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ORNL/TM--10189

DE88 010740

ORNL Waste Management Operations Program

FINAL INVENTORY WORK-OFF PLAN FOR ORNL TRANSURANIC WASTES (1986 VERSION)

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Date Published — May 1988

Prepared for the
Office of Defense Waste and Environmental Restoration
Budget Activity No. GF 02 07 00 0

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for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

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ABSTRACT

The Final Inventory Work-Off Plan (IWOP) for ORNL Transuranic Wastes addresses ORNL's strategy for retrieval, certification, and shipment of its stored and newly generated contact-handled (CH) and remote-handled (RH) transuranic (TRU) wastes to the Waste Isolation Pilot Plant (WIPP), the proposed geologic repository near Carlsbad, New Mexico. This document considers certification compliance with the WIPP waste acceptance criteria (WAC) and is consistent with the U.S. Department of Energy's Long-Range Master Plan for Defense Transuranic Waste Management.

This document characterizes Oak Ridge National Laboratory's (ORNL's) TRU waste by type and estimates the number of shipments required to dispose of it; describes the methods, facilities, and systems required for its certification and shipment; presents work-off strategies and schedules for retrieval, certification, and transportation; discusses the resource needs and additions that will be required for the effort and forecasts costs for the long-term TRU waste management program; and lists public documentation required to support certification facilities and strategies.

RH-TRU waste at ORNL presently totals ~1280 m^3, including 946 m^3 of sludges. It is currently forecast that 1532 m^3 will be available before 2013, the projected end of the work-off period. After the Waste Handling Pilot Plant becomes operable (targeted for 1996) at ORNL, RH waste will be worked off at the rate of 137 shipments per year. The CH-TRU waste at ORNL presently totals 542 m^3 and will increase to 1719 m^3; it will require 7 shipments per year for a 25-year work-off of CH-TRU waste. A conservative estimate for the cost of the total work-off effort is approximately $165 million.

FINAL INVENTORY WORK-OFF PLAN FOR ORNL TRANSURANIC WASTES (1986 VERSION)

L. S. Dickerson

1. INTRODUCTION

Approximately 1840 m^3 of transuranic (TRU) waste has been accumulated at Oak Ridge National Laboratory (ORNL) since 1970 and is currently in retrievable storage there. Remote-handled (RH) solid TRU waste accounts for ~1280 m^3 of this inventory as of December 31, 1986; additional RH-TRU waste is expected to be generated at the rate of ~10 m^3/year. Contact-handled (CH) TRU waste makes up the remainder and is projected to be generated at the rate of ~44 m^3/year. Plans call for the transfer of all this waste to the Waste Isolation Pilot Plant (WIPP), a deep geologic waste repository now under construction near Carlsbad, New Mexico, for disposal of TRU waste from the U.S. Department of Energy (DOE) system. DOE has developed a draft Defense Waste Management Plan (DWMP)[1] that encompasses the disposal of TRU waste at WIPP and has established the Joint Integration Office (JIO) to facilitate this goal. This Inventory Work-Off Plan (IWOP) has been prepared to outline ORNL's strategy for retrieving its defense TRU waste, certifying that the waste meets the WIPP waste acceptance criteria (WAC), packaging the waste for transportation, and, finally, shipping it to WIPP.

During the interval since waste storage began, several changes have occurred in regulations and philosophy concerning TRU waste. In 1970, the U.S. Atomic Energy Commission (now DOE) directed that all waste contaminated with >10 nCi/g of all alpha-emitting radionuclides be stored retrievably in packages designed to last 20 years or more. Further, in 1982, DOE redefined TRU waste to include only those materials which, at the end of institutional control, contained >100 nCi/g of alpha-emitting radionuclides with atomic numbers greater than 92 and half-lives >20 years. However, during most of the accumulation period, packages containing such alpha-emitting radionuclides at concentrations >10 nCi/g were stored for future disposition. To date, nondestructive analysis (NDA) and nondestructive examination (NDE) have shown that <10% of the waste packages can be disposed of on-site as low-level waste (LLW). In addition to NDA/NDE, container integrity studies may be conducted on each package with an ultrasonic probe to determine whether WIPP criteria are being met before final disposition can be made. Alternatively, overpacking the CH-TRU waste drums may exclude the use of a drum-integrity monitor.

The CH waste in storage at ORNL has been placed in stainless steel drums [208-L (55-gal)] or mild-steel drums [114-L (30-gal)]; the RH waste has been placed principally in concrete casks. However, 208-L drums will probably be used to contain the solidified TRU wastes resulting from ORNL's liquid waste operations. Portions of the RH-TRU waste that have been in storage for >10 years may now be considered CH-TRU waste if sufficient decay of the gamma- or neutron-emitting radionuclides has occurred.

The Defense Long-Range Master Plan[2] calls for the construction of a RH-TRU Waste Handling Pilot Plant (WHPP) to process the RH waste presently contained in the concrete casks. The waste will be transferred into drums and, if required, into RH-TRU canisters for shipment and emplacement in WIPP. Provisions will also be made for the project to process and package the RH-TRU sludges. Further, unusual CH-TRU packages that may require processing other than overpacking may be handled in the WHPP, a facility which is currently scheduled to become fully operational in April 1996, depending on timely funding.

Certification of newly generated (NG) RH waste forms, but not the container, began in January 1987. High levels of neutron radiation will delay shipment of the wastes to WIPP, thus necessitating interim storage (5 to 10 years) to allow ^{252}Cf decay. Therefore, ORNL will not be shipping any NG RH waste in the near future. Aged RH waste is scheduled to be transferred in January 1996, but the actual date will depend on the construction schedule for the WHPP. The RH waste inventory is projected to be worked off by October 2013.

Certification of stored and NG CH waste was initiated in FY 1986; shipment of the certified CH waste to WIPP will begin in October 1988. The CH-TRU drums composed of mild steel will be overpacked, as will be any drums that show corrosion. Further, all 114-L drums and all drums >5 years old will be overpacked into 208-L or 299-L (79-gal) stainless steel drums as appropriate. The CH-TRU work-off is expected to be completed by October 2013.

Section-specific guidance for the topics and layout of the IWOP, which was provided by DOE, is as follows: Sect. 2 characterizes all TRU wastes currently stored and projected to be stored at ORNL (the waste characterization tables are contained in Appendix B); Sect. 3 gives an overview of the methods and facilities that will be necessary to retrieve and certify the waste for shipment; Sect. 4 presents operational milestones and cost estimates; Sect. 5 defines the resource needs and tasks that need implementation; and Sect. 6 lists reporting requirements and public documentation. Appendixes A and B contain supporting information and the waste characterization tables.

2. WASTE CHARACTERIZATION

This section includes data on RH and CH waste generated and stored at ORNL from January 1970 through December 1986, along with a projection of future RH and CH waste generation. ORNL RH-TRU waste disposition depends on the timely construction of the ORNL WHPP since little or no processing of stored waste will be possible without it.

RH-TRU waste at ORNL is stored principally in concrete casks in Building 7855 and in trenches in the Solid Waste Storage Area 5 (SWSA-5). Retrievable burial of RH waste in the SWSA-5 area was discontinued in 1979. Of the buried casks, approximately 90 were retrievably buried under a 46-cm (18-in.) covering of concrete. The contents of the casks, originally considered for on-site disposal, will be retrieved and shipped to WIPP. This decision represents a strategy change from our earlier data submissions.

ORNL recently sampled and reclassified as RH-TRU wastes the radioactive sludges stored in the liquid waste tanks. This 116,000 gal of material (prior to sluicing) represents ~1000 m^3 of additional waste to be shipped to WIPP.

In addition, it is possible that cans of waste originating from the Consolidated Edison Uranium Solidification Project (CEUSP) and other uranium oxide-containing waste stored on-site may be packaged as RH-TRU waste for shipment to WIPP. The 2 m^3 of CEUSP waste has been designated RH-TRU waste, and a plan to certify this material for shipment to WIPP is being prepared. The wastes are included in Table B.2 of Appendix B for the completeness of presentation.

ORNL has about 7 m^3 of irradiated fuel elements/assemblies placed in stainless steel-lined storage wells in Buildings 7827 and 7829. This material is not strictly considered to be TRU waste and probably is not WIPP-certifiable; however, it is being included in these evaluations because it has been historically regarded as TRU waste.

The method used for calculating volumes in this characterization report differs from past methods used for calculating volumes in data submitted to the Integrated Data Base (IDB) Program. In previous reporting, volumes were calculated on the basis of the outside dimensions of the container (usually casks). For greater accuracy, however, RH-TRU waste volumes in this report are based on the actual waste volume, that is, the internal volume of the cask adjusted for actual estimated waste content. This method affords a more accurate view of the actual volume that ORNL has on hand, is presently producing, and will be shipping to WIPP. Waste to remain buried on-site retains the waste package volume since it is both difficult to determine the packing efficiency and suitable to consider the waste form and container as a unit. CH-TRU waste is also shown as a package volume since the drums will be shipped as a unit and the packing of the boxes varies.

The method used in this report to determine the total curies in the RH waste also differs from that used to obtain previous IDB data. This modification results from the distinction being made between radionuclides that are TRU nuclides by definition rather than simply nuclides contained in TRU waste. Previously, radionuclides were designated as TRU nuclides because they were contained in TRU-contaminated waste, not because of their strict isotopic classification.

Contact-handled TRU wastes are first stored in 114- or 208-L stainless steel drums in Building 7823, after having been sealed with a Neoprene gasket and a closure ring. Once a sufficient number of drums have been accumulated, they are moved to a cell of the Retrievable Waste Storage Facility, Building 7826 or Building 7834. Presently, more than 2200 drums are stored in these 85%-below-grade concrete bunkers. ORNL has discontinued the use of mild-steel drums for storage, and plans are to refuse 114-L containers for CH-TRU waste storage.

Stored CH-TRU drums are scheduled to be completely assayed and characterized by June 1988. These drums are first examined by a segmented gamma scanner (SGS) and then by a neutron assay system (NAS) in the Waste Examination Assay Facility (WEAF; previously called the TRU Waste Drum Assay Facility), Building 7824. All CH-TRU waste drums will also be scanned by the real-time radiography (RTR) unit for certifiability of content form by January 1988. Of the drums assayed since April 1982, ~70% have proven to contain TRU waste, 5% are classifiable as LLW, and 25% of the assayed drums are uncategorized. The majority of these questionable drums will likely be conservatively classified as TRU waste.

An examination of the drums by an ultrasonic-thickness probe for drum-wall integrity could complete the certification checks of the drums. However, it is more likely that overpacking drums >5 years old will be substituted for this last step.

Table B.1, in Appendix B, does not include the drums that will likely be reclassified to LLW; these drums are characterized in Table B.11. The uncategorized drums are included in Table B.1, however. Reassaying the questionable drums will likely result in modifications to both Table B.1 and Table B.11.

The projections of Table B.3 are based on ORNL's production of certifiable waste to date. Table B.5 (soft waste) and Table B.6 (hard waste) were compiled by taking the future CH waste projection and apportioning the likely combustible content as soft waste and the noncombustible portion as hard waste. However, it must be pointed out that most of ORNL's TRU waste is a mixture of both soft and hard waste and is not segregated according to form.

A significant addition appears in Table B.3 among the waste expected to be generated in the future. Here, in addition to the projected 28 m^3 of CH waste per year that will be placed in 208-L drums, six boxes per year of decontamination debris are projected to be generated, thereby producing an additional 16 m^3 of CH waste on an annual basis. Although the CH drum generation rate is currently 21 m^3/year, the rate of 28 m^3 has been retained for consistency with the 1986 IDB submittal. The characteristics of the boxed waste were assumed to be similar to those of other ORNL boxed waste. The 6 by 4 by 4 ft steel box shown in the table is the most commonly used container available for waste storage.

2.1 RH-TRU SLUDGE

ORNL has recently classified ~439,000 L (116,000 gal) of radioactive sludge as RH-TRU material: 193,000 L (51,000 gal) of sludge in the eight Melton Valley storage tanks (MVSTs) and 246,000 L (65,000 gal) of solid "heels" in the six old Gunite tanks. This material includes the residual sludge and "heels" from the Gunite Tank Sludge Removal Project which were processed for hydrofracture before ORNL terminated its hydrofracture operations for disposing of low-level liquid wastes in 1984.

2.1.1 Isotopic Composition

The MVSTs contain ~570 Ci of TRU isotopes, and the Gunite tank sludge contains ~6700 Ci of TRU isotopes. The percentages of isotopic activity for the sludge-containing tanks were calculated on the basis of these estimates. In the waste characterization tables in Appendix B, this isotopic distribution is coded as "a". Table 2.1 was constructed using the estimated isotopes present.

2.1.2 Work-Off of Sludges

ORNL recommends that this material be immobilized in a solid matrix and shipped to WIPP in the proposed RH-TRU canister. An estimate made

Table 2.1. Activity of sludges

Melton Valley storage tanks[a]		Gunite tanks[b]	
Nuclide	Activity (% of total)	Nuclide	Activity (% of total)
^{241}Am	0.20	^{90}Sr	86.30
^{244}Cm	1.03	^{137}Cs	11.05
^{233}U	0.04	Others	2.65
^{238}Pu	0.15		
^{239}Pu	0.14		
^{60}Co	1.48		
^{95}Nb	0.04		
^{137}Cs	3.87		
^{95}Zr	1.06		
^{152}Eu	4.60		
^{154}Eu	2.74		
^{155}Eu	1.00		
^{198}Au	0.08		
^{90}Sr	83.56		

[a] Source: F. J. Peretz, *Characterization of the Low-Level Liquid Waste Concentrate Stored at the Oak Ridge National Laboratory (Preliminary Draft)*, February 1986.

[b] Source: J. R. Horton, *Preliminary Decommissioning Study Reports: Vol. 4: Gunite Storage Tanks*, X-OE-231, September 1985.

of the dose on the surface of 208-L drums for grouting the sludge indicates that the average drum should read <11 R/h and that the maximum reading would be <15 R/h. The immobilization technique will affect the surface dose level.

The addition of sluicing water to remove the sludge from the tanks will increase the volume to roughly 250,000 gal (950 m^3). Assuming that there is no volume reduction and that an RH-TRU canister will contain three 208-L drums for a usable 0.62 m^3, the 950 m^3 would require 1530 canisters (4600 208-L drums) for its work-off. Over the 18-year period from 1996 to 2013, these canisters can be worked off at the rate of 85 canisters per year by shipment to WIPP.

2.2 CANNED URANIUM WASTES

The Consolidated Edison Uranium Solidification Program (CEUSP) campaign conducted during 1986 produced 402 cans, each 9.525 × 62.55 cm in size. The material resulted from a U.S. Atomic Energy Commission project that involved reprocessing a ThO_2-UO_2 fuel core which had been irradiated in the Consolidated Edison Indian Point Reactor from 1962 to 1965. The original oxide fuel pellets were produced at Hanford and Savannah River. The reprocessing was performed at the Nuclear Fuel Services Plant at West Valley, New York, and the product solution was transferred to ORNL during 1968-1969.

The gross weight of each can is ~10 kg; the tot 1 weight of all cans is 1047 kg of initial heavy metal. Each can reads ~300 to 350 R/h at contact and 20 to 40 R/h at 12 in. from the surface. This material is presently being stored in a secure area.

The isotopic composition and the typical constituents of a CEUSP can are as follows:

Nuclide	% of total	Nuclide	% of total
^{232}U	140 ppm	^{235}U	76.52
^{233}U	9.69	^{236}U	5.60
^{234}U	1.39	^{238}U	6.80

Can Contents

2.605 kg of uranium (isotopic distribution as shown above)
0.8 kg of cadmium (nuclear poison) as CdO
0.1 kg of gadolinium (nuclear poison) as ^{203}Gd
Minor contaminants such as Si, Fe, Al, P, Cr

An additional 200 cans of uranium oxide, each approximately 8.89 cm diam by 25.4 cm high, exist. This material was generated by various programs at Hanford and Savannah River. Each can weighs ~500 g and reads ~1000 R/h at 1 in. from the surface and 100 R/h at 12 in. These cans have higher concentrations of ^{232}U (220 ppm) than do the CEUSP cans and contain no nuclear poisons.

2.2.1 Work-off of CEUSP and Other Cans

The nuclear poisons in the CEUSP cans effectively eliminate any criticality concerns; hence, these cans can be packed as appropriate from the standpoint of canister surface activity (100 R/h). Based on the latest criticality evaluations, a total of 52 cans may be placed in a canister. This will result in approximately eight shipments. It is planned that this waste will be repacked and shipped to WIPP; otherwise, it will be proposed to become the responsibility of the Federal Waste Management System (FWMS).

The cans of miscellaneous uranium oxide contain no poisons, and therefore, criticality concerns are important. Stacking 10 to 15 cans longitudinally appears to be the maximum loading per RH-TRU canister; however, these cans may remain on-site, stored in the Penthouse Storage Area of Building 3019, since they are not officially recognized as containing TRU waste. If the CEUSP cans are certifiable for the WIPP, an attempt may be made to solidify this material in a process similar to that used for CEUSP and then shipped to WIPP.

2.3 HOT-CELL WASTES

As of December 31, 1986, ORNL had 324 m^3 of actual RH-TRU waste (adjusted for container content) retrievably stored in 349 concrete casks. The majority of this waste was produced in ORNL's Buildings 3019, 3038, 5505, 7920, and 7930. The bulk of this waste resulted from the preparation of californium neutron sources and the subsequent recovery of curium, berkelium, and einsteinium from target materials irradiated in the High Flux Isotope Reactor (HFIR) at ORNL. Hot-cell waste consists of cloth, paper, glass, rubber, plastic, and metal (small tools). This waste is principally packaged in l-gal metal paint cans, overpacked and sealed in a 4-gal plastic bucket, and placed in concrete casks. Newly generated hot-cell material originates almost exclusively from Building 7920. Table 2.2 shows the isotopic composition of typical, casked RH-TRU waste.

2.3.1 Work-Off of Hot-Cell Waste

The hot-cell waste is contaminated with significant quantities of neutron-producing ^{252}Cf. Hence, present plans are to store NG RH waste from 5 to 10 years to allow ^{252}Cf to decay below the current WIPP waste acceptance criteria limits of 270 mrem/h. ORNL currently plans to retrieve and repackage its RH waste in the proposed WHPP facility and then ship it to WIPP.

2.4 ESTIMATION OF ANNUAL NUMBER OF RH WASTE SHIPMENTS

For the determination of the number of shipments per year that will be required to work off the RH-TRU waste, an estimate of the actual waste volume inside containers was used as a basis for the calculations shown below (also see Sect. 4.2.1).

Actual RH waste on hand [1]: 1279 m^3 (December 1986)
Actual generation rate [2]: 10 m^3/year
Assume 25.75 years of generation (January 1987 to October 2013)
Hence, additional RH waste generated: 258 m^3
Total actual RH waste for shipment: 1530 m^3
Shipment period: January 1996 to October 2013, >18 years
Canister load [3]: 3 drums of 208-L capacity or 36 cans of 50%-compacted RH waste
Assumptions:
- Only one canister will be loaded per shipping cask
- 50% volume reduction
- Newly generated waste will also be loaded into casks at 60% fill

Table 2.2. Average isotopic composition of significant contributors, by weight, for casked, retrievable, RH-TRU waste

Nuclide[a]	% of total	% TRU-alpha[b]	% beta-gamma
^{241}Am	0.64	0.99	
^{244}Cm	0.30	0.42	
^{239}Pu	41.16	56.97	
^{233}U	22.30	30.87	
^{252}Cf	0.005	0.01	
^{137}Cs	0.06		0.16
^{241}Pu	0.00		0.00
^{90}Sr	0.004		0.01
^{235}U	35.53		99.83

[a]Defined as having a half-life >5 years and contributing 1% or more of the total activity. However, since ^{252}Cf is so characteristic of ORNL TRU waste and decays to ^{248}Cm, an exception was made for it. This listing, derived from a summary of the ORNL Solid Waste Information Management System's (SWIMS) information, is made up of identified nuclides originally reported in the beta-gamma TRU waste stored retrievably from 1970 to late 1985. No accounting is taken of radioactive decay and daughter production. The total mass present is 1822 g.

[b]TRU-alpha nuclides represent both those nuclides that are actually TRU by definition and those that ORNL treats as TRU (i.e., ^{233}U and ^{226}Ra); ^{252}Cf and ^{244}Cm were also included because they are so prevalent in ORNL's RH-TRU waste. A more-detailed accounting of currently generated, typical RH casks was presented in correspondence from J. E. Bigelow to T. Grizzard (Oct. 23, 1984). "Estimated Contents of Waste Containers":

Nuclide	% of total
^{226}Ra	0.3
^{238}Pu	0.3
^{239}Pu	0.6
^{240}Pu	0.6
^{241}Am	0.4
^{246}Cm	0.3
^{244}Cm	97.5

Total shipments required [4]: 33,843 cans/18 cans/canister × 0.5
= 940 canisters
Sludges = 1526 canisters
CEUSP cans = 8 canisters

Shipments required for 18-year work-off: 2474/18 = 137/year

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[1] Actual RH waste on hand (retrievable and buried) calculation
6-in. Cask: 219 casks × 1.658 m^3/cask × 0.6 = 217.86 m^3
12-in. Cask: 35 casks × 0.657 m^3/cask × 0.5 = 11.50 m^3
4.5-in. Cask: 95 casks × 1.658 m^3/cask × 0.6 = 94.48 m^3

Total casked, stored actual RH waste = 324 m^3 in casks
Sludges: 946 m^3
CEUSP cans: 1.79 m^3
Other cans: 0.315 m^3
SS wells: 6.8 m^3

Total others: 955 m^3

Total stored waste for WIPP work-off = 1279 m^3

Calculation of filling efficiencies for casks:
Volume of polybucket that contains a paint can of RH waste:
$V = 3.1416 \times (5.5)^2 \times 10 \times 1.639E{-}05\ m^3/in.^3 = 0.0156\ m^3$

4.5-in. and 6-in. casks: 62 buckets/cask × 0.0156 = 0.966 m^3 actual waste volume
12 in.-cask: 21 buckets/cask × 0.0156 = 0.327 m^3

Packing efficiency: 0.966 actual waste/1.6576 internal volume = 60%

[2] Annual generation rate of RH waste
Previously reported gross projected rate: 29 m^3/year
29 m^3/year per 2.83 m^3/cask OD = 10 casks/year
Real waste volume:
10 casks/year × 1.658 m^3/cask ID × 0.6 = 9.95 m^3

Hence, 10 m^3 of actual RH waste is projected to be produced yearly.

