% of the RH-TRU elements in retrievable storage at all DOE sites.

TABLE I

TRU Solid Waste Sites

	Pre-1970	Post-1970	
		CH	RH
Number of Sites	11	6	I
TRU (kg)	350	345	5.4
Volume (m^3)	92,100	12,800	21.8
Area (ha)	17	NA	NA

DISPOSAL PLANS

As discussed in an earlier paper, three alternatives are being evaluated in the Hanford Defense Waste Environmental Impact Statement (HDW-EIS) for retrievably stored waste: Geologic Disposal, In Place Stabilization and Disposal, and Continued Storage (No Action). As a result of the analysis of technical and environmental options, a Reference Alternative was identified in the Hanford Defense Waste Management Plan. The following discussions are based upon the Reference Alternative for retrievably stored waste and current plans for already disposed of pre-1970 waste.

Pre-1970 TRU Solid Waste

Transuranic contaminated low-level waste buried prior to 1970 is considered disposed. As necessary, additional remedial action will be performed. These actions include additional subsidence control, barrier construction, and marker installation.[3]

Subsidence control for the pre-1970 TRU solid waste sites would include pile driving or alternative techniques to induce void space collapse and increase the density of the waste matrix. During recent testing, rods, cylinders, and I-beams have been driven to depths of 6 m through simulated waste packages, yielding void volume reductions of up to 90%. This technique transfers sufficient dynamic energy to the waste matrix and surrounding soil to induce direct compression of waste packages.[4]

Prior to pile driving in an actual burial ground, a geophysical survey would be conducted to identify the location of trenches with high subsidence potential. Next, pile installation would be performed using a vibratory hammer/extractor. Piles would then be withdrawn or, if found contaminated, would be driven to grade and left in place. Piles would be driven at a minimum of 2.5 m on center within the areas identified by geophysical surveys. The cost for this activity is estimated to be approximately $140,000 for all 11 sites.

Due to the large void space in the pre-1970 caissons, additional engineering study is needed to optimize subsidence control methods. One method under consideration is simply to inject grout into the caissons. An alternative method is to convert the waste and surrounding soil to glass, using in situ vitrification. The vitrification or conversion of the waste into a glass matrix would be performed by inducing a current in the ground around a caisson previously backfilled with Hanford soil or sand. The heat generated by inducing a current through the waste matrix would produce a stable, vitrified waste form. Field tests using clean, typical Hanford soil and sand have demonstrated the viability of this approach.

After all required subsidence control activities have been performed, barriers would be constructed over each site. A multilayer barrier, similar to the one discussed in an earlier paper, would be used to isolate these waste areas from intrusion by vegetation, animals, and man. During construction of the barriers, markers would be installed in geometrical patterns within the soil and riprap at varying depths such that at least one marker would be uncovered by any man-made excavation. In addition, surface markers will be placed around the perimeter of each site. The cost for barrier construction is estimated to be $50 million for all 11 sites.

Post-1970 TRU Solid Waste

The Reference Alternative for post-1970 TRU solid waste is for its disposal in the WIPP geologic repository. Post-1970 TRU solid wastes

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	Pre-1970	Post-1970	
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Volume (m^3)	92,100	12,800	21.8
Area (ha)	17	NA	NA

DISPOSAL PLANS

As discussed in an earlier paper, three alternatives were evaluated in the Hanford Defense Waste Environmental Impact Statement (HDW-EIS): Geologic Disposal, Onsite Stabilization and Isolation, and Continued Storage (No Action). As a result of the analysis of the various options, a Reference Alternative was selected. The following discussions are based upon the Reference Alternative. Implementation of this alternative is dependent upon the final Record of Decision for the Environmental Impact Statement (EIS).