[3] RH waste is contained in paint cans that are sealed in plastic buckets whose dimensions are 10 × 11 in. The dimensions of a 208-L drum are 35 × 23.25 in. Hence, 6 paint cans of uncompacted waste will fit into a drum, and 18 paint cans will fit into a shipping canister. Assuming a volume reduction of 50%, 36 cans will be processed.

[4] Estimation of the number of paint cans of RH waste

Stored waste

4.5-in. Casks:	95 casks	×	62 buckets/cask	=	5,890
6-in. Casks:	219 casks	×	62 buckets/cask	=	13,578
12-in. Casks:	35 casks	×	21 buckets/cask	=	735
					20,203

Newly generated waste

6-in. Casks: 258 casks × 62 buckets/cask = 15,996

Total cans of RH waste in casks: 36,199

Canisters required for other wastes

Sludges: 946 m^3/0.62 m^3/canister = 1526

Canned: 402 CEUSP cans/52 = 8

2.5 CH-TRU WASTE

A variety of CH-TRU wastes, packaged principally in 114-L and 208-L stainless steel and mild-steel drums, have been retrievably stored in concrete bunkers at ORNL since 1970. CH-TRU wastes, as defined in DOE Order 5820.2, are those wastes having a measured radiation dose rate at the container surface of <200 mrem/h.

Most of the TRU waste at ORNL is generated by research laboratories: Pilot Plant (Building 3019), Transuranium Research (Building 3508), Transuranium Processing Plant (Building 7920), Radioisotope Production Laboratory A (Building 3028), Transuranium Research Laboratory (Building 5505), High Flux Isotope Reactor (Building 7900), and Thorium-Uranium Recycle Facility (Building 7930).

Criticality control is maintained by limiting the quantity of fissionable material to 20 g in each 114-L drum and to 36 g in each 208-L drum. Thus, only small quantities of the TRU isotopes are contained in large quantities of discarded material. Since more than 20 alpha-emitting isotopes have been identified in ORNL CH-TRU waste, the waste definitely has a complex isotopic composition. Table 2.3 gives the weight percent of the major isotopic contributors in this waste.

Table 2.3. Average isotopic composition of significant contributors, by weight, for retrievable CH-TRU waste

Nuclide[a]	% of total	% TRU-alpha[b]	% beta-gamma
^{241}Am	0.70	0.70	
^{252}Cf	0.01	0.01	
^{244}Cm	0.33	0.33	
^{237}Np	2.45	2.45	
^{238}Pu	1.98	1.99	
^{239}Pu	42.51	42.66	
^{240}Pu	2.10	2.11	
^{233}U	49.40	49.58	
^{137}Cs	0.15		41.64
^{241}Pu	0.15		41.61
^{90}Sr	0.06		16.74

[a]Defined as having a half-life <5 years and contributing 1% or more of the total activity. However, since ^{252}Cf is so characteristic of ORNL TRU waste and decays to ^{248}Cm, an exception was made for it. This listing, derived from a summary of the SWIMS information, is of identified nuclides originally reported in the CH waste stored retrievably from 1970 to late 1985. No accounting is taken of radioactive decay and daughter production. The total mass present is 24,790 g.

[b]TRU-alpha nuclides represent both those nuclides which are actually TRU nuclides by definition and those which ORNL treats as TRU nuclides (i.e., ^{233}U); ^{252}Cf and ^{244}Cm were also included because they are so prevalent in ORNL's RH-TRU waste.

The average container of CH-TRU waste weighs <60 kg. The contained material includes about 14% contaminated equipment, 4% decontamination debris, and 82% dry solids. Approximately 60% of the waste is combustible.

2.5.1 Work-Off of CH-TRU Waste

Drums will be assayed for certifiability using an NAS, SGS, and RTR unit, and also possibly an ultrasonic thickness probe. If the drums (or boxed wastes) pass these checks and are classified as TRU wastes, they will be appropriately packaged for shipment to WIPP. Material falling in the non-TRU category will be disposed of locally as low-level waste (LLW). Drums of noncertifiable CH wastes that require processing of contents will be returned to the generator if they were received after July 1984. Drums generated before this date will be repackaged by ORNL waste management in a facility to be completed in the near future.

Drums not meeting the WIPP WAC criteria for containers will be overpacked and shipped. All 114-L drums will be overpacked into 208-L drums, and all mild-steel 208-L drums will be overpacked into 299-L stainless steel drums. The overpacking of drums will probably supplant use of the ultrasonic thickness probe; hence, it is likely that all drums of ' .e stored >5 years will be overpacked.

Results of calculations performed as described in Sect. 2.6 indicate that approximately seven shipments per year in TRUPACTS will be required to work off this waste to WIPP.

2.6 ASSUMPTIONS AND ESTIMATES FOR TRUPACT USAGE

In determining the number of shipments to WIPP that would be required annually in order to work off ORNL CH-TRU waste, the waste volume was considered to be equal to the package volume (waste and container). Shipment packing was based on the use of the current TRUPACT design. With this base, the following calculations were generated (also see Sect. 4.1.1):

CH waste in storage: 426 m^3 in drums
106 m^3 in boxes

Total drums in storage: 2142
Total boxes in storage: 30

TRUPACT working volume: 226 × 68 × 77 in.
TRUPACT drum capacity: 36 drums per TRUPACT
TRUPACT II efficiency box size: 38.5 × 52.5 × 75 in.
TRUPACT box capacity: 6 TRUPACT IIs per TRUPACT

Drum work-off: 2142/36 = 60 trips
Box work-off:
Waste in storage as of December 1986:
Boxes (12), 7.3 ft long
Boxes (3), 5.7 ft long
Boxes (15), <6.2 ft long
Assumptions for work-off:
Assume 40% of waste is either void space or LLW
Assume 50% compaction
Assume TRUPACT II efficiency box used (80% fill)

32 m^3 of processed boxed waste/2.5 m^3 × 0.8/TRUPACT II =
16 TRUPACT II or 2.7 trips

Trips required to work off stored waste: 63 total trips

Future generation: assume 27 years (1987–2013)

For consistency with 1986 IDB submissions, 28 m^3/year (or 135 drums) will be used instead of the current generation rate of 21 m^3/year (or 100 drums)

135 drums/year × 26.75 years × 50% = 1806 drums

6 boxes (6 ft long) × 26.75 years = 160 boxes

Trips required to work off future waste: 77 total trips

Drum work-off: 1806/36 = 50 trips
Boxed waste assumes only 50% compaction:

8 m^3 processed waste × 27 years/2 m^3/TRUPACT II = 108 TRUPACT IIs or 18 trips required

Work-off shipping period: 26 years (October 1988 to October 2013)

Trips required per year to work off total CH waste:

181 total trips/26 years = 7 trips required/year

It is assumed that all 114-L drums will be overpacked into 208-L drums and that 208-L mild-steel drums will be overpacked into 299-L drums. Overpacking into 299-L drums will not result in additional shipments being required, however, because a different shipping container will be used.

2.7 ASSUMPTIONS FOR WASTE CHARACTERIZATION TABLES

Eleven categories of stored and NG RH, CH, and special-case (SC) waste are represented in the waste characterization tables in Appendix B. The assumptions used and the coverage of these categories are discussed in this section.

2.7.1 Table B.1. Stored Waste Expected to Be Certifiable Without Processing

Only CH waste is listed in this category since processing is required for all of ORNL's stored RH waste. The listed CH waste includes those drums which have been assayed and were found to be questionable; that is, there is some doubt as to whether they should be listed as CH or reclassified to LLW. However, those drums that will probably be classified as LLW have not been included in this count. The drums listed in this table represent the anticipated 55% that will successfully pass the WEAF assay; this table corresponds to Table T2[3] of ORNL's submission to the 1986 IDB annual inventory report.[4]

2.7.2 Table B.2. Stored Waste Not Expected to Be Certifiable Without Processing

This table lists the stored RH and CH waste that is expected to be shipped to the WIPP. The CH waste drums in this category represent the expected 45% rejects resulting from the WEAF assay. All boxed CH-TRU waste is shown because processing (at the least, compaction) will be necessary for its certification. Included are both retrievable and all buried RH waste casks stored from 1970 until December 1986, including some buried RH waste previously considered not to be feasible to certify. These entries assume that ORNL's projected WHPP will become operable. Also, the included CEUSP material and other uranium oxide-containing cans may not be designated as RH-TRU waste that will be shippable to WIPP. The volumes correspond to the values given in Tables T1 and T2[3] of ORNL's submission to the 1986 IDB annual inventory report.[4]

2.7.3 Table B.3. Newly Generated Waste Expected to Be Certifiable Without Processing (1987–2013)

Only CH drummed waste is included in this table since boxed waste may require both drumming and compaction. The projected estimates for the CH waste are based on the characteristics of the stored CH waste. A packing efficiency of 0.9 is assumed for the wastes, based on RTR scans during assaying. For practical purposes, however, the packing efficiency of the CH drums can be regarded as 1 since the waste form and container will be treated as a package. The boxed CH waste is that debris which is expected to result from decontamination activities in the future. This table corresponds to Table T9[3] of ORNL's submission to the 1986 IDB annual inventory report.[4]

2.7.4 Table B.4. Newly Generated Waste Not Expected to Be Certifiable Without Processing (1987–2013)

The NG CH-TRU drums (approximately 5%) that will be rejected by the WEAF assay [principally due to the presence of high-efficiency particulate aerosol (HEPA) filters] appear in this category. All NG boxed CH-TRU waste will need some minimal processing. Projections for the RH-TRU waste are based on the characteristics of RH waste currently stored in 6-in.- and 12-in.-walled casks. This table may be compared with Table T8[3] of ORNL's submission to the 1986 IDB annual inventory report.[4]

2.7.5 Table B.5. Soft Waste That Will Become Available for Shipment (1987–2013)

"Soft" waste was compiled principally by using the percentage of the stored RH and CH waste that was combustible. The combustible waste, some of which has been compacted, was termed "soft." Drums containing filters were also termed soft. The other data were obtained from an average of stored waste and its characteristics. The number of containers was obtained by projecting the future generation of the waste and multiplying it by the percent combustible of the waste category. It needs to be understood that most of ORNL's TRU waste is a mixture of both soft and hard waste and is not segregated according to form. Tables T3, T4, T10, and T11[3] of the 1986 IDB submissions correspond to Table B.5.

2.7.6 Table B.6. Hard Waste That Will Become Available for Shipment (1987–2013)

"Hard" waste was compiled by using the noncombustible percentage of stored RH and CH waste as a basis for its projection. The boxes of CH waste listed in this table are those that are likely to be composed of decontamination debris and contaminated equipment; hence, this type of waste will be essentially hard. The characteristics of the boxed hard waste are conservative. Tables T3, T4, T10, and T11[3] of the 1986 IDB submissions correspond to this table.

2.7.7 Table B.7(a). NG Special-Case TRU Waste That Will Become Available for Shipment (1987-2013)

This table is blank because ORNL will not be generating any SC waste, since it is assumed that the WHPP will be functional.

2.7.8 Table B.7(b). Stored Special-Case TRU Waste That Will Become Available for Shipment (1987-2013)

ORNL sludges and uranium oxide-containing cans are not considered to be SC waste; therefore, operation of the WHPP will eliminate this category.

2.7.9 Table B.8. Stored and Newly Generated Waste to Be Left On-Site: Waste Deemed Not to Be Certifiable Through the Year 2013

The assumption is made that the ORNL WHPP will become operable and that all ORNL RH waste stored in casks will be processed for shipment to WIPP, including 86 m^3 of actual RH waste that was previously listed in this table (see Tables B.2 and B.10). Buried RH-TRU waste is shown in Table B.10. Waste that will likely be left on-site is encapsulated in stainless steel wells with a capacity of 0.0537 to 0.1891 m^3. This entry is reflected in Table T1[3] of the 1986 IDB submission.

2.7.10 Table B.9. Special-Case TRU Waste: Soil Contaminated with TRU Nuclides

This soil was contaminated during the early days (pre-1970) of waste emplacement and is not contained in packages. If the TRU-contaminated soil cannot be isolated from the total volume of contaminated soils, then the volume of TRU-contaminated soil will approach the estimate of up to 1,600,000 m^3 of LLW soils. Further, it needs to be emphasized that ORNL currently regards this TRU-contaminated soil as buried waste and not as SC waste. Table B.9 is comparable to Table T18[3] of the 1986 IDB submission.

2.7.11 Table B.10. Special-Case TRU Waste: Buried TRU Waste

This table includes both CH and RH wastes. The uncharacterized waste that was buried prior to 1970 is probably more characteristic of the CH waste than is the RH waste. Although designated as "uncontained" because all of the containers are not specifically known, it is listed in the CH category. This information represents portions of Tables T15 and T18[3] of the 1986 IDB submission.

The RH-TRU waste that is contained in wood or metal boxes and is planned to be left on-site is included in this table. Also, a drum of contaminated waste, to remain buried on-site, is included in this count. Packing efficiencies are listed as 1, basing the volume on the waste package itself. (Because ORNL's RH waste that is buried in concrete casks is considered retrievably stored, it has been removed from this category.)

2.7.12 Table B.11. Stored Waste to Be Managed as Low-Level Material

This table includes those drums of CH waste which assay indicates should be reclassified to LLW. Drums assaying <50 nCi were placed in this category. Future results could increase the number of entries in this category. Characterization data that the SWIMS records currently contain on the drums are shown for consistency with ORNL records. When the WEAF assay results are officially incorporated, our records will reflect the changes. The WEAF results, corresponding to entries from Table T2[3] of the 1986 IDB submission, are shown as a note for comparison.

2.7.13 Other Notes Pertaining to Waste Tables

The average heat output, in watts per cubic meter, is calculated by summing the watts for the container type and dividing this sum by the container volume, loading efficiency, and number of particular containers. The isotopic composition key is as follows:

1. See Table 2.1, activity of sludges.
2. See Sect. 2.2, Canned Uranium Wastes.
3. See Table 2.2, RH isotopic composition.
4. See Table 2.3, CH isotopic composition.

3. METHODS AND FACILITIES REQUIRED FOR CERTIFICATION OF WASTE

ORNL will use a variety of methods and facilities to certify its TRU waste inventory and NG waste. Efforts are now being concentrated on the certification of both stored and NG CH-TRU waste; it is planned that future emphasis will be shifted to other waste forms. This section first describes the other waste forms that ORNL must deal with: RH waste, impractical-to-certify (ITC) waste, and buried waste. These waste forms will probably prove more difficult to certify. The facilities required for waste certification will then be discussed: WEAF (formerly called the TRU Waste Drum Assay Facility), RH-TRU Waste Processing Pilot Plant, retrieval facilities, loading dock, and additional storage. The systems required for certification and meeting the WIPP WAC are also discussed here. These systems include the NAS, SGS, RTR, bar coding, and an ultrasonic thickness probe.

3.1 TRU WASTE THAT IS DIFFICULT TO CERTIFY

The WIPP facility is designed for retrievable, underground emplacement of ~180,000 m^3 of CH-TRU and ~7,000 m^3 of RH-TRU waste. Some waste forms, such as buried waste that could be too costly and/or too hazardous to process for WIPP disposal, may be ITC for disposal at WIPP. ORNL does not have any waste that is considered ITC other than that which is identified in the tables of Appendix B. However, future evaluations, assaying, redefinition, or a change in work-off plans or strategies may result in some waste being classified as ITC. If this is the case, in the absence of guidance from the DWMP and in accordance with DOE Order 5820.2, the material will be handled appropriately through alternative TRU waste management practices that are as yet undefined.

3.1.1 <u>RH Wastes</u>

A waste is defined as RH-TRU waste when the contents have an activity level >100 nCi/g and the waste container's surface beta-gamma-neutron radioactivity is >200 mrem/h but does not exceed 100 rem/h. ORNL stores its RH-contaminated material in concrete casks and stainless steel capsules. Recently classified TRU sludge will be packaged in 208-L drums. This sludge from the Gunite Tank Sludge Removal Project now comprises the bulk (~950 m^3) of the ORNL RH-TRU waste.

Most of the currently generated RH waste is stored in reinforced concrete casks with dimensions of 1.27 to 1.37 m in OD by 2.13 m to 2.44 m long. Until 1980, these casks were placed in unlined trenches; casks of waste generated since 1980 have been placed in a concrete-block, cave-type facility. No sludges are contained in the casks, and ORNL estimates the metal content at ~10%.[5] A few casks contain large equipment items such as pumps, furnaces, and equipment racks that will require size reduction before they will fit into the RH canister.

A very small amount of RH-contaminated material is placed in stainless steel capsules at ORNL and stored in stainless steel wells whose tops are at ground level and surrounded by a concrete pad. A removable concrete plug is used to close the wells. The material inside these capsules may be either bagged, canned, or loose since packaging was done on a case-by-case basis. The contents are composed primarily of fuel elements and their associated hardware, which have been cut up for examination.[5]

ORNL also has canned RH waste. About 2 m^3 of this material results from the CEUSP campaign, which ended in 1986, and is stored in ~400 cans whose dimensions are 9.525 × 62.55 cm. An additional 200 oxide-containing cans, measuring approximately 8.89 × 25.4 cm, are stored in Building 3019. (See Sect. 2 for additional information on waste types and contents.)

Recently, ORNL reclassified as RH-TRU ~439,000 L of sludge that is currently stored in the Gunite tanks, the evaporator tank, and the MVSTs. The sludges of the Gunite tanks are leftovers of sluicing operations to remove the tank contents. The sludges of the evaporator tank and the MVSTs resulted from TRU particles dropping from suspension and remaining in the tanks during their 40 years of sluicing and hydrofracture operations. (See Sect. 2.1 for more of the characteristics of this waste and Sect. 4.2 for its handling.)

Because of the greater radiation hazard of RH waste, its subsequent handling, certifying, processing, and transporting require more extensive shielding and greater equipment complexity than CH waste. After successful RH waste demonstrations at WIPP, routine shipments of RH-TRU waste will begin in 1996 if WHPP has timely funding (see Sect. 4.3).

3.1.2 Waste That May Be Impractical to Certify

ORNL's stored defense TRU wastes will be certified to the maximum extent practicable for disposal at WIPP. A minor portion of the stored TRU waste may be considered ITC. Waste that is judged by management to have too high a radiation hazard, an economic cost, or an environmental impact to warrant repackaging, assaying, reprocessing, or other modification in order to certify it for WIPP disposal is termed ITC TRU waste.[6] Such waste must be evaluated to determine the most practical alternatives for its permanent disposal.

The waste will require more extensive processing or treatment prior to certification and transportation to WIPP. In most instances, it will also require continual monitoring and consideration of management alternatives other than WIPP if certification is not practical.

Wastes with unusual size or weight, such as equipment or machines, may be reduced in size or buried. All CH-TRU drums containing ITC waste will be repackaged on-site. Any required processing may be conducted in the proposed RH-TRU WHPP. Greater confinement disposal (GCD) does not appear to be a feasible option for ORNL waste.

3.1.3 Waste That Is Already Buried

Before 1970, TRU-contaminated solid material was not distinguished from other low-level solid waste and was disposed of by shallow-land burial. As much as 6200 m^3 of waste that would now be defined as TRU was buried and is now considered to be in permanent disposal. This waste does not present a hazard to the public, nor is it expected to in the future. The National Academy of Science and other organizations have found that retrieval of this waste can be more hazardous than leaving it in place. Retrieving, processing, and shipping buried waste to a repository are currently expected to be costly and to pose a significant health hazard. Therefore, technologies required to achieve deep geologic disposal must substantially reduce these risks in order to be implemented. The reference plan for such buried waste is to monitor it and to take such remedial actions as may be necessary to ensure its safety.[1] ORNL's Remedial Action Program will evaluate and determine the final disposition of this waste and will ensure the continued safety of such buried waste.[7]

Some of the alternatives for management of buried wastes are to (1) continue current practices; (2) improve confinement of all, or portions of, the wastes at their present location; (3) retrieve the wastes and process them for shipment to a deep geologic repository; and (4) immobilize the wastes in situ. Improved confinement methods are at various stages of development and may be implemented when they are technologically sound. Key activities for the buried waste program will build on in situ vitrification work at Hanford and grouting work at ORNL. If ORNL's soil is suitable, then in situ vitrification could be practical. Grouting tests were initiated at ORNL in September 1985.

3.2 FACILITIES REQUIRED FOR CERTIFICATION

The main facility needed for certifying CH-TRU waste, the WEAF, is already in operation; however, a loading dock will need to be constructed for shipping the drums to WIPP. RH-TRU waste will require the installation of several new facilities, including the RH-TRU WHPP for processing and certification and additional storage capacity for NG waste.

3.2.1 Waste Examination Assay Facility

The waste packages stored at ORNL since 1970 include many in which the characteristics of the waste make emplacement in WIPP unsuitable. This is especially true of waste generated during the early years of the storage cycle. Changes in the goals of the programs, requirements for storage, and especially a change in the lower limits placed on the activity levels requiring storage led to the waste being sent to retrievable storage. In order to handle some of this redefined waste as LLW, an NDA facility has been constructed in Building 7824 to examine CH-TRU waste contained in 208-L and 114-L mild-steel and stainless steel drums.

3.2.1.1 Facility Description

This facility, located in SWSA-5 of ORNL, has now been expanded to include the NAS, the SGS, the RTR unit, the bar-code labeling system, computer equipment, handling equipment, temporary storage areas, weighing scales, and the necessary services and equipment needed to ensure safe operation. (See Fig. A.3 in Appendix A for the layout of the WEAF.)

3.2.1.2 Process Description[8]

The facility operates one shift per 5-d week and utilizes 2.5 technicians. Waste drums are transferred from the retrievable storage site to the WEAF on a weekly basis. Approximately 175 drums of CH-TRU waste can be nondestructively assayed each month to determine their TRU isotopic identity and content. (The WEAF can also handle an additional 70 drums of LLW on a monthly basis.)

The examination includes a passive-neutron and a pulsed-neutron interrogation (differential die-away) using the NAS and a gamma-ray examination using the gamma-ray drum scanner. The NAS provides the total fissile mass, expressed in milligrams of ^{239}Pu (mg ^{239}Pu) equivalent, contained in the drums (see Sect. 3.3.1). The SGS provides a list of the gamma-emitting isotopes, present in sufficient quantities, contained in the drums (see Sect. 3.3.2). Together, these two systems allow determination of the upper-limit TRU content of a waste drum and identities of the gamma-emitting isotopes present, enabling classification of the drum as LLW or TRU waste. This classification has been proceeding since April 1982. In September 1985, the RTR unit was added to the certification procedure. It complements the above systems by determining the outline of the waste within the containers (i.e., form of waste, presence of liquids, etc.) (see Sect. 3.3.3 and also Sect. 3.3.4). Bar coding has been under way since 1986 (see Sect. 3.3.5).

An ultrasonic thickness monitor was once proposed to verify the integrity of the containers. However, it now appears that the overpacking of all drums >5 years old and visual inspection of the NG waste containers will supplant use of the monitor.

3.2.2 RH-TRU WHPP

The WIPP is scheduled to begin receiving RH-TRU waste for emplacement and testing in 1989; actual bulk shipment of waste will begin several years later. The RH-TRU WHPP has been designed to retrieve, characterize, process, repackage, and certify RH-TRU wastes for shipment to WIPP.

3.2.2.1 Facility Description[9]

The proposed new building will be constructed with seven basic areas: (1) process cells, (2) access cells, (3) receiving and shipping areas, (4) operating and computer room, (5) equipment rooms, (6) offices, and (7) change room. The total floor area is ~12,800 ft^2, with the total process cell area being ~2000 ft^2. The three separate shielded process cells will form the core of this facility:
(1) monitoring/WIPP canister loading cell, or monitoring cell;
(2) preparation and drum loading cell (or prep) cell; and
(3) decontamination (or decon) cell. These cells will be constructed of concrete and are necessary to provide complete processing. Each of the cells will be equipped with a remotely operated bridge crane and a separate remotely operated manipulator crane. A minimum number of viewing windows are provided to supplement the closed-circuit television system.

3.2.2.2 Process Description[9]

Wastes that enter the WHPP will be processed, as required, to characterize, package, and certify the waste for emplacement in WIPP. All waste will undergo certain process steps, such as monitoring and loading into RH canisters; but, because of the variety of wastes that will be received, no fixed set of additional processing steps will be used which all waste packages must follow. Using written records of the waste, as supplied by the source site and/or monitoring equipment available in the WHPP, a determination will be made as to which processing steps will be required for each container of waste. A package of waste can be subjected to more than 20 significant processing steps or functions. Some of the primary steps include the following, although not necessarily in this order: (1) weighing upon receipt of package; (2) gamma, neutron, and X-ray monitoring before and after repackaging; (3) container opening; (4) size reduction; (5) repackaging; (6) addition of cement grout and shielding; (7) loading into an RH canister; (8) welding, leak testing, and smearing of RH canister; (9) reweighing; and (10) loading into shipping cask.

Mechanical and instrumentation requirements are listed in Appendix A. A waste process step flow diagram (Fig. A.1) and processing flow diagram (Fig. A.2) are also included.

3.2.2.3 Operations

Manpower requirements per shift and the required number of shifts per month will be determined on the basis of the desired facility throughput. Values for the minimum, nominal, and maximum waste throughput limits have been estimated by using inventories previous to ORNL's reclassification of its sludges as RH-TRU (see Tables A.1 and A.2 of Appendix A). Based on ORNL's present requirement of processing and shipping ~137 canisters/year of its own waste, it may be necessary to add another shift to have the capability of doubling the nominal work-off rate to 340 canisters annually. Hence, the facility will have to operate two shifts, 5 d/week, based on the following personnel per shift: one health physics staff member, three operators, and one supervisor. Reevaluation of the facility and its work-load expectancy during 1987 may result in design modifications that would allow more operators to work in the facility per shift.

3.2.3 Retrieval Operations

Since 1970, ORNL has been following a policy of retrievable storage, pending selection and development of permanent disposal methods for its TRU wastes. Depending on their radiation backgrounds, TRU wastes are packaged retrievably in 114-L or 208-L stainless steel drums, concrete casks, or stainless steel cylinders. A specific section of SWSA-5 has been reserved for the retrievable storage of TRU wastes.

3.2.3.1 Facility Description[10]

Building 7826, a one-story concrete-block structure built ~85% below grade, is utilized for the retrievable storage of CH-TRU waste in

208-L drums. It has 24 compartments or cells, each of which will accommodate sixty-four 208-L drums stacked in four layers with 16 drums per layer. A thin sheet of plywood is placed between each layer. Building 7834, the newer CH-TRU waste storage facility, has a design that is very similar to Building 7826, except that it has removable concrete plugs and storage capacity for 80 drums in its 24 cells (with 5-high layering). Each of the cells of both facilities has a sump for monitoring purposes. As of December 31, 1986, these two facilities contained approximately one hundred 114-L drums of CH-TRU waste and approximately twenty-one hundred 208-L drums; 277 of the CH-TRU drums are of mild-steel construction and were placed in storage prior to FY 1974.

An area west of the CH-TRU storage buildings was used during the period October 1970 through FY 1979 for the retrievable burial of concrete casks containing RH-TRU waste. However, it was determined that burial of the concrete casks was not completely acceptable because of the difficulty in exhuming the containers. Hence, a concrete storage building, Building 7855, was constructed southeast of the cask burial area. This one-story facility contains four bays for cask storage, with a total capacity for 108 casks. Presently, 249 casks, each approximately 1.3 × 2.2 m (4.3 × 7.3 ft), are stored in the SWSA-5 area; ~90 are retrievably buried in trenches under a concrete capping.

TRU wastes with very high beta-gamma background radiations are placed in a group of stainless-steel-lined storage wells designated as Buildings 7827 and 7829. These facilities are located just to the south of the drum storage buildings. Building 7827 is a two-sectioned structure, constructed primarily below grade, that contains 30 wells in one section and 24 wells in the other. The wells have diameters of 20 to 76 cm (8 to 30 in.) and are 3 to 4.6 m (10 to 15 ft) deep. Building 7829 has only 10 wells, each of which is 30.5 cm (12 in.) in diameter by 4.6 m (15 ft) deep. These stainless steel wells are placed on a 15-cm-thick (6-in.-thick) concrete slab. A stepped 0.9-m-thick (3-ft-thick) removable concrete plug is used to seal the wells. Waste to be placed in a storage well is packaged in stainless steel 208-L drums or other, smaller, stainless steel cylindrical packages that have attached lifting cables to facilitate retrieval. Presently, ~7 m^3 of RH-TRU waste is buried here in capsules that range from 0.15 to 0.76 m (6 to 30 in.) in diameter and are 12.7 to 366 cm (4 in. to 12 ft) long.

3.2.3.2 Process Description

The retrieval of CH-TRU waste is expected to be straightforward, with capital needs limited to the possible replacement of cranes, forklifts, etc. Also, funds will have to be allocated for a loading platform to handle TRUPACTs for transporting CH waste. The general procedure would entail lifting the removable roof section from the selected waste storage cell, using a crane to raise the drums (four at a time) by a fabricated rig, and placing the drums on a skid. These operations will be conducted under the surveillance of Health Physics personnel. The drums are further scanned and visually checked for structural integrity; then the skid of drums is moved by forklift to the staging area, Building 7823. This facility, a partially underground shed (two-thirds below grade), is currently used for temporary storage of CH-TRU waste before it is placed in retrievable storage. From the staging facility, the drums are later transferred by forklift to the nearby WEAF for assay and examination. The handling of RH-TRU waste is expected to be more complicated, for it will include removal of the front seal wall of Building 7855 and excavation for the casks that are stored in trenches.

3.2.3.3 Possible Difficulties During Retrieval

In early waste emplacement practices, some of the RH-TRU waste casks were placed in trenches and covered with a 46-cm (18-in.) layer of concrete. Obviously, this waste will be difficult to exhume. Casks stored in Building 7855, on the other hand, will be relatively easy to retrieve. The casks, as constructed, are not Type A containers and thus cannot be used for transporting waste to WIPP. Therefore, the waste must be repackaged into a certified RH canister to meet WIPP WAC criteria. A modified defense high-level waste (HLW) shipping cask or specially designed shipping container will be used to transport the RH canister to WIPP.

Buried waste can be considered to be permanently disposed of and unlikely to be retrieved since exhumation would pose a health risk and would be economically unfeasible. However, the final decision on the disposition of the buried waste (see Sect. 3.1.3) will depend on the results of a risk assessment evaluation to be made by the Remedial Action Program.

3.2.4 Loading Dock

The use of the TRUPACT-I and other acceptable shipping casks will necessitate the construction of a minimum loading facility that is properly equipped to handle the containers and can ensure the secure loading of trucks for transfer to WIPP. Plans for the loading facility have not been finalized; however, it is assumed that the loading dock will be constructed in the area of the WEAF and the staging facility. Moreover, it is quite likely that the loading platform itself will suffice for ORNL; in this case, no additional facility will be needed. Assuming that the transportation options focus on truck transport instead of rail transport, the procedure for loading six-packs of drums into TRUPACT-I by on-the-semitrailer loading will be used, since ORNL does not plan to manipulate the TRUPACT-I as the off-the-transporter loading platform would require.[11] Significant changes are presently being discussed with regard to the structure of the loading platform (e.g., using a "slip-sheet" concept instead of rollers), which will probably result in modifications to the loading platform and loading procedure. Further, changes to the design of TRUPACT-I will necessitate redesign of the loading platform.

3.2.4.1 Facility Description

As presently conceived, no facility per se will be necessary. The loading platform is planned to be a straight-roller conveyor with two rows of rollers that will interface with the roller bed of the TRUPACT and permit manual loading and unloading of the TRUPACT without lift trucks having to enter the body of the TRUPACT. .e portable conveyor, a one-piece unit, would be from 4.6 to 6.1 m (15 to 20 ft) long and would cost about $5000. It would be loaded from the side by forklift and would not be equipped with a turntable. As previously stated, modifications to this evolving need will probably result in changes to both the loading platform and the loading procedure.

3.2.5 Additional Storage

Additional storage space for RH-TRU casks will be necessary in order to handle the waste volumes that accumulate during the period before waste is shipped to WIPP. Additional storage space will also be necessary for the irradiated wastes that have high beta-gamma readings and have been placed in stainless-steel-lined wells for on-site storage. Field Task Proposal/Agreements (FTP/As) have been prepared for the construction of these required facilities.

3.2.5.1 Facility Description

The building to be used for storing additional concrete casks will be constructed similar to that of existing Building 7855, the retrievable storage facility for RH waste. Descriptive material and a discussion of the justification are included in Sects. 3.2.3 and 5.3, respectively. The TRU well storage addition will be constructed so as to be similar in function and design to Buildings 7827 and 7829. A more-detailed description and the justification of need may be found in Sects. 3.2.3 and 5.4, respectively.

3.3 SYSTEMS FOR CERTIFICATION

Except for the ultrasonic thickness probe, all of the systems used for certifying CH-TRU waste are presently operational. These systems include the NAS, SGS, RTR unit, and records computerization. A bar coder for tracking will complete these systems. Modifications will likely be made to some of the systems so that their technology can be applied to RH-TRU waste.

3.3.1 Neutron Assay System (NAS)

Each container will be subjected to nondestructive testing by using an NAS in order to measure the activity level of the stored waste and, consequently, to determine whether the drums can be buried as LLW or will be shipped to WIPP. This instrument is capable of determining the isotopic content of a container both qualitatively and quantitatively.

3.3.1.1 Process Description[12]

The NAS drum counter, developed by the Los Alamos National Laboratory (LANL) Advanced Nuclear Technology Group, is an active and passive 4-pi neutron-detection system. The active assay [differential die-away technique (DDT)] refers to interrogating the waste container with an external source of neutrons, such as a portable neutron generator or an electron linear accelerator. The fast (14-MeV) neutrons produced by the neutron generator are then moderated by the graphite walls of the assay chamber. The resulting interrogating thermal neutrons induce fission reactions in the fissile material contained in the waste. The induced radioactivity (prompt and delayed fission neutrons) is proportional to the fissile TRU content (e.g., ^{235}U and ^{239}Pu). The passive assay refers to monitoring the radioactivity that occurs naturally in the sample (e.g., spontaneous fission neutrons from ^{252}Cf atoms, reaction neutrons, etc.). The neutron-detection packages consist of moderated (cadmium-shielded) and bare ^{3}H proportional counters embedded in the assay chamber walls.

Three neutron time-histories (counts per channel vs detector dwell-time) are acquired for each drum during the NAS active scan. The ratio of the net shielded totals (background corrected) to the flux monitor totals taken in the same time interval is proportional to the fissile content of the waste container. Modifications to the system have occurred since its installation. Presently, a software program called SNEUT, written by LANL personnel, is used for reporting purposes.

3.3.1.2 Operation

The NAS, which is housed in the WEAF, has been operational since April 1982. Presently, 75 drums of CH-TRU waste are examined per week; also, an additional 75 drums of LLW can be examined in this time frame. Containers that do not meet the definition of TRU waste will be buried as LLW on-site. Of the 2182 drums scanned since March 1, 1986, 69.5% of them were classified as TRU waste and 5.5% were classified as LLW; most of the remaining drums are suspected to be TRU wastes.

3.3.2 Segmented Gamma Scanner (SGS)

To assist in the classification of ORNL-drummed CH waste into TRU and non-TRU categories, the SGS will complement the work of the NAS by providing a list of the gamma-emitting isotopes contained in the waste drums. The present assay scheme provides for all waste drums to be qualitatively scanned for gamma-ray-emitting radioisotopic identification. However, only those drums which cannot be positively identified through the neutron measurements as having a TRU concentration of less than 100 nCi/g will be quantitatively scanned.[13]

3.3.2.1 Process Description

The gamma-ray drum scanner used in the assay system is an upgraded Canberra segmented drum scanner, Model 2220B. The computer-operated SGS uses a solid-state detector to passively scan the waste drum in three horizontal segments with data-collection time, as well as live-time determination, for each segment. The effects of vertical and radial inhomogeneities are reduced, respectively, by scanning individual horizontal segments along the vertical axis of the drum and by rotating the drum on a turntable at a constant speed. Each active assay scan is corrected for the drum's varying mass absorption coefficient. The captured gamma-ray signatures are then compared with known energy values for radioisotopic identification. Further, each segment's spectrum, along with a summation spectrum, is stored on floppy magnetic disks.[12]

3.3.2.2 Operation

The SGS, which is housed in the WEAF, has been operational since April 1982. It is used in conjunction with the NAS to examine ~150 drums of waste per week, operating one shift per 5-d week.

3.3.3 Real-Time X-Ray Inspection System

Once the initial separation of TRU vs non-TRU waste has been made, it will be necessary to determine whether the individual TRU waste packages meet the additional WIPP WAC criteria. As a part of this procedure, X-ray examination of each of the TRU packages will be performed to (1) determine whether free liquids are present, (2) determine whether fines that could be in excess of WIPP WAC-established acceptable levels are present, (3) give an outline of the contents, and (4) aid in making a decision as to the certifiability of the waste package.

3.3.3.1 Process Description[14]

The system used for certifying TRU waste is a 320-kV constant potential semiautomatic, real-time X-ray examination module. The real-time X-ray imaging system has a closed-circuit video display, as does the fluoroscopic image generated by the image intensifier. The system is capable of handling a 208-L drum on its rotating manipulator. Particular areas of interest in the specimen being examined can be remotely positioned to the proper X-ray beam/imaging plane orientation, enabling both dynamic and static viewing of the item, or portion of the item, being examined. The videotaped radiograph has hard-copy features and a video character generator to type operator-noted observations onto the video monitor with keyboard entry, as well as continuous data and time generation. X-ray and radiation protection are provided.

3.3.3.2 Operation

The radiographic examination station handles ~50 drums per week. The unit operates each day of the 5-d work week. To date, 55% of the stored CH-TRU waste packages have passed this inspection. Of the 45% that have been initially rejected, ~12% contain HEPA filters. The fate of these rejects containing HEPA filters is uncertain and must be resolved by the WIPP Waste Acceptance Criteria Compliance Committee (WACCC). The other uncertifiable drums will be retained on-site for repackaging (possibly at the WHPP) or, if packaged after July 1984, will be returned to their generator for reprocessing.

3.3.4 Computerized Record Keeping

The volume of waste currently being stored on-site is recorded in several data bases at DOE Headquarters, ORNL, and other national laboratories. As waste passes through the WEAF and is scanned, x-rayed, monitored, and possibly overpacked, it will be necessary to update the data bases and perhaps create new ones. The efficiency of the certification of TRU waste for WIPP depends greatly on computerization of data. All the systems planned for waste certification (NAS, SGS, and RTR) have computer interfacing.

3.3.4.1 Process Description

The NAS has had continuous computer software updates during the reporting period. The latest NAS system software version is called SNEUT, a LANL-personnel-developed program. A LeCroy 3500 system is used for data acquisition and analysis. The time histories from the main detector packages and the flux monitor are recorded on magnetic diskettes for archival storage.

The SGS is operated by a Los Alamos/ORNL gamma-ray scanner program. For simplicity in data handling and computer software compatibility, it was decided to process the gamma-ray data through the LeCroy 3500 multichannel analyzer system, thereby resulting in a single data acquisition and analysis system for both the neutron and the gamma-ray assay measurements. A second LeCroy 3500 analyzer has recently been added to the assay procedure for even more versatility and capacity. Also, a new computer peak-search program has been introduced which identifies photon energy peaks and correlates each with its parent radionuclide. Besides providing hard copies, the data spectra are stored on floppy magnetic disks.

The RTR module produces videotaped radiographs with hard-copy features, has a video character generator to type operator-noted observations onto the video monitor with keyboard entry, and provides continuous data and time generation. Its data analysis and storage are also tied in with the other WEAF operations.

The computer-generated data and analytical results from WEAF will be continously interfaced with the overall data management system of ORNL. Improvements, modifications, and updates are expected to occur throughout the certification period.

3.3.5 Bar Coding

ORNL has a color-code system as well as a bar-code labeling system for its CH waste. However, to meet the WIPP WAC criteria, standardized bar-code labels will be required on each drum and box shipped to WIPP, in addition to ORNL's internal systems. These labels will be used both for identification and for tracking purposes.

3.3.5.1 Process Description

The package's bar-code label shall match the specifications of Data Package Format for Certified Transuranic Waste for the Waste Isolation Pilot Plant (WIPP-DOE-157).[15] These labels will be used on all NG CH-TRU drums and will be affixed to stored CH-TRU drums as soon as practical (i.e., as the drums are retrieved for further assay and/or repackaging activity). ORNL procedures currently call for the placement of bar-code labels on a given empty CH-TRU drum as part of the acceptance of that drum and prior to its transfer to the waste generator for filling. The new labels will also be placed on each existing drum as the next requirement for handling that drum. In all cases, the labels will be in place prior to shipment of any drum to WIPP.[16]

In addition, ORNL will procure equipment, as necessary, for utilizing the bar codes for internal tracking purposes. Specifically, ORNL is currently proceeding with procurement of a more accurate system for waste drum neutron and gamma external surface-dose-rate measurement which will include the capability for reading the standard bar codes. This system will be the initial point of entry into the assay/examination procedure for ORNL waste drums and will contain (1) neutron and gamma detectors for measuring external surface radiation, (2) a load cell for obtaining the mass of the drum, (3) a bar-code reader for logging the drum into the WEAF, and (4) a microcomputer for data acquisition and control. The drum identification obtained via the bar-code reader will then be used to track the drum through the remainder of the assay/examination steps in the WEAF and into interim storage.