Pre-1970 TRU Solid Waste

The Reference Alternative for pre-1970 buried TRU solid waste is "in situ disposal." Efforts required to perform in situ disposal include additional subsidence control, barrier construction, and marker installation.[3]

Subsidence control for in situ disposal of the pre-1970 TRU solid waste sites would include pile driving or alternative techniques to induce void space collapse and increase the density of the waste matrix. During recent testing, rods, cylinders, and I-beams have been driven to depths of 6 m through simulated waste packages, yielding void volume reductions of up to 90%. This technique transfers sufficient dynamic energy to the waste matrix and surrounding soil to induce direct compression of waste packages.[4]

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Post-1970 TRU Solid Waste

The Reference Alternative for post-1970 TRU solid waste is for its disposal in the WIPP geologic repository. Post-1970 TRU solid wastes include the inventory of wastes retrievably stored between 1970 and 1985, and "newly generated" wastes produced since 1985. The division between stored and newly generated wastes coincides with implementing the use of WIPP Waste Acceptance Criteria (WIPP-WAC) certification procedures and testing equipment. Efforts required for this Reference Alternative include retrieval of all stored TRU waste containers, assaying of both stored and newly generated wastes to segregate TRU from non-TRU wastes, non-destructive examination (NDE) of TRU waste containers to certify that the contents meet the WIPP-WAC, and shipment of certified TRU waste to the WIPP repository. Transuranic wastes not meeting the WIPP-WAC will be processed into a certifiable form, reassayed, and certified prior to shipment to the WIPP repository.

A neutron interrogation assay system ("assayer") is now being installed in the 224-T CH-TRU Storage and Assay Facility (TRUSAF) to segregate newly generated wastes into TRU and non-TRU categories. This assay capability will thus allow waste segregation based upon measured TRU content rather than by point-of-origin. It is estimated that approximately 45% of the assayed waste will be disposed of as low-level waste. The assayer is scheduled to be operational by September 30, 1985. A real time radiography (RTR) NDE unit will be used to inspect CH-TRU waste drums by using X-rays to assure compliance with the WIPP-WAC. The RTR system is now installed in TRUSAF and is undergoing testing. The RTR is scheduled to be operational in June 1985. In order to minimize the future generation of waste packages not meeting the WIPP-WAC, and therefore to minimize the need for additional processing, waste certification procedures are now being implemented by the generating facilities.

The certification of retrievably stored CH-TRU waste and of uncertifiable, newly generated CH-TRU waste will require a facility for reprocessing the waste into a certifiable form. This capability will be provided by the proposed CH-TRU Waste Receiving and Processing (CH-WRAP) Facility, which is scheduled to be operational in October 1993. Upon startup, the CH-WRAP Facility will centralize CH-TRU processing and thus replace TRUSAF.

When the CH-WRAP facility becomes operational (Fig. 2), the stored, drummed CH-TRU waste will be retrieved and examined for container integrity. Since the stored CH-TRU waste is free of external contamination and has been packaged to permit easy retrieval in containers, excavation will be safely accomplished in an open environment without generating an airborne release of radioactivity. The container will be sent to the CH-WRAP facility where it will be assayed to determine TRU content and NDE tested to determine if the container integrity and waste constituents are certifiable to the WIPP-WAC. If certifiable, appropriate labeling and color-coding will be applied, data packages produced, and the drums will be transported to WIPP or to an interim storage location.