3.4 COST ESTIMATES

Cost estimates for the implementation of the IWOP have been made; however, they do not include the purchase of the NAS or SGS or the expense of upgrading the WEAF since these costs have already been absorbed. The total estimate for implementation of the IWOP is

$166 million. (See Sect. 5 for details of the costs for the major TRU waste management activities planned and of the costs for the facilities.)

4. STRATEGIES AND SCHEDULES

The strategies and schedules for retrieval and certification of NG and stored TRU waste at ORNL are based on the Long-Range Master Plan for Defense Transuranic Waste Management.[2] The strategies used take advantage of existing facilities and operations, as well as additional technology for certification and transportation of TRU waste to WIPP. The strategies to be used in the implementation of the IWOP are relatively simple for CH-TRU waste but will require additional facilities for accommodating the RH-TRU waste. An overview of the strategies and options for the TRU waste at ORNL is presented in Figs. 4.1 (CH), 4.2 (stored RH), 4.3 (NG RH), 4.4 (RH sludge), 4.5 (buried), and 4.6 (CEUSP). ORNL's preferred course of action for its wastes is shown by the boldfaced arrows.

4.1 STRATEGY FOR CH-TRU WASTE

The CH-TRU waste at ORNL has been, and is being, collected in 208-L stainless steel drums and stored retrievably. The approach will be to retrieve, x-ray, subject to the NAS and the SGS, and directly certify as much of this waste as possible for shipment to WIPP after all documentation, labeling, and identification have been completed.

All the currently generated and stored CH waste drums on hand have been examined in Building 7824 by both pulsed-neutron interrogation and passive-neutron measurements and the SGS. All stored CH-TRU drums will be examined via the RTR by January 1988. Since all iron-walled drums, 114-L drums, and drums >5 years old are expected to be overpacked, examination of the containers for wall integrity by an ultrasonic thickness probe is considered unnecessary. Drums that are found to be in noncompliance after the RTR inspection will be returned to the generator for repackaging if they were packaged after July 1984.

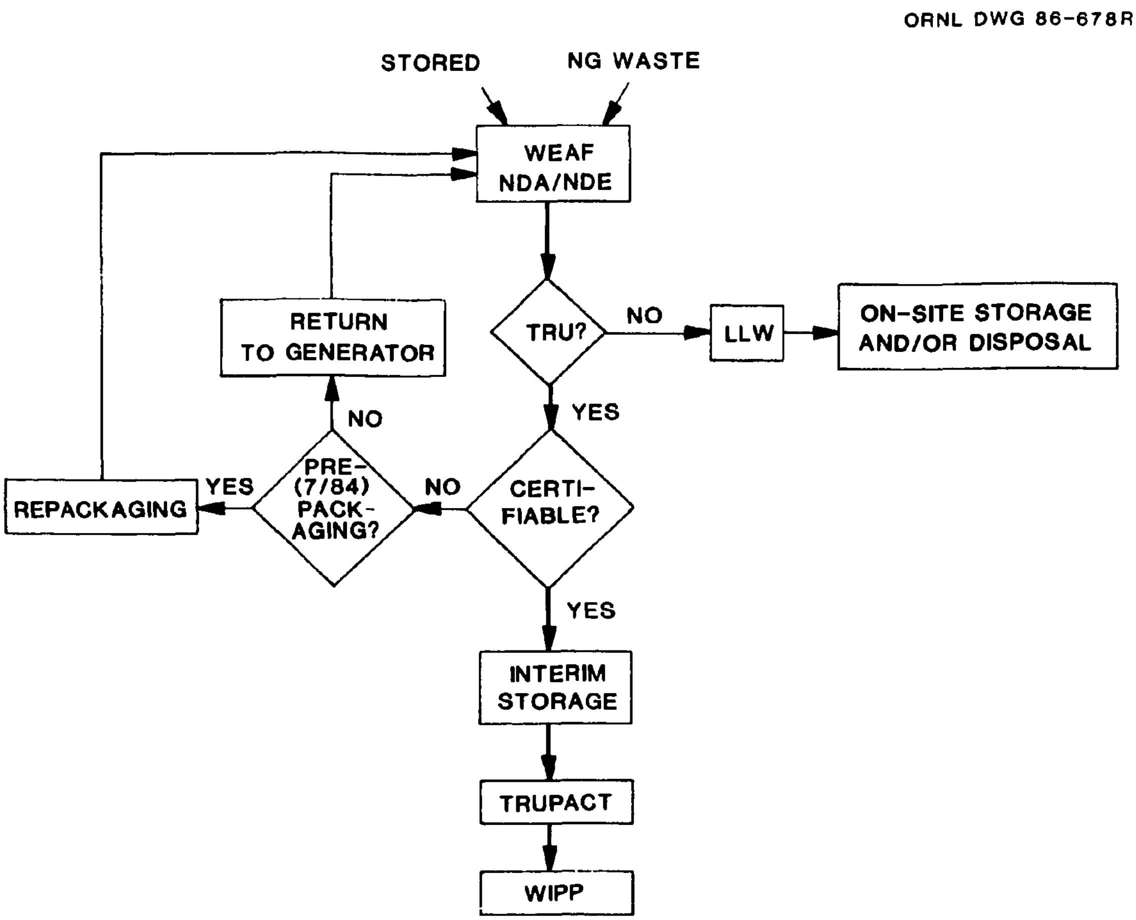

Fig. 4.1. Strategy flowchart for CH-TRU waste.

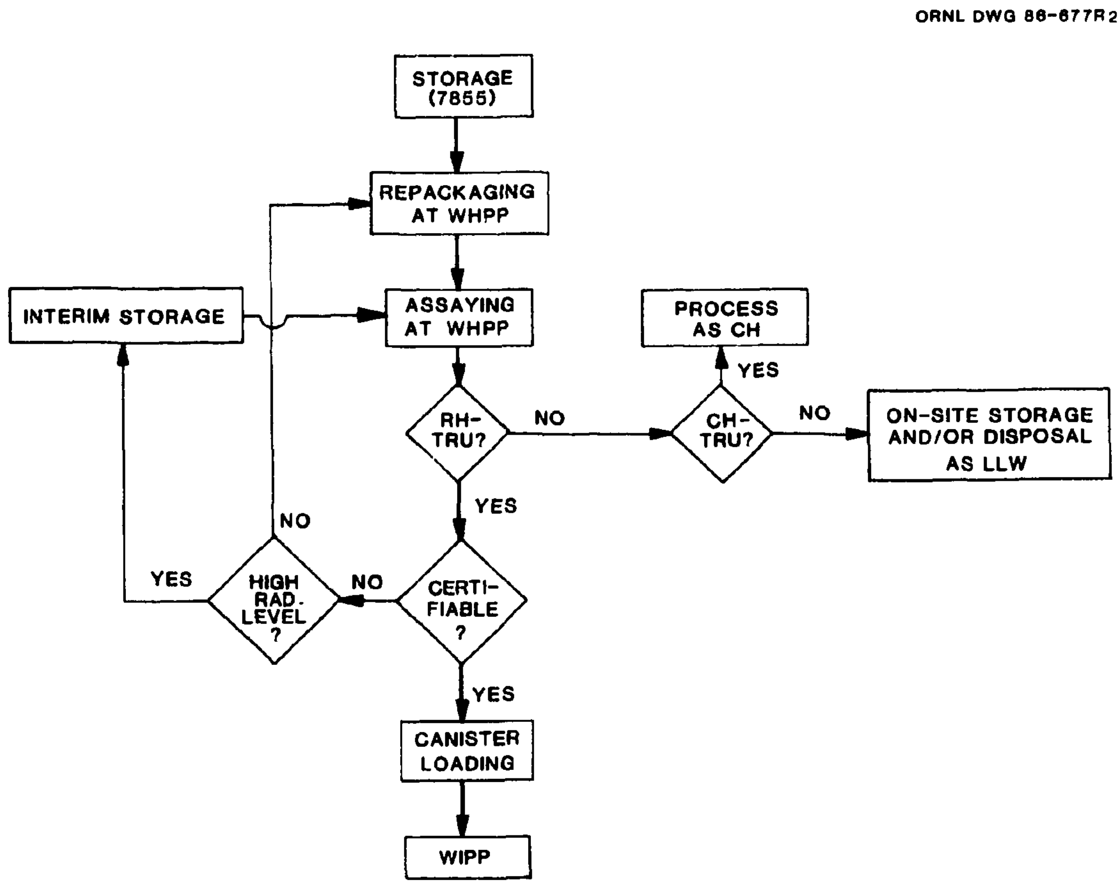

Fig. 4.2. Strategy flowchart for stored RH-TRU waste.

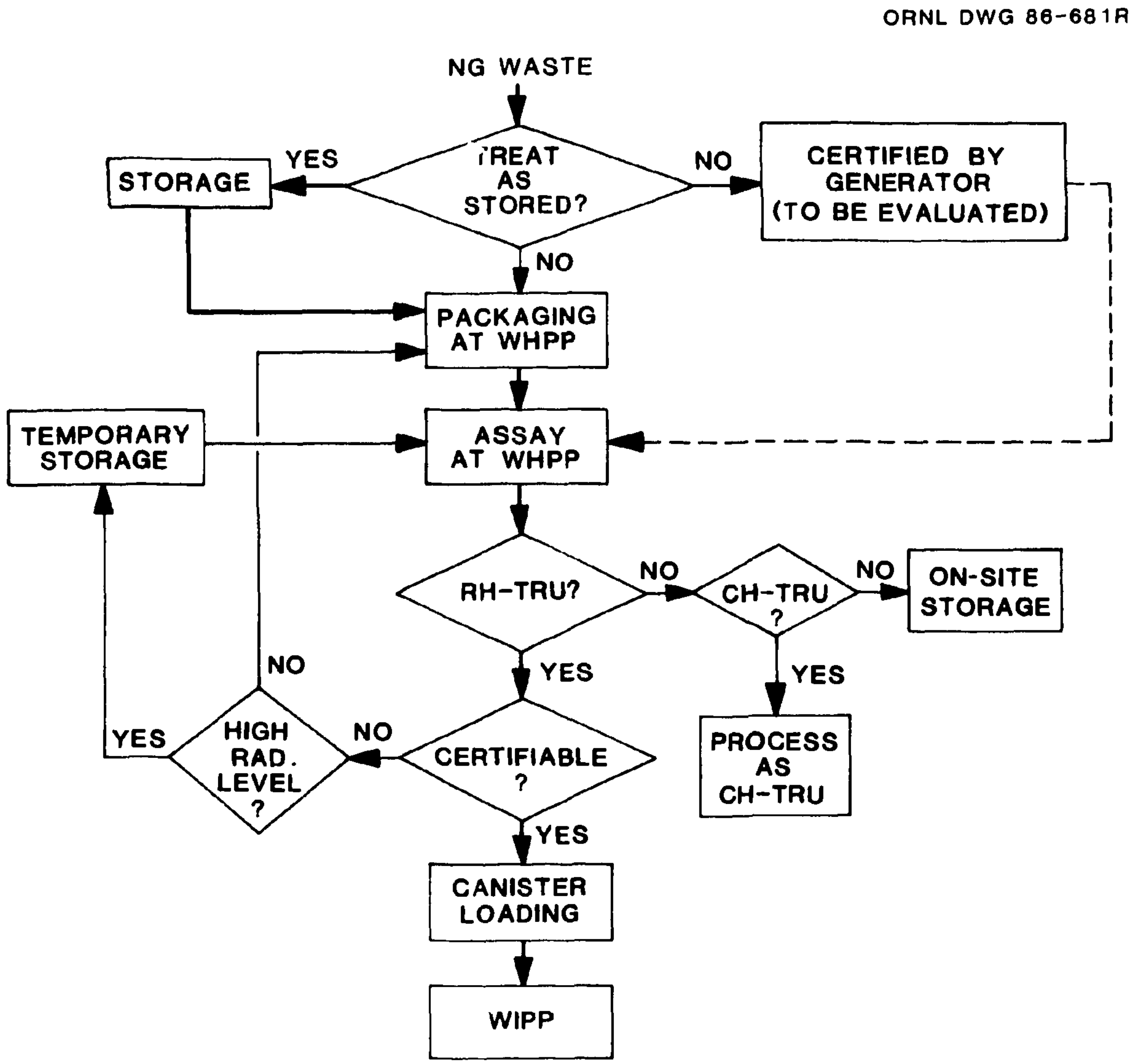

Fig. 4.3. Strategy flowchart for newly generated RH-TRU waste.

ORNL DWG 86-679

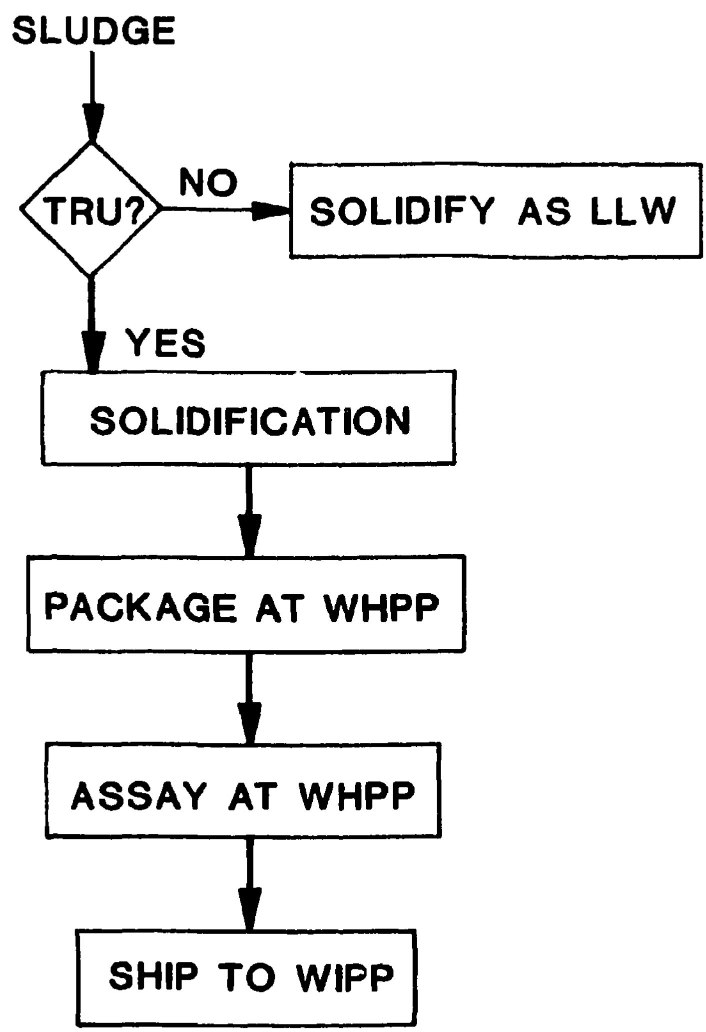

Fig. 4.4. Strategy flowchart for Melton Valley and Gunite tank sludge.

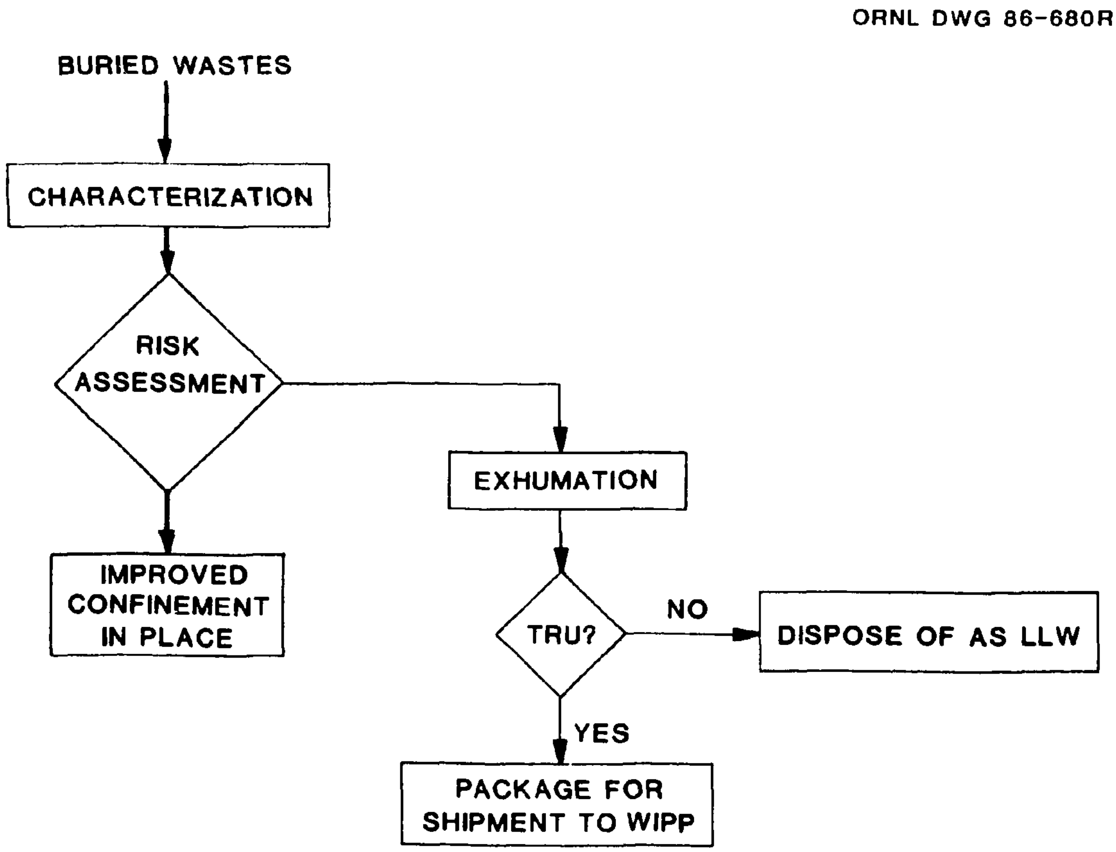

Fig. 4.5. Strategy flowchart for buried TRU waste (activities to be conducted by the ORNL Remedial Action Program).

ORNL DWG 86-682R

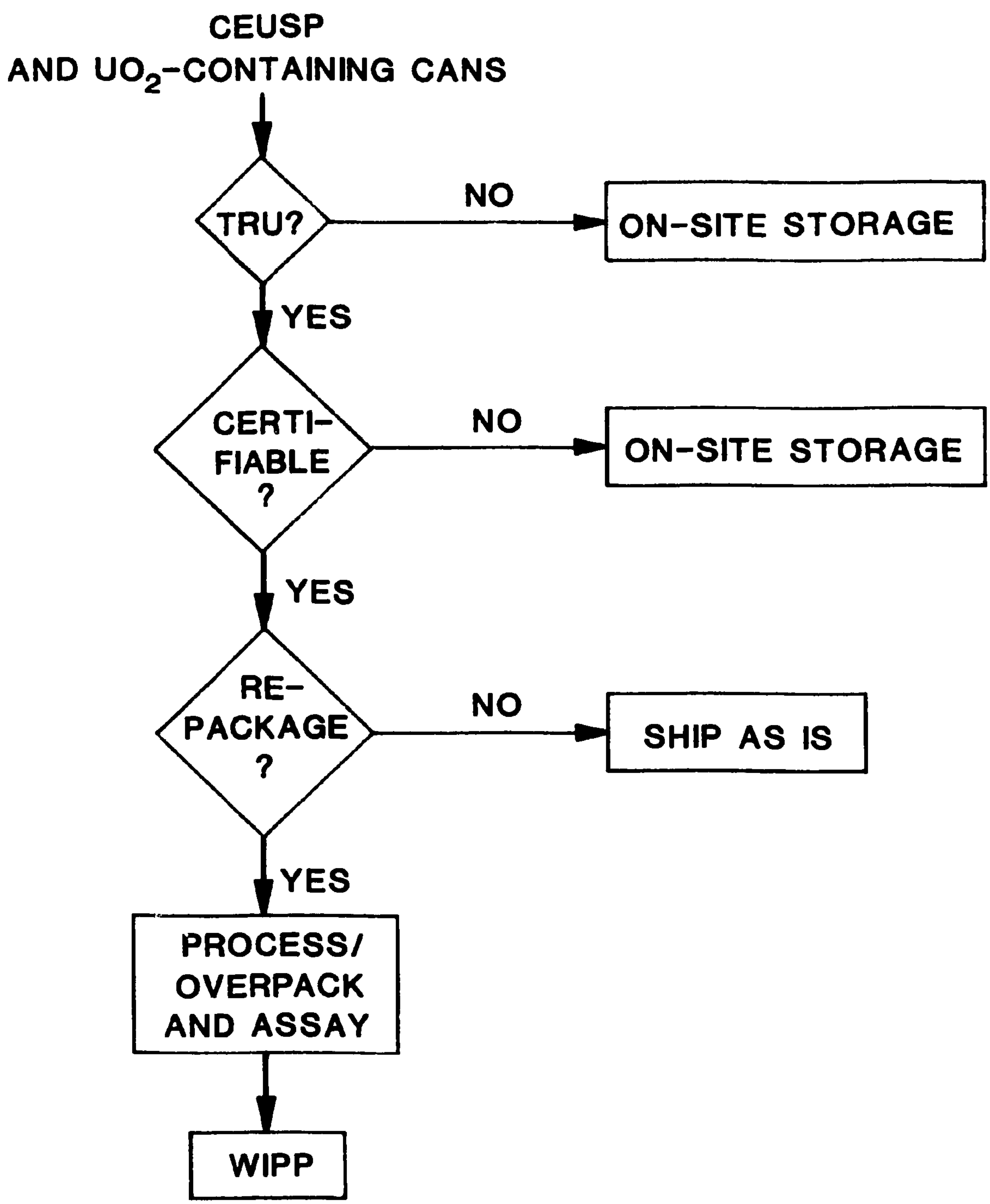

Fig. 4.6. Strategy flowchart for canned TRU waste.

Otherwise, uncertifiable drums will be sent to the proposed WHPP for repackaging. After repackaging, it is likely that only a small number of drums will fail to meet the WIPP WAC criteria.

Assay of all stored CH-TRU drums will be completed at the WEAF by June 1988. Approximately 70% of these drums have been classified as CH-TRU. The majority of the drums that have not been conclusively labeled LLW or CH-TRU are expected to be classified as CH-TRU after additional analysis. The accuracy of these assays will be determined by validating the assay system with prepared drums of known isotopic content.

Shipment of certified, NG CH waste to WIPP will begin in October 1988, and work-off of all stored/retrieved CH waste is presently scheduled to be completed by October 2001. The CH-TRU waste certification for work-off is proceeding well, and no delays in scheduling or completion are anticipated. Table 4.1 presents ORNL's milestones for stored and NG CH waste. A schedule for the work-off of CH-TRU is presented in Table 4.2; the assumptions used as the basis for compiling the schedules are given in Sect. 4.1.1. Fluctuations in shipments per year reflect scheduling constraints (elimination of a waste stream). The schedule corresponds to Tables T5, T6, T12, and T13[3] of ORNL's submission to the 1986 IDB annual inventory report.[4]

4.1.1 Assumptions for CH Waste Work-Off

The assumptions that were made to prepare Table 4.2 are as follows:

Total CH-TRU waste to be worked off: 1719 m^3
Work-off period: 26 years (1988 to 2013)
Waste to be worked off starting in 1989: 1701 m^3
1701/25 = 68 m^3/year of CH to be worked off

NG CH-TRU is assumed to be produced at the rate of 28 m^3/year for consistency with previous documents; however, the generation rate is currently observed to be closer to 21 m^3, or 100 drums, per year.

Table 4.1. ORNL work-off milestones for CH inventory

Milestone	Scheduled date
WACCC[a] audit of ORNL certification activities	5/85
Issue ORNL drum assay final report	9/85
Modify certification plan and procedures for stored waste	10/85
Final WACCC approval	10/85
Assay drums of CH stored waste	10/85
Procure/install NDE equipment (RTR)	10/85
Develop Action Description Memorandum for shipping waste to WIPP	10/85
Begin generating certifiable waste	1/86
Finalize NEPA documentation	9/86
Develop site plan (IWOP) for CH processing	9/86
Complete examination of stored waste	3/87
Construct CH loading platform	10/88
Begin certification of directly certifiable waste	10/88
Begin shipping stored CH waste to WIPP	10/88
Ship new CH waste directly to WIPP	10/88
Complete shipping of stored CH waste to WIPP	10/13

[a]Waste Acceptance Criteria Compliance Committee.

Table 4.2. CH-TRU waste inventory

(Values given in cubic meters)

Year	Beginning volume	NGW[a] boxed	NGW drummed	Shipped to WIPP	Yearly work-off	Retrieved cumulative	Ending volume	NGW boxed work-off	NWG drum work-off	Shipment by year
1987	532[b]	16	28	0	0	0	576	0	0	0
1988	576	32	56	17.9	9.8	9.8	602.1	0	7.5	17.3
1989	602.7	48	84	81.7	56.3	66.1	577.1	0	7.5	63.8
1990	582.9	64	112	145.5	56.3	122.4	522.1	0	7.5	63.8
1991	563.1	80	140	209.3	56.3	178.7	527.1	0	7.5	63.8
1992	543.3	96	168	273.1	56.3	235	502.1	0	7.5	63.8
1993	523.5	112	196	336.9	56.3	291.3	477.1	0	7.5	63.8
1994	503.7	128	224	407.8	63.4	354.7	452.1	0	7.5	70.9
1995	476.8	144	252	471.6	56.3	411	427.1	0	7.5	63.8
1996	457	160	280	533	14.8	425.8	402.1	0	46.6	61.4
1997	439.6	176	308	612.5	26.5	452.3	377.1	8	45	79.5
1998	404.1	192	336	712	26.5	478.8	352.1	28	45	99.5
1999	348.6	208	364	811.5	26.5	505.3	327.1	28	45	99.5
2000	293.1	224	392	811.5	26.5	531.8	302.1	28	45	99.5
2001	237.6	240	420	975.4	0	0	277.1	28	36.4	64.4
2002	217.2	256	448	1,039.8	0	0	252.1	28	36.4	64.4
2003	196.8	272	476	1,104.2	0	0	227.1	18	36.4	64.4
2004	176.4	228	504	1,168.6	0	0	202.1	28	36.4	64.4
2005	156	304	532	1,233	0	0	177.1	28	36.4	64.4
2006	135.6	320	560	1,297.4	0	0	152.1	28	36.4	64.4
2007	115.2	336	588	1,361.8	0	0	127.1	28	36.4	64.4
2008	94.8	352	616	1,426.2	0	0	102.1	28	36.4	64.4
2009	74.4	368	644	1,490.6	0	0	77.1	28	36.4	64.4
2010	54	384	672	1,555	0	0	52.1	28	36.4	64.4
2011	33.6	400	700	1,619.4	0	0	27.1	28	36.4	64.4
2012	13.2	416	728	1,679.8	0	0	2.1	24	36.4	60.4
2013	-3.2	432	752	1,715.9	0	0	0	8	28.1	36.1
2014				0	0	0	0	0	0	
2015				0	0	0	0	0	0	
Total					531.8			432	751.5	1,715.3

[a]NGW = newly generated waste.
[b]Pre-1986 volume.

4.1.1.1 Boxed Waste

The assumptions that were made for boxed waste are as follows:

- Original boxes: 60% full and 50% compaction
- Total volume of boxed waste: 541 m^3
- Shipping TRUPACT will hold six TRUPACT II efficiency boxes
- Total shipments for boxes: 124/6 = 21 trips required
- Stored boxes will be shipped first; 3 loads/year
- 106 m^3 to be worked off at 26 m^3/year
- Stored-box shipment begins in 1997 and ends in 2000
- Work-off of NG boxed waste begins in 1997 and ends in 2013
- 50% compaction into TRUPACT II boxes
- 435 m^3 to be worked off

4.1.1.2 Drummed Waste

The assumptions that were made for drummed waste are as follows:

- Pre-1986 stored waste worked off by 1997 (excluding boxed waste)
- Drummed waste total for work-off: 1178 m^3

4.2 STRATEGY FOR RH-TRU WASTE

Through December 31, 1986, ORNL had 1280 m^3 of RH-TRU waste in retrievable storage, with the inclusion of 946 m^3 of sludges that were recently classified as RH-TRU. The future generation rate for RH waste is estimated at 10 m^3/year. With the exception of the sludges, most RH waste has been (and is being) collected in concrete casks. There are presently 349 casks, 90 of which are retrievably buried under a small cover of concrete.

The RH casks are not certifiable as is, nor are they Type A containers. These containers of waste will be retrieved, repackaged, and scanned in ORNL's WHPP to determine whether the waste contained inside the casks is the certifiable RH-TRU type or has decayed to a lesser category. The quantity of radionuclides in the containers may allow some of the material to be repackaged and disposed of on-site as LLW. The retrieval of RH-TRU waste for certification and shipment to a processing site or to WIPP is scheduled to begin in October 1995 (see Table 4.3 for ORNL milestones).

Table 4.3. ORNL work-off milestones for RH-TRU inventory

Milestone	Scheduled date
Complete final inventory work-off plan	9/86
Perform RH waste gas generation studies	10/86–10/89
Complete NEPA analysis	9/87
Begin generating certifiable new RH waste	1/87
Complete NDA/NDE field demonstration	10/88
Complete shipment of RH demonstration waste to WIPP	1/89
Develop additional storage capacity	10/90
Design and construct WHPP	10/91–10/94
Begin retrieval of stored/not-precertified RH waste	10/95
Begin certifying stored RH waste	10/95
Begin shipping stored/retrieved RH waste to WIPP	1/96
Complete retrieval and processing of stored waste	10/13
Complete shipping stored RH waste to WIPP	10/13

The sludges of the Gunite storage tanks, the evaporator tank, and the MVSTs will probably be sluiced out and fixed in 208-L drums for disposal at the WIPP. Modifications will likely be made to the WHPP design so that these sludges can be processed. No definite immobilization technique has been chosen to fix the sludges, nor has a method to remove them from the tanks been definitely selected. Studies that address these uncertainties are currently in progress.

Certification of NG RH waste forms (but not the container) began in January 1987. High-neutron-level counts will likely prevent immediate shipment of the wastes, thus necessitating interim storage to allow for ^{252}Cf decay. This storage period will probably be of 5 to 10 years' duration.[17] Hence, stored RH waste will be worked off first; for this reason, ORNL has no NG RH waste scheduled for shipment.

Alternatives for the disposition of retrievably stored RH-TRU waste and NG RH-TRU waste are presently under consideration. The strategy for the stored waste is to construct a new facility to process, repackage in canisters, and certify the package for shipment to WIPP. Local disposal of the waste using GCD is not presently considered a feasible alternative for this stored waste. Options for the NG RH-TRU waste include (1) loading the waste directly into 208-L drums that will be stored inside the concrete casks or shielded in some other way until they can be placed into the RH canisters and certified for shipment to WIPP or (2) placing the waste in canisters at interim storage facilities for alpha decay before final disposal.

Current studies being undertaken in support of ORNL's RH-TRU waste program include (1) an RH NDA/NDE field demonstration, (2) reduced-waste-generation studies, (3) stored-waste certification plan development, (4) RH waste gas generation studies, (5) RH canister loading studies, (6) buried-waste studies, and (7) RH strategy implementation. The goal is to prepare, package, certify, and transport a drum of waste to WIPP by January 1989. Also, a feasibility study on the vitrification of the RH-TRU sludges is being prepared. These and other studies should contribute greatly to the RH-TRU work-off efforts and could give new direction and alternatives to ORNL's current RH-TRU waste program.

Table 4.4 presents a schedule for the work-off of RH-TRU waste. In this schedule, it is assumed that the WHPP will be operational in 1996 and that the work-off rate is 85 m^3/year. The schedule is consistent with entries of Tables T5, T6, T12, and T13[3] to the 1986 IDB annual inventory report.[4] Other assumptions pertinent to construction of the schedule are presented in Sect. 4.2.1.

4.2.1 Assumptions for RH Waste Work-Off

If WHPP construction proceeds on schedule, 18 years (January 1996 to October 2013) will be available for the RH work-off effort (see Sect. 2.4 for additional information). The assumptions can be summarized as follows:

- Canister load: three 208-L drums
- Volume of canister: $3 \times 55 \times 0.003785 = 0.6245$ m^3
- Packing efficiency of a canister: 0.674
- Only one canister will be loaded per shipping cask
- 50% volume reduction
- Total actual waste to be worked off: 1532 m^3
- Yearly work-off:
  1532 m^3 of RH/18 years = 85 m^3/year
- Canisters required to be worked off (2463 total):
  [314 (4.5-in. and 6-in.) casks × 62 buckets/cask +
  35 (12-in.) casks × 21 buckets/cask] × canister/18 buckets ×
  50% volume reduction = 561 canisters
  946 m^3 sludge × canister/0.6246 m^3 = 1514 canisters
  402 CEUSP cans × canister/52 cans = 8 canisters
  220 6-in. NG casks (48 remaining) × 50% requires 379 canisters
- Trips per year required for RH work-off:
  2463/18 = 137 canisters or trips/year
- Shipping casks required for work-off:
  Assuming a 360-d year and a 6-d turnaround for shipping,
  360/6 = 60 trips per year per canister possible
  Hence, for 137 trips/year work-off:
  137/60 = roughly three shipping casks required for RH work-off.

Table 4.4. RH-TRU waste inventory work-off

(Values given in cubic meters)

Year	Pre-1987 stored	Drummed sludge	NG casks	Total stored[a]	Shipped to WIPP	Work off	
						Sludge	NG casks
1986	326	0	0	326	0	0	0
1987	326	0	10	336	0	0	0
1988	326	0	20	346	0	0	0
1989	326	0	30	356	0	0	0
1990	326	0	40	366	1	0	0
1991	326	0	50	376	1	0	0
1992	326	0	60	386	0	0	0
1993	326	0	70	396	0	0	0
1994	326	0	80	406	0	0	0
1995	326	0	90	416	0	0	0
1996	241	189	100	256	85	0	0
1997	156	378	110	266	85	0	0
1998	71	567	120	191	85	0	0
1999	0	756	130	130	85	14	0
2000	0	946	140	140	85	85	0
2001	0	0	150	150	85	85	0
2002	0	0	160	160	85	85	0
2003	0	0	170	170	85	85	0
2004	0	0	180	180	85	85	0
2005	0	0	190	190	85	85	0
2006	0	0	200	200	85	85	0
2007	0	0	210	210	85	85	0
2008	0	0	220	220	85	85	0
2009	0	0	230	230	85	85	0
2010	0	0	240	237	85	82	3
2011	0	0	250	162	85	0	85
2012	0	0	260	87	85	0	85
2013	0	0	268	42	45	0	55
Total					1492	946	228

[a]Numbers in this column reflect the possibility of the neutron level of the NG waste being high and requiring time for ^{252}Cf decay. Hence, waste generated after 2009 may remain on-site unless some other option such as shielding is employed. Thus, ~50 m^3 of RH waste may be stored on-site.

4.2.1.1 Assumptions for Stored Waste

The assumptions used for stored waste are as follows:

- For pre-1987 wastes, >10 years will be allowed for ^{252}Cf decay.
- Work-off begins in 1996 at an 85-m^3/year work-off rate.
- Work-off ends in 1999.

4.2.1.2 Assumptions for Sludge

The assumptions used for sludge are as follows:

- All sludge removed is TRU.
- Five years will be required to remove sludge from tanks.
- Sludge will be completely drummed in the year 2000.
- Work-off of sludge begins in 1999 and is completed in 2010.

4.2.1.3 Assumptions for NG Casks

The assumptions used for NG casks are as follows:

- Casks will not be worked off until sludge work-off is completed.
- Cask work-off begins in 2010 and ends in 2013.

4.3 TRANSPORTATION STRATEGIES

Transportation from ORNL to WIPP will be by common carrier over public highways in accordance with the U.S. Department of Transportation (DOT) and other federal, state, and local regulations. It is recognized that these regulations are subject to change, and strategies will have to change to meet them. Supportive investigations into the design of an RH transportation system are scheduled to be completed by December 1986 and should help detail ORNL's transportation strategy.

Transportation and shipment will further involve the allocation of holding areas and construction of a loading platform for loading six-packs of drums into the TRUPACT (see Sect. 3.2.4).

Scoping studies have been undertaken to determine the effectiveness of modifying the defense HLW shipping cask for transporting ORNL RH-TRU waste to WIPP. These calculations were made for shielding with steel, borated polyethylene, and limonite concrete to address the restrictive proposal of limiting the neutron dose rate to 75 mrem/h on the surface of the RH-TRU waste canister because of handling limitations at WIPP. It was determined that borated polyethylene was the most effective shield considered but that holding wastes at ORNL for decay of the ^{252}Cf is the most attractive solution.[18] Recently, this limit was raised to 270 mrem/h; however, interim storage appears to be warranted. If the reduced storage time at ORNL for ^{252}Cf decay is still undesirable, then redesign of the shipping and transfer casks that shield neutrons should be considered.

Currently, DOE is supporting studies that are aimed at producing a more efficient cask.[19] The proposed shielded, double-contained cask would reduce ORNL's transportation costs. January 1989 has been set as the date for the delivery of either a modified defense HLW cask or a specially designed RH-TRU cask. A decision regarding this matter is needed prior to 1996, when ORNL is scheduled to begin shipping RH waste to WIPP.

4.4 KEY MILESTONES AND SCHEDULES

The milestones for ORNL's work-off of CH and RH waste are presented in Tables 4.1 and 4.3. Developing strategies and new concerns have caused modifications and changes to both the previously scheduled dates and some of the listed milestones themselves. Table 4.5 and Table 4.6 present a comparison of ORNL's milestones with those of both the <u>Defense Waste Management Plan</u> and the <u>Long-Range Master Plan for Defense Transuranic Waste Management</u>.[2]

The estimation of WIPP transportation needs is not an ORNL milestone since this is now a JIO effort. Many of the date changes stem from a delay in certification necessitated by the WIPP-WAC requirements or reflect more current programmatic direction (i.e., extension of WIPP operation period). Justification is given for discrepancies between the milestone dates for ORNL and those for the DWMP[1] and the LRMP.[2]

Table 4.5. Comparison of *Defense Waste Management Plan* with ORNL milestones

Milestone	DWMP	ORNL
Begin certification of NG waste	FY 1983	FY 1986[a]
Begin shipping certified TRU waste to WIPP	FY 1990–FY 2013	FY 1988–FY 2013[b]
Select location of TRU waste processing facility	FY 1990	FY 1990
Begin retrieving RH-TRU waste for certification and send to processing site or WIPP	FY 2002	FY 1995[c]

[a]Requirements to meet WIPP-WAC criteria necessitated delay.
[b]Plans are to ship CH-TRU in FY 1988 and to continue shipping TRU waste for as long as WIPP accepts shipments.
[c]Retrieval will begin immediately after WHPP becomes operable.

Table 4.6. Comparison of ORNL milestones with *Long-Range Master Plan for Defense Transuranic Waste Management*

Milestone	LRMP	ORNL
Begin certification of new RH waste at ORNL	1/87	1/87[a]
Complete certification plans for stored waste	9/87	9/87
Complete certification of stored/not-precertified CH waste	10/88	10/00[b]
Begin shipment of new CH waste directly to WIPP	10/88	10/88
Begin shipment of stored/retrieved CH waste to WIPP	10/88	10/88
Begin design of WHPP	10/90	10/90[c]
Begin construction of WHPP	10/91	10/91
Begin retrieval of stored/not-precertified RH	10/95	10/95
Begin WHPP hot operations	10/95	10/95
Begin shipment of aged RH waste to WIPP	1/96	1/96
Complete retrieval and processing of stored/not-precertified CH waste at ORNL	10/13	10/13
Complete retrieval and processing of stored/not-precertified RH waste at ORNL	10/13	10/13
Complete shipment of stored RH waste to WIPP	10/13	10/13
Complete shipment of stored/retrieved CH waste to WIPP from ORNL	10/13	10/13

[a]The waste (but not containers) will be certifiable.
[b]Boxed CH waste will probably require processing in the WHPP. Additionally, perhaps 5% of drummed waste will require some processing. Certification of all stored waste, including that which requires some processing, may be achievable somewhat sooner if it is required.
[c]Dependent on funding requests, as are other WHPP milestones.

5. RESOURCE NEEDS

New facilities or significant modifications to existing facilities that are required by ORNL for the implementation of its IWOP will be presented in this section, along with the estimated resources that will be required to install, operate, and maintain them.

The only new addition that will be required by the CH-TRU waste work-off will be a loading area for the packaging of drums into TRUPACTS (see Sect. 3.2.4 for a description of this facility). Work-off of RH-TRU waste will require that additional space be provided for RH waste storage. Additional TRU well-storage space for the on-site storage of small packages of TRU-contaminated wastes with high external gamma exposure rates will be needed. Also, another retrievable storage building similar to Building 7855 will be required for additional cask storage space. The schedule for RH-TRU waste work-off will be dependent on the construction of the RH-TRU WHPP for packaging and certification of waste for shipment to WIPP (see Sect. 3.2.2).

Justification for these facilities will be presented, along with their projected costs. Table 5.1 presents the costs associated with the planning, construction, and operation of the WHPP. Certification and packaging charges for the work-off of RH-TRU and CH-TRU waste are shown under yearly operations. Table 5.1, however, does not represent ORNL's total projected costs because of ongoing developments and the concomitant recognition of needs. Minor program expenditures, such as for storage construction, are not shown.

5.1 COSTING CONSIDERATIONS

ORNL plans to ship its waste to WIPP by carrier transport. It is felt that a portable, single-sectioned loading platform for placing six-packs of CH waste into the TRUPACTs can be attached to existing facilities to meet our requirements. Hence, ORNL expenses for a loading dock are limited to the TRUPACT loading platform itself and other minor expenses, such as six-pack framing. The TRUPACT loading platform that ORNL feels will be adequate for its needs (see Sect. 3.2.4) is estimated to cost roughly $5,000.

Table 5.1. Cost estimates for the ORNL Defense TRU Waste Program

(Values are in millions of 1986 dollars)

	Pre-1987	1987	1988	1989	1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2013	Total
RH-TRU Waste Handling Pilot Plant											
R&D design support (Title 1, 2)	0	0.93	0.36	0.92	0.33	2.25	0	0	0	0	4.79
Construction	0	0	0	0	0	48.0	0	0	0	0	48.0
Total project cost	0	0.93	0.36	0.92	0.33	50.25	0	0	0	0	52.79
Operations[a]	0	0	0	0	0	0	11.5	11.5	11.5	6.9	41.4
Decommission[b]	0	0	0	0	0	0	0	0	0	5.3	5.3
Interim operations[c]	0	0.74	0.3	0.49	0.49	2.45	2.45	2.45	2.45	1.47	13.29
Total											165.57

[a]Charges for certification and processing of RH-TRU waste only. Charges for boxed CH-TRU waste and ~5% of the CH-TRU waste that may need WHPP certification are not shown here. CEUSP waste charges are also averaged into other RH waste costs. Annual charges for NG waste will likely be assessed to the generators. NG average yearly costs are $356,000, a total of $6,405,000 for the program.