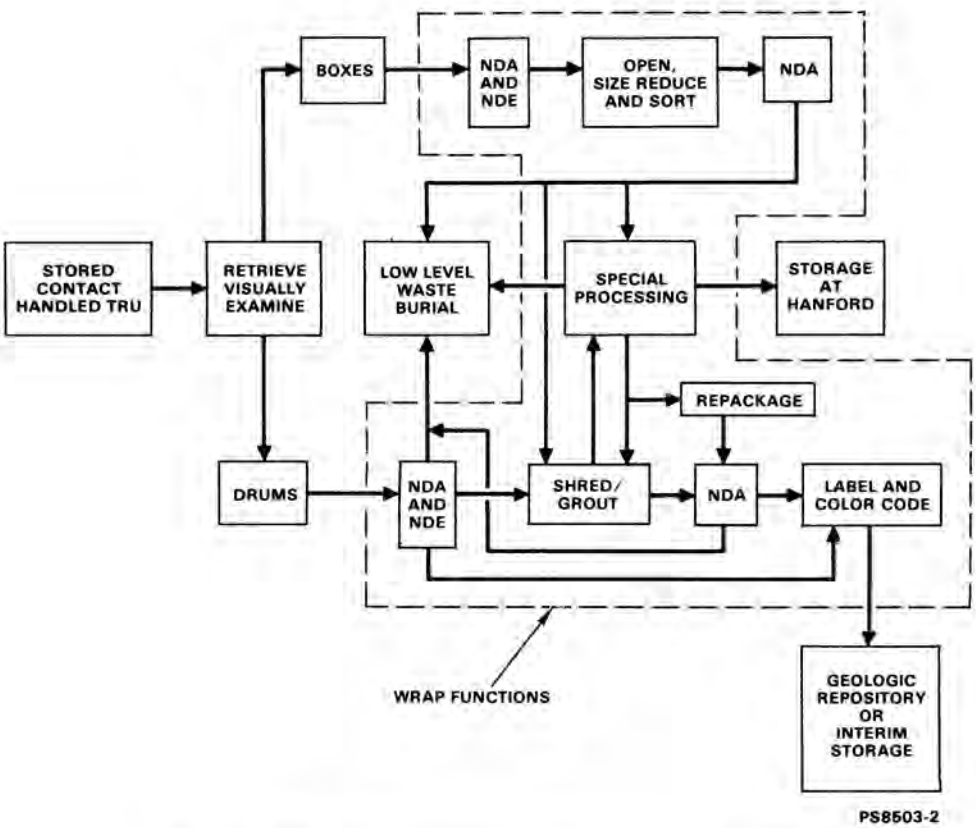

Fig. 2. WRAP Waste Certification Process Flow Diagram.

If not certifiable, the waste will be processed through the CH-TRU shred/grout process. Unshreddable wastes will be segregated for special processing so the waste can either be fed to the shredder, packaged directly in a WIPP approved and certifiable condition, or returned to storage for ultimate disposal by another method. The shredded CH-TRU waste will be mixed with grout, placed in drums, and assayed after the grout has cured. The final waste form will meet the WIPP-WAC.

The CH-WRAP facility will be similar to facilities now under construction at the Idaho National Engineering Laboratory (INEL). The INEL plant will process solid waste and sludge, drums, boxes, and bins through a shredder and rotary kiln incinerator. The ash will then be immobilized for disposal in the WIPP.

The disposal of retrievable RH-TRU waste stored in post-1970 caissons requires site preparation, waste retrieval, waste packaging, and site isolation. Engineering studies to finalize retrieval methods and waste reprocessing facilities for retrievable caisson waste are planned but not completed.

The RH-TRU caisson waste will be retrieved using an airtight, double-walled metal structure or "retrieval building" constructed on and sealed to a concrete pad located above the caisson. The waste will be retrieved using remotely operated grapples and placed in an RH-TRU transfer cask. An airlock and conveyor system will be used to transfer the cask to a chamber where the cask will then be transported to a proposed RH-WRAP facility for processing, which would include size reduction and grout immobilization. The finished container will then be transported to the WIPP in the shielded TRUPACT container. After removal of the RH-TRU waste, post-1970 caisson site isolation will consist of filling the caissons with grout and capping the caisson site. It is currently proposed to have the RH-WRAP facility operational in 1996.

CONCLUSIONS

From 1944 to 1970, solid TRU waste was disposed of through shallow land burial without consideration for eventual retrieval or further processing. Since 1970, wastes containing or suspected of containing TRU radionuclides were separated from the other waste streams and stored for future processing and/or geologic disposal. The natural barriers inherent to the pre-1970 burial sites are being augmented with protective barriers to prevent radionuclide migration, thus providing secure, permanent disposal sites. Solid TRU waste generated after 1970 will be retrieved, processed for handling, and transported to the WIPP geologic repository in New Mexico.

REFERENCES

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