[b]Assumed to be 10% of the total project cost.

[c]These operation charges are for the certification and processing of CH-TRU waste. Included also is a $150,000 annual charge for certification plan development, audits, and updates. NG waste charges will be $220,000/year, a total of $5,725,000 for CH waste work-off.

ORNL's CH-TRU waste will probably be placed in stainless steel drums that will then be loaded into the TRUPACT, a container which is designed to comply with federal regulations governing the design and operation of equipment for transporting nuclear materials, by truck, in interstate commerce. ORNL will require only one TRUPACT (cost, $800,000) to work off its waste, assuming that a TRUPACT can make 2000 round trips during the 25-year work-off period.[19] Since the waste will be shipped in six-pack bundles, another expense for consideration is the frames for the bundles. Studies are now being conducted to figure this expense. In 1985, the cost was estimated to be $800 per frame, with only $100 of the expense being a direct materials cost. At this cost, framing would total $1.1 million. Bar coding the drums will be a comparatively minor expense, costing approximately $30,000 for the ~6000 labels that will be needed initially. These and other expenses are still being discussed and modified to reflect ongoing developments in the TRU waste management program. These costs were not figured into the annual TRU program cost projection because of their uncertainty.

An estimate of the annual cost for the TRU Waste Program is shown in Table 5.1. The average annual cost of the program will be $2.8 million after the WHPP becomes operable. The yearly operational charges are based on ORNL's TRU waste volume and the number of trips that will be required to work off the waste.

The yearly charges for CH-TRU waste total $340,000, based on seven trips per year. This estimate includes the cost of the container, the storage cost, NDA/NDE charges, TRUPACT loading costs, and a 33% contingency cost. Approximately $1430 will be needed to certify and ship each drum of CH waste, assuming that stainless steel drums are used. The freight cost and WIPP operation expenses are not included in the total. Maintenance and capital costs for the TRUPACT will not be supported by the sites.

The yearly charges for RH-TRU waste total $5,206,000, based on 137 trips per year at a cost of $16,900 per canister. This estimate includes the costs of on-site storage, certification, waste processing, canister loading, RH shipping cask loading, and a 33% contingency cost.

The WIPP canister emplacement charge and transportation were not considered to be site expenses. Based on 1000 trips per RH cask, three casks will likely be required for the work-off of RH-TRU waste; they are expected to be provided without direct charge. These costs are, of course, subject to modification based on ongoing studies and programmatic developments.

The TRU program will not finance all the costs of CH and RH waste certification and work-off because the waste generators will be required to pay for their NG waste. Annual waste charges for newly generated CH-TRU will be $220,000/year; charges for NG RH-TRU waste will be $356,000. Yearly average charges were estimated by dividing the total work-off costs by the full period available for work-off (26 years for CH waste and 18 years for RH-TRU waste).

5.2 FACILITY FOR PROCESSING RH-TRU WASTE

For the work-off of ORNL's RH-TRU waste, necessary modifications for the packaging of the waste in suitable containers for shipment are too extensive for the present facilities to accommodate. Hence, ORNL will need to construct a facility to provide minimum processing of its RH waste for shipment to WIPP for permanent disposal. The minimum processing that will be required will be that which is necessary to meet the restrictions of the canisters and the WIPP-WAC criteria. This minimum processing/repackaging pilot plant, the WHPP, is described in Sect. 3.2.2. The projected costs for research and development, design support, construction, operation, and decommissioning are shown in Table 5.1. The WHPP is critical to ORNL's plan for disposal of RH waste.

5.3 ADDITIONAL FACILITY FOR RETRIEVABLE STORAGE

ORNL's RH-TRU wastes are currently being collected in concrete casks and stored in Building 7855. However, this building is nearing its capacity load; and, with the projected generation rate of more than nine casks per year, a new storage facility will be required in 5 years. Facility construction, scheduled for 1988, is projected to cost $300,000.

5.4 TRU WELL STORAGE ADDITION

Stainless steel wells, or auger holes, are used to store TRU-contaminated waste packages with high external gamma exposure rates. Of 54 wells, approximately 8 are currently vacant. With a fill rate of at least 4 wells per year, it is imperative that additional space be created immediately for this waste. This facility will be similar to the current well storage areas, Buildings 7827 and 7829. Facility construction is scheduled for 1987 at a cost of $200,000.

6. PUBLIC DOCUMENTATION REQUIREMENTS

The DOE program for TRU waste proposes to retrieve, process, certify, and ship stored and NG CH and RH materials to WIPP. An Action Description Memorandum (ADM) and an environmental assessment (EA) will be prepared for this work-off. WACCC audits will also be performed. Disposal operations at WIPP are already covered by an environmental impact statement (EIS).[20]

Measures to aid in working off ORNL's TRU waste include building a new facility (the WHPP), constructing additional retrievable storage facilities to handle NG RH waste, and possibly making modifications to existing buildings for a loading and shipping dock.

A feasibility study has been prepared for the WHPP. The EA will address impacts to the environment resulting from construction activities, occupational radiation exposure associated with handling and processing of TRU wastes, emergency situations and accident scenarios, and shipment of the waste to WIPP.[21] Air permits and other necessary documentation essential to the operation of the WHPP will be provided as needed. Construction of the RH retrievable storage facility will be covered by the EA and the operating guidelines for Building 7855. Some modifications to existing structures will not require involved documentation since they are considered routine. Therefore, such modifications should be regarded to fall under the coverage of ORNL's general operation procedures. If other requirements are later determined for the projects, then additions to the EAs or some other form of detailed documentation will be provided.

All the resources and facilities required to support the IWOP will observe such standards as DOE Order 5480.1 concerning worker safety and occupational radiation exposure and DOE Order 4583.1, "Occupational Safety and Health Program for Government-Owned Contractor-Operator Facilities." Moreover, to ensure that the IWOP is implemented without "undue risk to the environment and in full compliance with all federal and state environmental permits, rules, and regulations," ORNL's Environmental Protection Procedure (EPM-22.0) will be adhered to for documentation and regulatory considerations.[22] Further, the following documents and/or records must be available to regulating agencies and possibly to the general public under the Freedom of Information Act:

- Safety Assessment Document (SAD)
- Preliminary Safety Analysis Report (PSAR)
- Final Safety Analysis Report (FSAR)
- Operational Safety Requirements (OSR)
- Quality Assurance Plan
- Air Permits
- Waste Discharge Permits
- Waste Discharge Records
- Waste Packaging Records
- Shipping Documents
- QA Records (scans, examinations, tests, etc.)
- Bills of Lading
- Certificates of Competent Authority
- Training Records of Personnel
- Radiation Exposure Records
- Environmental Assessment
- SNM Transfer Records
- Approval Records on Shoring of Containers on Truck Beds

Some of the preceding documents will require several engineering studies to provide the consequences of natural phenomena (seismic events, high winds, floods, etc.) and credible accident scenarios with their consequences and control. These studies will be incorporated into the

EA for ORNL's TRU Waste Program. All of these reports fall under ORNL's general procedure guidelines and will be applied and maintained, as necessary, with due consideration to ORNL's quality assurance procedures.

7. REFERENCES

1. The Defense Waste Management Plan, DOE/DP-0015, U.S. Department of Energy, Washington, D.C., June 1983.

2. Long-Range Master Plan for Defense Transuranic Waste Management, Final Draft, DOE-TRU-8201, U.S. Department of Energy, June 1983.

3. L. D. Bates, Oak Ridge National Laboratory, letter to D. R. Brown, U.S. Department of Energy, Oak Ridge Operations, "FY-1987 Update of the Oak Ridge National Laboratory Inventory Work-Off Plan," Mar. 30, 1987.

4. Integrated Data Base for 1986: Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics, DOE/RW-0006, Rev. 2, prepared by Oak Ridge National Laboratory for U.S. Department of Energy, September 1986.

5. J. Andrew Detamore, Remote-Handled/Special Case TRU Waste Characterization Summary, RFP-3680, Rockwell International Corp., March 1984.

6. Transuranic Lead Organization, Position Paper: Disposal of Stored Defense Transuranic Wastes That Are Impractical to Certify, December 1984.

7. J. R. Trabalka, Buried TRU Wastes at ORNL, ORNL/RAP-8 (Draft), December 1986.

8. F. J. Schultz et al., Oak Ridge National Laboratory, and J. T. Caldwell et al., Los Alamos National Laboratory, First-Year Evaluation of a Nondestructive Assay System for the Examination of ORNL TRU Waste, ORNL-6007, Oak Ridge National Laboratory, April 1984.

9. Martin Marietta Energy Systems, Inc., Feasibility Study for RH-TRU Waste Handling Facility, X-OE-254, Oak Ridge National Laboratory, September 1984.

10. L. D. Bates, Radioactive Solid Waste Storage and Disposal at ORNL: Description and Safety Analysis, ORNL/TM-8201, Oak Ridge National Laboratory, October 1983.

11. GA Technologies, Inc., Operations and Maintenance Manual: TRUPACT-1, SAND-84-7123, December 1984.

12. F. J. Schultz et al., Neutron and Gamma-Ray Nondestructive Examination of Contact-Handled Transuranic Waste at the ORNL TRU Waste Drum Assay Facility, ORNL-6103, Oak Ridge National Laboratory, March 1985.

13. F. J. Schultz et al., ORNL TRU Waste Drum Assay and Sampling Facilities: Operation Procedures Manual, Internal Memorandum, January 1984.

14. TFI Corporation, Introduction to Real-Time X-Ray Fluoroscopic Inspection, NDT Products Division, Rucker, Ga., 1985.

15. Westinghouse Electric Corp., Data Package Format for Certified Transuranic Waste for the Waste Isolation Pilot Plant, WIPP-DOE-157, Rev. 1, September 1985.

16. L. D. Bates, Oak Ridge National Laboratory, letter to D. R. Brown, U.S. Department of Energy, Oak Ridge Operations, "TRU Waste Container Bar Coding," May 1, 1986.

17. F. E. Harrington, Oak Ridge National Laboratory, letter to F. R. Mynatt, Oak Ridge National Laboratory, "Outstanding Issues in ORNL's TRU Waste Disposal," Jan. 15, 1985.

18. F. E. Harrington, Process Engineering for Remote-Handled Transuranic Waste, Internal Memorandum, Sept. 4, 1985.

19. J. A. Detamore et al., TRU Waste Management Program Cost/Schedule Optimization Analysis (Draft), prepared by the S. M. Stoller Corporation for the Transuranic Waste Systems Office, Mar. 22, 1985.

20. Final Environmental Impact Statement, Waste Isolation Pilot Plant, EIS-0026, U.S. Department of Energy, Assistant Secretary of Defense Programs, Washington, D.C., October 1980.

21. J. B. Cannon, Action Description Memorandum for Defense Transuranic Waste Management, Oak Ridge National Laboratory, Oct. 8, 1985.

22. Environmental Protection Procedure EPM-22.0, "Environmental Review and Documentation Program," Oak Ridge National Laboratory, Dec. 16, 1985.

Appendix A.

EQUIPMENT AND INSTRUMENTATION OF THE WHPP

A summary (from the Feasibility Study for RH-TRU Waste Handling Facility, pages 31 to 39) of some of the instrumentation and equipment that will be used in the WHPP is contained in this appendix. Other presentations include a waste process flow diagram showing the certification steps and processing flow of an RH waste package through WHPP (Fig. A.1) and a facility processing flow diagram showing the path of a package through the various departments of WHPP (Fig. A.2). Table A.1 and Table A.2 (discussed in Sect. 3.2.2.3) conclude the referenced WHPP items. The WEAF's floor plan is detailed in Fig. A.3.

A.1 INSTRUMENTATION

The in-cell manipulator system will be a bridge crane and a bridge crane-mounted electromechanical manipulator. Master-slave manipulators will be used in the drum loading station of the preparation cell. All crane system drives will be interfaced to the process cell Programmable Logic Controller (PLC) system that it serves. Cathode-ray tube (CRT) terminals will be used to facilitate operations in the control room.

All in-cell viewing will be provided by a remotely operated, closed-circuit television system (CCTV). The CCTV monitors will be centrally located in the operating and control room. Each cell will have a high-resolution, five-camera system (two color and three black-and-white). System control will be effected through a remote serial digital data link that will send encoded camera-addressing and control command sequences throughout the CCTV network.

The waste handling operations within each cell will be primarily sequential in nature. The manipulator systems will have numerous interlocks to provide safe operation. The PLC will provide a comprehensive solution to these requirements, allowing the operator to initiate preprogrammed sequences of operations while executing system interlocks. These PLC systems will have touch-screen graphic control panels as the operator interface to the cell control systems, which will eliminate the need for hardwired control panels for in-cell operations.

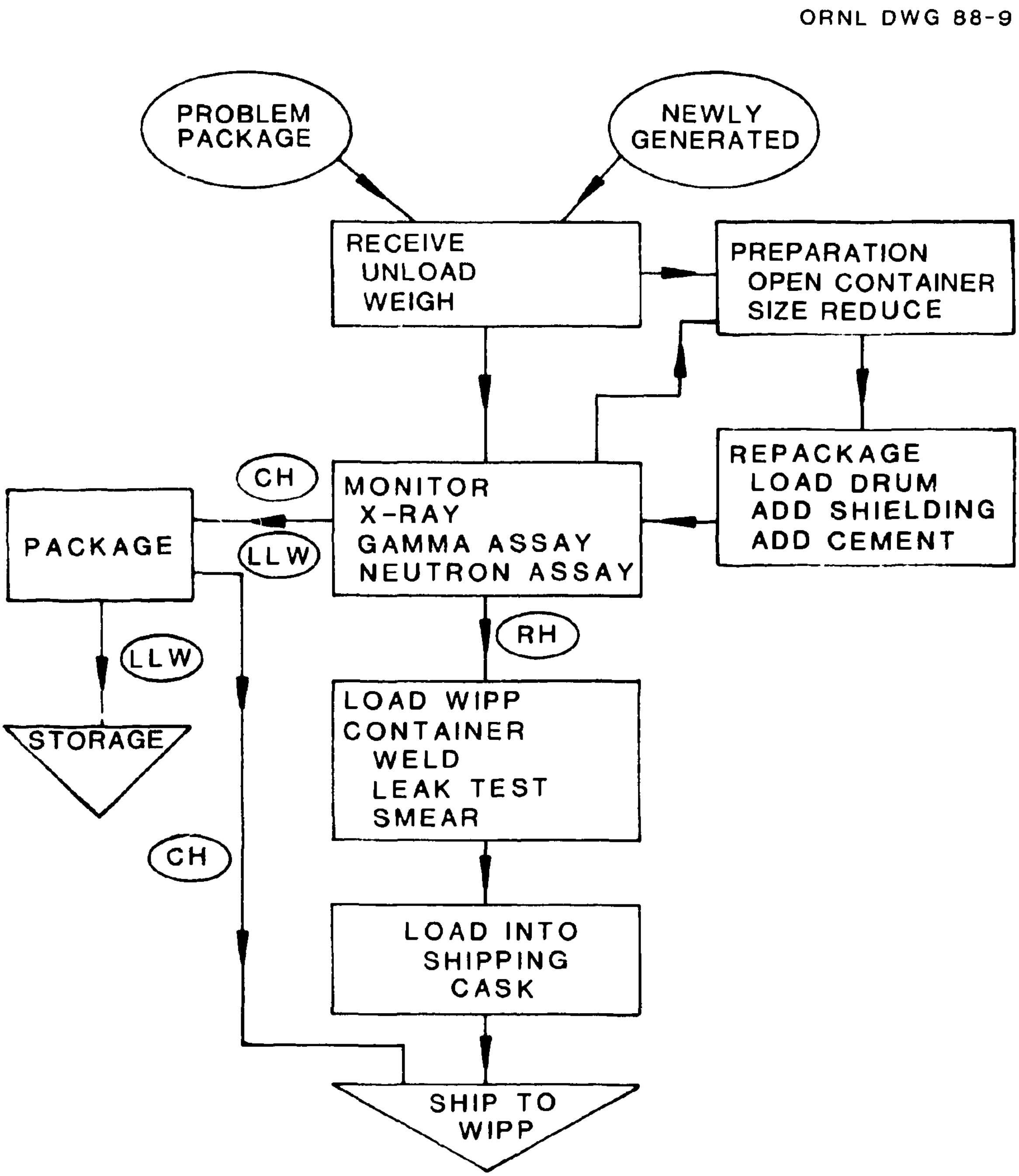

Fig. A.1. Waste process step flow diagram of WHPP.

ORNL DWG 88-8

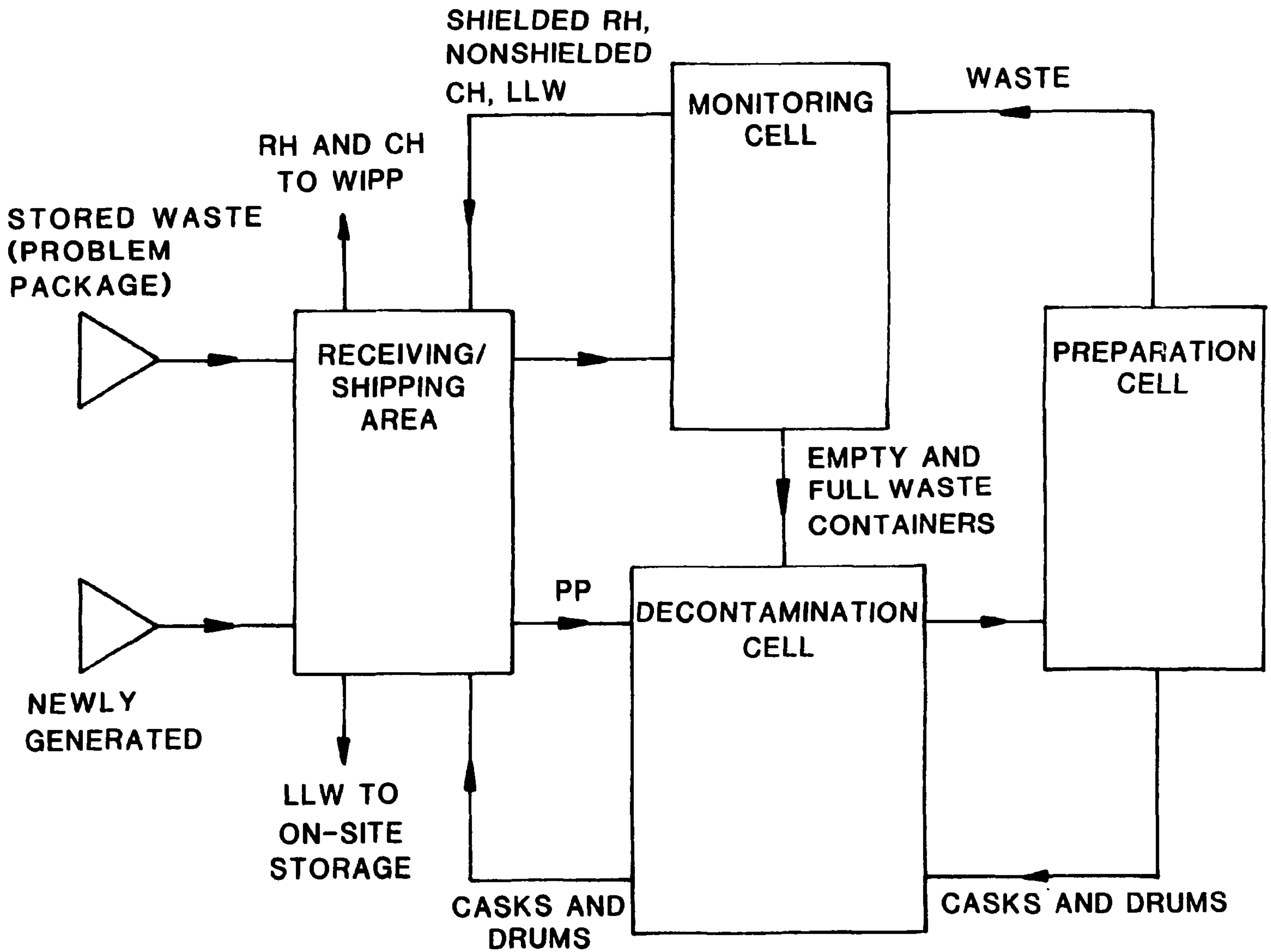

Fig. A.2. Generic processing facility flow diagram.

Table A.1. RH-TRU waste volume per shift[a]

DOE facility	Retrievable (m^3)			Newly generated 1984 - 1994 (m^3)			Total (m^3)			Avg. waste/year over 10 years (m^3/year)		
	Min.	Nom.	Max.	Min.	Nom.	Max.	Min.	Nom.	Max.	Min.	Nom.	Max.
INEL	45	45	51	83	83	146	128	128	177	12.8	12.8	17.7
LANL	1	1	1	2	4	4	3	5	5	0.3	0.5	0.5
ORNL	0	190	190	63	133	133	63	323	323	6.3	32.3	32.3
RHO	0	22	24	10	14	36	10	36	60	1.0	3.6	6.0
Totals	46	258	266	158	234	319	204	492	565	20.4	49.2	56.5

[a]Source: Martin Marietta Energy Systems, Inc., Feasibility Study for RH-TRU Waste Handling Facility, X-OE-254, Oak Ridge National Laboratory, September 1984.

Table A.2. WIPP RH canisters of waste volume per shift[a]

DOE facility	Retrievable (No. of canisters)			Newly generated 1984 - 1994 (No. of canisters)			Total (No. of canisters)			Avg. canister/year 1984-1994 (can./year)		
	Min.	Nom.	Max.	Min.	Nom.	Max.	Min.	Nom.	Max.	Min.	Nom.	Max.
INEL	142	142	151	312	312	412	454	454	563	45.4	45.4	56.3
LANL	3	3	3	3	6	6	6	9	9	0.6	0.9	0.9
ORNL	0	724	724	100	404	404	100	1128	1128	10.0	112.8	112.8
RHO	0	104	120	13	18	124	13	122	244	1.3	12.2	24.4
Totals	145	973	998	428	740	946	573	1713	1944	57.3	171.3	194.4

[a]Source: Martin Marietta Energy Systems, Inc., Feasibility Study for RH-TRU Waste Handling Facility, X-OE-254, Oak Ridge National Laboratory, September 1984.

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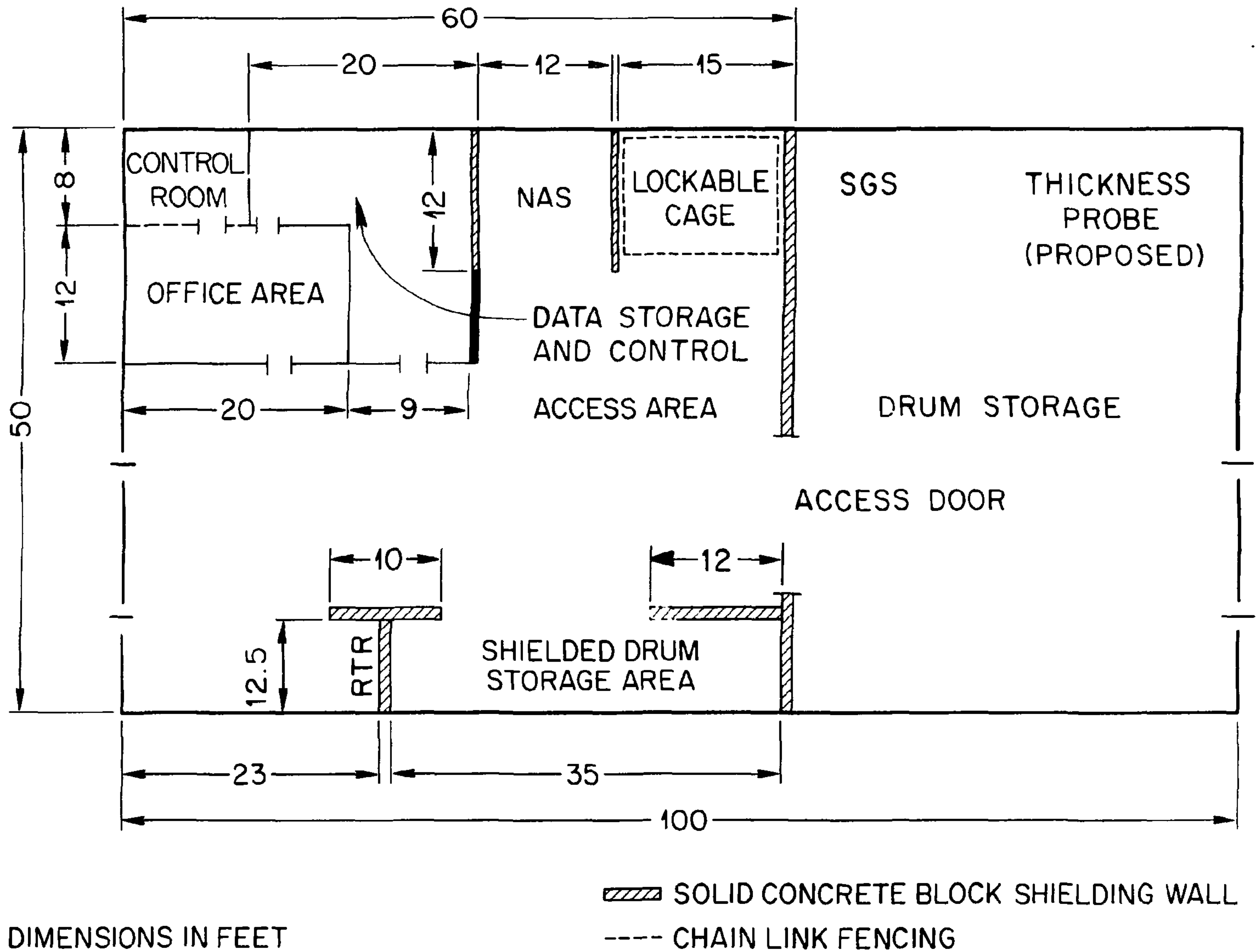

Fig. A.3. Floor plan of ORNL Waste Examination and Assay Facility - Building 7824.

The data management system will consist of a network of one master and four slave processors for data entry and management. Each processor will be an IBM-type personal computer. The network will be used to create a relational data base for all waste containers received, processed, and shipped.

Portal alpha and beta-gamma monitors will be available at all entrances to the facility. Alpha and beta-gamma air monitors will be located in the operating and controlling room and in the entrance to the access cell. Monitron beta-gamma background monitors will be situated in the receiving and shipping area, operating and control room, and access cell.

A.2 MECHANICAL

Mechanical equipment is found in five main areas: (1) receiving and shipping area, (2) access cell, (3) monitoring/WIPP canister loading cell, (4) preparation and drum loading cell, and (5) decontamination cell. All equipment except that in the receiving and shipping area will be monitored and controlled from the operating and control room. The LLW collection system also contains some equipment that bears mentioning.

A.3 RECEIVING AND SHIPPING

A 30-ton bridge crane and a 10-ton monorail crane will be provided for handling waste containers, shipping casks, and other miscellaneous items. Special lifting fixtures will be available for all items that are handled repeatedly.

A.4 ACCESS CELL

Two 30-ton remotely operated cranes will be used for transferring items between the receiving and shipping area and the process cells. They will also be used for removing cell roof plugs and for installing and removing cell equipment. Transfer locks will replace one section of cell roof plugs in both the monitoring cell and the decontamination cell and will interface with receiving and shipping.

A.5 MONITORING/WIPP CANISTER LOADING CELL

A 20-ton bridge crane and a bridge-mounted electromechanical manipulator will be used for material handling and for maintenance support of in-cell equipment. Both of these devices will be designed to maximize wall-to-wall coverage. Special lifting fixtures will be provided to facilitate waste container handling. Other mechanical equipment included in this cell are the NAS, SGS, RTR, RH-canister welding station, and drum-loading station (shared with the preparation cell). The design of these systems will be modified to enable them to be used on RH-TRU wastes packaged in RH canisters.

A.6 PREPARATION AND DRUM LOADING CELL

A 20-ton bridge crane and a bridge-mounted electromechanical manipulator will be used for material handling and for maintenance support of in-cell equipment. Both of these devices will be designed to maximize wall-to-wall coverage. Other mechanical equipment included in this cell are the drum opener, size reduction station, drum-loading station (shared with the monitoring cell), waste container positioning fixture, and transfer cart (shared with the decontamination cell).

A.7 DECONTAMINATION CELL

A 20-ton bridge crane and a bridge-mounted electromechanical manipulator will be used for material handling and for maintenance support of in-cell equipment. Both the crane and the manipulator will be designed to maximize wall-to-wall coverage. Other mechanical equipment included in this cell are an automated wash station and a positioning fixture. The wash station will be used primarily for cleaning the outside surface of loaded RH canisters, while the positioning fixture will be able to tilt large items to facilitate the cleaning operation. A hand-held spray wand will be provided for use as needed.

A.8 LLW COLLECTION SYSTEM

The LLW collection system will be located outside the facility and will include an underground vault, two 20,000-gal storage tanks, two positive displacement pumps, and a ground-level control house. A control panel in the control house will contain instrumentation that will completely monitor and control the total collection and containment of the LLW collection system.

A.9 MISCELLANEOUS

All air vented from the cells will be drawn through a high-efficiency particulate air (HEPA) filter system and exhausted through a stack fitted with an isokinetic sampling probe. The exhaust stack monitoring system will be used to monitor for radioactive particulate emissions from the facility.

All area radiation monitors will have alarms annunciated in the operating and control room and will provide alarms to transmit to a central alarm-reporting facility. Process alarms will be annunciated through the cells' control systems.

Appendix B.

WASTE CHARACTERIZATION TABLES

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	NUMBER OF CONTAINERS	VOLUME OF CONTAINER (M^3)	AVE. PACK. EFF. OF CONTAINERS	VOLUME OF WASTE (METERS^3)	VOLUME OF WASTE CONT. (METERS^3)	RAD MA RAD (mr/
CH-WASTE						
DRUMS						
GAL-30, SS	45	1.136E-01	0.9000	4.599E+00	5.110E+00	<
GAL-55, SS	995	2.082E-01	0.9000	1.864E+02	2.072E+02	<
GAL-30, Fe	9	1.136E-01	0.9000	9.202E-01	1.022E+00	<
GAL-55, Fe	129	2.082E-01	0.9000	2.417E+01	2.686E+01	<
				0.000E+00	0.000E+00	
				0.000E+00	0.000E+00	
BOXES						
74.5"X50.5"X38.5"	0	0	0	0	0	
88"X54"X54"	0	0	0	0	0	
112"X68"X77"	0	0	0	0	0	
68"X54"X54"	0	0	0	0	0	
88"X48"X48"	0	0	0	0	0	
THREE METER CUBED	0	0	0	0	0	
NON-STANDARD BOX*	0	0	0	0	0	
				0.000E+00	0.000E+00	
				0.000E+00	0.000E+00	
				0.000E+00	0.000E+00	
				0.000E+00	0.000E+00	
BINS						
M III	0	3.398E+00	0.0000	0.000E+00	0.000E+00	0.
M-4	0	3.323E+00	0.0000	0.000E+00	0.000E+00	0.
120 CU FT BIN	0	3.398E+00	0.0000	0.000E+00	0.000E+00	0.
				0.000E+00	0.000E+00	
				0.000E+00	0.000E+00	
				0.000E+00	0.000E+00	
				0.000E+00	0.000E+00	
RH-WASTE						
ONE GALLON	0	3.785E-03	0.0000	0.000E+00	0.000E+00	0.
FIVE GALLON	0	1.893E-02	0.0000	0.000E+00	0.000E+00	0.
THIRTY GAL	0	1.136E-01	0.0000	0.000E+00	0.000E+00	0.
FIFTY FIVE GAL	0	2.082E-01	0.0000	0.000E+00	0.000E+00	0.
CAN 12"X60"	0	3.707E-02	0.0000	0.000E+00	0.000E+00	0.
CYLIND. 1'X 6'	0	4.448E-02	0.0000	0.000E+00	0.000E+00	0.
FIVE CUBIC FT	0	1.416E-01	0.0000	0.000E+00	0.000E+00	0.
LONG RH-CANISTER	0	8.976E-01	0.0000	0.000E+00	0.000E+00	0.
SHORT RH-CANISTER	0	3.851E-01	0.0000	0.000E+00	0.000E+00	0.

Table B.1. Stored waste expected to be certifiable without processing

	RAD LEVEL AT CONTACT		(ACTIVITY)				WEIGHT DIST.	
LUME OF STE CONT. ETERS^3)	MAXIMUM RAD LEVEL (mr/hr)	AVERAGE RAD LEVEL (mr/hr)	TOTAL Pu CURIES	TOTAL OF ALL ACTIVITY (CURIES)	TOTAL OF TRU-ALPHA (CURIES)	% LESS THAN 100 (nci/gram)	TOTAL WEIGHT (Kgs)	AVERAG DENSIT (Kgs/m
5.110E+00	<200	<100	2.00E+02	4.08E+02	4.0[illegible]E+02	0.0	2.102E+03	4.11
2.072E+02	<200	<100	1.54E+03	7.19E+03	4.06E+03	0.0	6.167E+04	2.97
1.022E+00	<200	<100	3.44E+01	5.55E+02	3.1[illegible]E+01	0.0	3.606E+02	3.52
2.686E+01	<200	<100	2.67E+03	6.87E+03	5.[illegible]E+03	0.0	4.677E+03	1.74
0.000E+00								
0.000E+00								
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0.000E+00								
0.000E+00								
0.000E+00								
0.000E+00								
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00	
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00	
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00	
0.000E+00								
0.000E+00								
0.000E+00								
0.000E+00								
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00	
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00	
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00	
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00	
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00	
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00	
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00	
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00	
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00	

recessing

WEIGHT DIST.

LESS THAN ■ ci/gram)	TOTAL WEIGHT (Kgs)	AVERAGE DENSITY (Kgs/m^3)	AVERAGE HEAT OUTPUT (WATTS/M^3)	FINES CONTENT (YES/NO)	NON-RAD HAZARDOUS MATERIAL	SS MATERIAL DESIGNATION
0.0	2.102E+03	4.113E+02	2.347E+00	N	N	d
0.0	6.167E+04	2.977E+02	6.922E-01	N	N	d
0.0	3.606E+02	3.527E+02	1.747E+01	N	N	d
0.0	4.677E+03	1.741E+02	7.607E+00	N	N	d
		ERR				
		ERR				
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
		ERR				
		ERR				
		ERR				
		ERR				
		ERR				
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
		ERR				
		ERR				
		ERR				
		ERR				
		ERR				
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			

	NUMBER OF CONTAINERS	VOLUME OF CONTAINER (M^3)	AVE. PACK. EFF. OF CONTAINERS	VOLUME WASTE (METERS
CH-WASTE				
DRUMS				
GAL-30, SS	37	1.136E-01	0.9000	3.782
GAL-55, SS	814	2.082E-01	0.9000	1.525
GAL-30, Fe	7	1.136E-01	0.9000	7.157
GAL-55, Fe	106	2.082E-01	0.9000	1.986
				0.000
				0.000
BOXES				
74.5"X50.5"X38.5"	1	2.374E+00	1.0000	2.374
88"X54"X54"	0	4.205E+00	0.0000	0.000
112"X68"X77"	0	9.610E+00	0.0000	0.000
68"X54"X38.5"	3	3.172E+00	1.0000	9.516
88"X48"X48"	12	3.323E+00	1.0000	3.987
THREE METER CUBED	0	3.000E+00	0.0000	0.000
NON-STANDARD BOX*	14	3.030E+00	1.0000	4.242
				0.000
				0.000
				0.000
				0.000
BINS				
M III	0	3.398E+00	0.0000	0.000
M-4	0	3.329E+00	0.0000	0.000
120 CU FT BIN	0	3.398E+00	0.0000	0.000
				0.000
				0.000
				0.000
				0.000
RH-WASTE				
ONE GALLON	0	3.785E-03	0.0000	0.000
FIVE GALLON	0	1.893E-02	0.0000	0.000
THIRTY GAL	0	1.136E-01	0.0000	0.000
FIFTY FIVE GAL	4579	2.082E-01	1.0000	9.533
CAN 3.75"X24.625	401	4.458E-03	1.0000	1.788
CAN, 3.5"X10"	200	1.577E-03	1.0000	3.154
Fe DRUM, 55 GAL	0	2.082E-01	0.0000	0.000
LONG RH-CANISTER	0	8.976E-01	0.0000	0.000
SHORT RH-CANISTER	0	3.851E-01	0.0000	0.000
CONCRETE CASK, 4.	95	1.658E+00	0.6000	9.448
CONCRETE CASK, 6"	219	1.658E+00	0.6000	2.178
CONCRETE CASK, 12	35	6.569E-01	0.5000	1.150

Table B.2. Stored waste not expected to be certifiable without pro

F R	AVE. PACK. EFF. OF CONTAINERS	VOLUME OF WASTE (METERS^3)	VOLUME OF WASTE CONT. (METERS^3)	RAD LEVEL AT CONTACT MAXIMUM RAD LEVEL (mr/hr)	 AVERAGE RAD LEVEL (mr/hr)	(ACTIVITY) TOTAL Pu CURIES	 TOTAL OF ALL ACTIVITY (CURIES)	 TOTAL OF TRU-ALPHA (CURIES)	% 1 (
-01	0.9000	3.782E+00	4.202E+00	<200	<100	1.63E+02	3.34E+02	3.32E+02	
-01	0.9000	1.525E+02	1.695E+02	<200	<100	1.26E+03	5.88E+03	3.32E+03	
-01	0.9000	7.157E-01	7.952E-01	<200	<100	2.68E+01	4.32E+02	3.96E+01	
-01	0.9000	1.986E+01	2.207E+01	<200	<100	2.18E+03	5.62E+03	4.17E+03	
		0.000E+00	0.000E+00						
		0.000E+00	0.000E+00						
+00	1.0000	2.374E+00	2.374E+00	<200	<100	0.00E+00	1.00E-04	1.00E-04	
+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
+00	1.0000	9.516E+00	9.516E+00	3.00E+00	1.67E+00	0.00E+00	2.20E-03	2.20E-03	
+00	1.0000	3.987E+01	3.987E+01	5.00E+00	3.60E+00	1.52E+00	3.03E+00	2.97E+00	
+00	0.0000	0.000E+00	0.0[illegible]E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
+00	1.0000	4.242E+01	1.4[illegible]E+01	1.00E+01	4.00E+00	3.01E+01	6.88E+02	3.35E+01	
		0.000E+00	0.000E+00						
		0.000E+00	0.000E+00						
		0.000E+00	0.000E+00						
		0.000E+00	0.000E+00						
+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E[illegible]	0.00E+00	
		0.000E+00	0.000E+00						
		0.000E+00	0.000E+00						
		0.000E+00	0.000E+00						
		0.000E+00	0.000E+00						
-03	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
-02	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
-01	1.0000	9.533E+02	9.533E+02	5.20E+00	3.30E+00	2.18E+02	2.40E+04	1.16E+03	
-03	1.0000	1.788E+00	1.788E+00	3.50E+05	3.25E+05	0.00E+00	0.00E+00	9.59E+02	
-03	1.0000	3.154E-01	3.154E-01	1.50E+06	1.00E+06	0.00E+00	0.00E+00	0.00E+00	
-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
+00	0.6000	9.448E+01	1.575E+02	3.00E+03	1.75E+02	5.17E+00	2.31E+02	2.31E+02	
+00	0.6000	2.178E+02	3.630E+02	8.00E+03	6.59E+02	1.84E+01	3.97E+02	2.13E+02	
-01	0.5000	1.150E+01	2.299E+01	9.00E+03	1.47E+03	4.83E-01	5.81E+01	5.14E+01	

put processing

F HA S)	% LESS THAN 100 (nci/gram)	TOTAL WEIGHT (Kgs)	AVERAGE DENSITY (Kgs/m^3)	AVERAGE HEAT OUTPUT (WATTS/M^3)	FINES CONTENT (YES/NO)	NON-RAD HAZARDOUS MATERIAL	SS MATERIAL DESIGNATION
	WEIGHT DIST.						
E+02	0.0	1.719E+03	4.091E+02	2.347E+00	N	N	d
E+03	0.0	5.046E+04	2.977E+02	6.922E-01	N	N	d
E+01	0.0	2.804E+01	3.526E+01	1.747E+01	N	N	d
E+03	0.0	3.827E+03	1.734E+02	7.607E+00	N	N	d
			ERR				
			ERR				
E-04	0.0	2.270E+02	9.562E+01	0.000E+00	N	N	d
E+00	0.0	0.000E+00	ERR	0.000E+00			
E+00	0.0	0.000E+00	ERR	0.000E+00			
E-03	0.0	1.636E+03	1.719E+02	0.000E+00	N	N	d
E+00	0.0	3.818E+03	9.576E+01	1.700E-03	N	N	d
E+00	0.0	0.000E+00	ERR	0.000E+00			
E+01	0.0	1.281E+04	9.148E+02	2.590E-02	N	N	d
			ERR				
			ERR				
			ERR				
			ERR				
			ERR				
E+00	0.0	0.000E+00	ERR	0.000E+00			
E+00	0.0	0.000E+00	ERR	0.000E+00			
E+00	0.0	0.000E+00	ERR	0.000E+00			
			ERR				
			ERR				
			ERR				
			ERR				
			ERR				
E+00	0.0	0.000E+00	ERR	0.000E+00			
E+00	0.0	0.000E+00	ERR	0.000E+00			
E+00	0.0	0.000E+00	ERR	0.000E+00			
E+03	0.0	9.570E+05	1.004E+03	3.500E-02	N	Y	a
E+02	0.0	4.020E+03	2.249E+03	1.554E+01	N	N	b
E+00	0.0	1.000E+02	3.171E+02	0.000E+00	N	N	b
E+00	0.0	0.000E+00	ERR	0.000E+00			
E+00	0.0	0.000E+00	ERR	0.000E+00			
E+00	0.0	0.000E+00	ERR	0.000E+00			
E+02	0.0	2.893E+05	1.837E+03	7.090E-02	N	N	c
E+02	0.0	8.149E+05	2.245E+03	2.950E-02	N	N	c
E+01	0.0	1.915E+05	8.327E+03	1.369E-01	N	N	c

Table

1987-2013

	NUMBER OF CONTAINERS	VOLUME OF CONTAINER (M^3)	AVE. PACK. EFF. OF CONTAINERS	VOLUME OF WASTE (METERS^3)	VOLUME OF WASTE CONT. (METERS^3)
CH-WASTE					
DRUMS					
GAL-30	0	1.136E-01	0.0000	0.000E+00	0.000E+00
GAL-55	3430	2.082E-01	0.9000	6.427E+02	7.141E+02
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
BOXES					
72"X48"X48"	0	0.000E+00	0.0000	0.000E+00	0.000E+00
88"X54"X54"	0	4.205E+00	0.0000	0.000E+00	0.000E+00
112"X68"X77"	0	9.610E+00	0.0000	0.000E+00	0.000E+00
68"X54"X38.5"	0	2.317E+00	0.0000	0.000E+00	0.000E+00
88"X48"X48"	0	3.323E+00	0.0000	0.000E+00	0.000E+00
THREE METER CUBED	0	3.000E+00	0.0000	0.000E+00	0.000E+00
NON-STANDARD BOX*	0		0.0000	0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
BINS					
M III	0	3.398E+00	0.0000	0.000E+00	0.000E+00
M-4	0	3.323E+00	0.0000	0.000E+00	0.000E+00
120 CU FT BIN	0	3.398E+00	0.0000	0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
RH-WASTE					
ONE GALLON	0	3.785E-03	0.0000	0.000E+00	0.000E+00
FIVE GALLON	0	1.893E-02	0.0000	0.000E+00	0.000E+00
THIRTY GAL	0	1.136E-01	0.0000	0.000E+00	0.000E+00
FIFTY FIVE GAL	0	2.082E-01	0.0000	0.000E+00	0.000E+00
CAN 12"X60"	0	3.707E-02	0.0000	0.000E+00	0.000E+00
CYLIND. 1'X 6'	0	4.448E-02	0.0000	0.000E+00	0.000E+00
FIVE CUBIC FT	0	1.416E-01	0.0000	0.000E+00	0.000E+00
LONG RH-CANISTER	0	8.976E-01	0.0000	0.000E+00	0.000E+00
SHORT RH-CANISTER	0	3.851E-01	0.0000	0.000E+00	0.000E+00
CONCRETE CASK, 6"	0	1.658E+00	0.0000	0.000E+00	0.000E+00
CONCRETE CASK, 12				0.000E+00	0.000E+00

Table B.3. Newly generated waste expected to be certifiable without processing

		RAD LEVEL AT CONTACT		(ACTIVITY)				WEIGHT DIST.
F 3)	VOLUME OF WASTE CONT. (METERS^3)	MAXIMUM RAD LEVEL (mr/hr)	AVERAGE RAD LEVEL (mr/hr)	TOTAL Pu CURIES	TOTAL OF ALL ACTIVITY (CURIES)	TOTAL OF TRU-ALPHA (CURIES)	% LESS THAN 100 (nci/gram)	TOTAL WEIGHT (Kgs)
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+02	7.141E+02	<200	<10	5.41E+03	2.54E+04	1.44E+04	0.0	2.092E+05
E+00	0.000E+00							
E+00	0.000E+00							
E+00	0.000E+00							
E+00	0.000E+00							
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00							
E+00	0.000E+00							
E+00	0.000E+00							
E+00	0.000E+00							
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00							
E+00	0.000E+00							
E+00	0.000E+00							
E+00	0.000E+00							
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.000E+00
E+00	0.000E+00							

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	WEIGHT DIST.					
ESS THAN i/gram)	TOTAL WEIGHT (Kgs)	AVERAGE DENSITY (Kgs/m^3)	AVERAGE HEAT OUTPUT (WATTS/M^3)	FINES CONTENT (YES/NO)	NON-RAD HAZARDOUS MATERIAL	SS MATERIAL DESIGNATION
0.0	0.000E+00	ERR	0.000E+00			
0.0	2.092E+05	2.930E+02	7.000E-01	N	N	d
		ERR				
		ERR				
		ERR				
		ERR				
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
		ERR				
		ERR				
		ERR				
		ERR				
		ERR				
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
		ERR				
		ERR				
		ERR				
		ERR				
		ERR				
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
		ERR				

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1987-2013

	NUMBER OF CONTAINERS	VOLUME OF CONTAINER (M^3)	AVE. PACK. EFF. OF CONTAINERS	VOLUME OF WASTE (METERS^3)	VOLUME OF WASTE CO (METERS^
[illegible]	0	1.136E-01	0.0000	0.000E+00	0.000E
GAL-55	181	2.082E-01	0.9000	3.392E+01	3.768E
				0.000E+00	0.000E
				0.000E+00	0.000E
				0.000E+00	0.000E
				0.000E+00	0.000E
BOXES					
72"x48"x48"	160	2.719E+00	1.0000	4.350E+02	4.350E
88"X54"X54"	0	4.205E+00	0.0000	0.000E+00	0.000E
112"X68"X77"	0	9.610E+00	0.0000	0.000E+00	0.000E
68"X54"X38.5"	0	2.317E+00	0.0000	0.000E+00	0.000E
88"X48"X48"	0	3.323E+00	0.0000	0.000E+00	0.000E
THREE METER CUBED	0	3.000E+00	0.0000	0.000E+00	0.000E
NON-STANDARD BOX*	0		0.0000	0.000E+00	0.000E
				0.000E+00	0.000E
				0.000E+00	0.000E
				0.000E+00	0.000E
				0.000E+00	0.000E
BINS					
M III	0	3.398E+00	0.0000	0.000E+00	0.000E
M-4	0	3.323E+00	0.0000	0.000E+00	0.000E
120 CU FT BIN	0	3.398E+00	0.0000	0.000E+00	0.000E
				0.000E+00	0.000E
				0.000E+00	0.000E
				0.000E+00	0.000E
				0.000E+00	0.000E
RH-WASTE					
ONE GALLON	0	3.785E-03	0.0000	0.000E+00	0.000E
FIVE GALLON	0	1.893E-02	0.0000	0.000E+00	0.000E
THIRTY GAL	0	1.136E-01	0.0000	0.000E+00	0.000E
FIFTY FIVE GAL	0	2.082E-01	0.0000	0.000E+00	0.000E
CAN 12"X60"	0	3.707E-02	0.0000	0.000E+00	0.000E
CYLIND. 1'X 6'	0	4.448E-02	0.0000	0.000E+00	0.000E
FIVE CUBIC FT	0	1.416E-01	0.0000	0.000E+00	0.000E
LONG RH-CANISTER	0	8.976E-01	0.0000	0.000E+00	0.000E
SHORT RH-CANISTER	0	3.851E-01	0.0000	0.000E+00	0.000E
CONCRETE CASK, 6"	268	1.658E+00	0.6000	2.685E+02	4.476E
CONCRETE CASK, 12				0.000E+00	0.000E

Table B.4. Newly generated waste not expected to be certifiable without proc

[illegible]	VOLUME OF WASTE (METERS^3)	VOLUME OF WASTE CONT. (METERS^3)	RAD LEVEL AT CONTACT MAXIMUM RAD LEVEL (mr/hr)	RAD LEVEL AT CONTACT AVERAGE RAD LEVEL (mr/hr)	(ACTIVITY) TOTAL Pu CURIES	TOTAL OF ALL ACTIVITY (CURIES)	TOTAL OF TRU-ALPHA (CURIES)	% [illegible]S THAN 1[illegible] (nci/gram)
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0
[illegible]	3.392E+01	3.768E+01	<200	<100	2.85E+02	1.34E+03	7.59E+02	0.0
	0.000E+00	0.000E+00						
	0.000E+00	0.000E+00						
	0.000E+00	0.000E+00						
	0.000E+00	0.000E+00						
[illegible]	4.350E+02	4.350E+02	<200	<10	1.67E+02	3.69E+03	1.94E+02	0.0
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0
	0.000E+00	0.000E+00						
	0.000E+00	0.000E+00						
	0.000E+00	0.000E+00						
	0.000E+00	0.000E+00						
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0
	0.000E+00	0.000E+00						
	0.000E+00	0.000E+00						
	0.000E+00	0.000E+00						
	0.000E+00	0.000E+00						
.8000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.[illegible]
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.[illegible]
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.[illegible]
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.[illegible]
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.[illegible]
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.[illegible]
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.[illegible]
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.[illegible]
[illegible]	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.[illegible]
.6000	2.685E+02	4.476E+02	9.00E+03	4.25E+02	2.00E+01	4.91E+02	2.79E+02	0.[illegible]
	0.000E+00	0.000E+00						

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ESS THAN i/gram)	WEIGHT DIST. TOTAL WEIGHT (Kgs)	AVERAGE DENSITY (Kgs/m^3)	AVERAGE HEAT OUTPUT (WATTS/M^3)	FINES CONTENT (YES/NO)	NON-RAD HAZARDOUS MATERIAL	SS MATERIAL DESIGNATION
0.0	0.000E+00	ERR	0.000E+00			
0.0	1.104E+04	2.930E+02	7.000E-01	N	N	d
		ERR				
		ERR				
		ERR				
		ERR				
0.0	4.640E+04	1.067E+02	<1	N	N	d
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
		ERR				
		ERR				
		ERR				
		ERR				
		ERR				
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
		ERR				
		ERR				
		ERR				
		ERR				
		ERR				
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	0.000E+00	ERR	0.000E+00			
0.0	9.988E+05	2.248E+03	2.200E-01	N	N	c
		ERR				

(1987-2015)

	NUMBER OF CONTAINERS	VOLUME OF CONTAINER (M^3)	AVE. PACK. EFF. OF CONTAINERS	VOLUME OF WASTE (METERS^3)	VOLUME OF WASTE CONT. (METERS^3)	RAD LEVEL AT CONTACT: MAXIMUM RAD LEVEL (mr/hr)	RAD LEVEL AT CONTACT: AVERAGE RAD LEVEL (mr/hr)	NUMBER AT EACH LEVEL (mR/hr): UP TO 10	10 TO 100	100 TO 1K	1K TO 10K
CH-WASTE											
DRUMS											
GAL-79	222	2.996E-01	0.9000	5.986E+01	6.651E+01	<200	<100	36	167	19	0
GAL-55	3230	2.082E-01	0.9000	6.052E+02	6.725E+02	<200	<10	315	2620	295	0
				0.000E+00	0.000E+00						
				0.000E+00	0.000E+00						
				0.000E+00	0.000E+00						
				0.000E+00	0.000E+00						
BOXES											
74.5"X50.5"X38.	0	2.374E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				
80"X54"X54"	0	4.205E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				
112"X68"X77"	0	9.601E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				
68"X54"X38.5"	0	2.317E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				
88"X48"X48"	0	3.823E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				
THREE METER CUB	0	3.000E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				
NON-STANDARD BO	0	0.000E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				
				0.000E+00	0.000E+00						
				0.000E+00	0.000E+00						
				0.000E+00	0.000E+00						
				0.000E+00	0.000E+00						
				0.000E+00	0.000E+00						
BINS											
M III	1	3.398E+00	0.0000	0.000E+00	0.000E+00						
M-4	0	3.823E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				
120 CU FT BIN		3.398E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				
				0.000E+00	0.000E+00						
				0.000E+00	0.000E+00						
				0.000E+00	0.000E+00						
RH WASTE											
CONCRETE CASK.	0	1.658E+00		0.000E+00	0.000E+00						
FIVE GALLON	0	1.893E-02	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				
THIRTY GAL	0	1.136E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				
FIFTY FIVE GAL		2.082E-01		0.000E+00	0.000E+00						
CAN 12"X60"	0	3.707E-02	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				
CYLIND. 1'X 6'	0	4.448E-02	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				
FIVE CUBIC FT	0	1.416E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				
LONG RH-CANISTE	860	1.821E+00	0.6900	1.081E+03	1.566E+03	2.00E+02	1.00E+02	0	0	175	685
SHORT RH-CANIST	0	3.851E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00				

Table B.5. Soft Waste that will become available for shipment

NUMBER AT EACH LEVEL (mR/hr) UP TO 10	10 TO 100	100 TO 1K	1K TO 100K	100K TO 1000K	(ACTIVITY) TOTAL Pu CURIES	TOTAL OF ALL ACTIVITY (CURIES)	TOTAL OF TRU-ALPHA (CURIES)	NUMBER AT EACH Pu CURIE LEVEL 1E TO .6	.6 TO 2	2 TO 5	5 TO 10	10 TO 20	20 TO 84	84 TO 100	100 TO 1K	% LESS THAN 100 nci/gram	AVERAGE HEAT OUTPUT (WATTS/M^3)
36	167	19	0	0	4.06E+03	7.49E+03	5.30E+03	114	60	15	15	12	6	0	0	0.00	3.70E+00
315	2620	295	0	0	5.02E+03	2.35E+04	1.36E+04	2990	93	84	30	15	10	8	0	0.00	6.60E-01
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00
																0.00	0.00E+00
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00
																0.00	
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00
					0.00E+00	0.00E+00	0.00E+00										
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00
0	0	175	685	0	5.20E+01	2.95E+03	2.87E+03	0	820	30	10	0	0	0	0	0.00	1.60E-02
					0.00E+00	0.00E+00	0.00E+00									0.00	0.00E+00

[illegible] TO [illegible]	800 TO 1K	% LESS THAN 100 nci/gram	AVERAGE HEAT OUTPUT (WATTS/M^3	FINES CONTENT YES/NO	NON-RAD HAZARDOUS MATERIAL	WEIGHT DIST. TOTAL WEIGHT (Kgs)	AVERAGE DENSITY (Kgs/m^3)	NUMBER AT EACH WEIGHT (Kgs) UP TO 180	180 TO 360	360 TO 680	680 TO 1360	1360 TO 2270	2270 TO 11350	SS MATERIAL DESIGNATION
[illegible]	0	0.00	3.71E+00	N	N	1.304E+04	1.960E+02	222	0	0	0	0	0	d
[illegible]	0	0.00	6.60E-01	N	N	1.932E+05	2.873E+02	3230	0	0	0	0	0	d
							ERR							
							ERR							
							ERR							
							ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
							ERR							
							ERR							
							ERR							
							ERR							
							ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00					ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
							ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
[illegible]	0	0.00	1.60E-02	N	N	1.015E+06	6.479E+02	0	0	0	860	0	0	c
		0.00	0.00E+00			0.000E+00	ERR							

(1987-2015)

	NUMBER OF CONTAINERS	VOLUME OF CONTAINER (M^3)	AVE. PACK. EFF. OF CONTAINERS	VOLUME OF WASTE (METERS^3)	VOLUME OF WASTE CONT. (METERS^3)	RAD LEVEL AT CONTACT MAXIMUM RAD LEVEL (mr/hr)	RAD LEVEL AT CONTACT AVERAGE RAD LEVEL (mr/hr)	NUMBER AT UP TO 10	NUMBER AT 10 TO 10
CH-WASTE									
DRUMS									
GAL-74	148	2.996E-01	0.9000	3.591E+01	4.434E+01	<200	<100	25	[illegible]
GAL-55	2153	2.082E-01	0.9000	4.034E+02	4.483E+02	<200	<10	210	18[illegible]
				0.000E+00	0.000E+00				
				0.000E+00	0.000E+00				
				0.000E+00	0.000E+00				
				0.000E+00	0.000E+00				
BOXES									
TRUPACT II	124	2.500E+00	0.8000	2.480E+02	3.100E+02	<200	<100	32	[illegible]
80"X54"X54"	0	4.205E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0	
72"X48"X48"	0	2.719E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0	
60"X54"X38.5"	0	2.317E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0	
88"X48"X48"	0	3.328E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0	
THREE METER CUB	0	3.000E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0	
NON-STANDARD BO	0	2.600E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0	
				0.000E+00	0.000E+00				
				0.000E+00	0.000E+00				
				0.000E+00	0.000E+00				
				0.000E+00	0.000E+00				
				0.000E+00	0.000E+00				
BINS									
M III	0	3.398E+00	0.0000	0.000E+00	0.000E+00				
M-4	0	3.323E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00		
120 CU FT BIN	0	3.398E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00		
				0.000E+00	0.000E+00				
				0.000E+00	0.000E+00				
				0.000E+00	0.000E+00				
RH WASTE									
CONCRETE CASK.		1.658		0.000E+00	0.000E+00				
FIVE GALLON	0	1.893E-02	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00		
THIRTY GAL	0	1.136E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00		
FIFTY FIVE GAL	0	2.082E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00		
CAN 12"X60"	0	3.707E-02	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00		
CYLIND. 1'X 6'	0	4.448E-02	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00		
FIVE CUBIC FT	0	1.416E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00		
LONG RH-CANISTE	1997	1.821E+00	0.6900	2.007E+03	2.908E+03	2.00E+02	1.00E+02	0	
SHORT RH-CANIST	0	3.851E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00		

Table B.6. Hard waste that will become available for shipment

RAD LEVEL AT CONTACT		NUMBER AT EACH LEVEL (mR/hr)					(ACTIVITY)			NUMBER AT EACH Pu CURIE LEVEL								
MAXIMUM RAD LEVEL (mR/hr)	AVERAGE RAD LEVEL (mR/hr)	UP TO 10	10 TO 100	100 TO 1K	1K TO 100K	100K TO 1000K	TOTAL Pu CURIES	TOTAL OF ALL ACTIVITY (CURIES)	TOTAL OF TRU-ALPHA (CURIES)	UP TO .6	.6 TO 2	2 TO 5	5 TO 10	10 TO 20	20 TO 84	84 TO 100	100 TO 1K	% LESS 100 (nCi/
<200	<100	25	90	4[illegible]	0	0	2.04E+03	4.99E+03	4.53E+03	75	40	13	10	5	5	0	0	
<200	<10	210	1800	14[illegible]	0	0	3.35E+03	1.57E+04	[illegible]E+03	1980	60	55	50	5	3	0	0	
<200	<100	32	92	[illegible]	0	0	2.52E+02	5.39E+03	2.9[illegible]E+02	34	70	12	8	0	0	0	0	
0.00E+00	0.00E+00	0	0	[illegible]	0	0	0.00E+00	0.00E+00	0.00E+00	0	0	0	0	0	0	0	0	
0.00E+00	0.00E+00	0	0	[illegible]	0	0	0.00E+00	0.00E+00	0.00E+00	0	0	0	0	0	0	0	0	
0.00E+00	0.00E+00	0	0	[illegible]	0	0	0.00E+00	0.00E+00	0.00E+00	0	0	0	0	0	0	0	0	
0.00E+00	0.00E+00	0	0	[illegible]	0	0	0.00E+00	0.00E+00	0.00E+00	0	0	0	0	0	0	0	0	
0.00E+00	0.00E+00	0	0	[illegible]	0	0	0.00E+00	0.00E+00	0.00E+00	0	0	0	0	0	0	0	0	
0.00E+00	0.00E+00						0.00E+00	0.00E+00	0.00E+00									
0.00E+00	0.00E+00						0.00E+00	0.00E+00	0.00E+00									
0.00E+00	0.00E+00						0.00E+00	0.00E+00	0.00E+00									
0.00E+00	0.00E+00						0.00E+00	0.00E+00	0.00E+00									
0.00E+00	0.00E+00						0.00E+00	0.00E+00	0.00E+00									
0.00E+00	0.00E+00						0.00E+00	0.00E+00	0.00E+00									
0.00E+00	0.00E+00						0.00E+00	0.00E+00	0.00E+00									
0.00E+00	0.00E+00						0.00E+00	0.00E+00	0.00E+00									
2.00E+02	1.00E+02	0	0	32[illegible]	1272	0	9.60E+01	5.49E+03	5.34E+03	0	1520	45	32	0	0	0	0	
0.00E+00	0.00E+00						0.00E+00	0.00E+00	0.00E+00									

						WEIGHT DIST.		NUMBER AT EACH WEIGHT (Kgs)						
n	100 TO 1K	% LESS THAN 100 (nci/gram)	AVERAGE HEAT OUTPUT (WATTS/M^3)	FINES CONTENT YES/NO	NON-RAD HAZARDOUS MATERIAL	TOTAL WEIGHT (Kgs)	AVERAGE DENSITY (Kgs/m^3)	UP TO 180	180 TO 360	360 TO 680	680 TO 1360	1360 TO 2270	2270 TO 11350	SS MATERIAL DESIGNATION
0	0	0.00	3.70E+00	N	N	8.692E+03	1.960E+02	148	0	0	0	0	0	d
n	u	0 00	6.60E-01	N	N	1.288E+05	2.073E+02	2153	0	0	0	0	0	d
							ERR							
							ERR							
							ERR							
							ERR							
0	0	0.00	1.40E-02	N	N	1.116E+05	3.600E+02	1	0	0	124	0	0	d
0	0	0.00	0.00E+00			0.000E+00	ERR	0	0	0	0	0	0	
0	0	0.00	0.00E+00			0.000E+00	ERR	0	0	0	0	0	0	
0	0	0.00	0.00E+00			0.000E+00	ERR	0	0	0	0	0	0	
0	0	0.00	0.00E+00			0.000E+00	ERR	0	0	0	0	0	0	
0	0	0.00	0.00E+00			0.000E+00	ERR	0	0	0	0	0	0	
0	0	0.00	0.00E+00			0.000E+00	ERR	0	0	0	0	0	0	
							ERR							
							ERR							
							ERR							
							ERR							
							ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00				0	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
		0.00	0.00E+00			0.000E+00	ERR							
0	0	0.00	1.60E-02	N	N	1.884E+06	6.480E+02	0	0	0	1597	0	0	c,b,e
		0.00	0.00E+00			0.000E+00	ERR							

Table B.7a. NG Special-case TRU waste that will become available fo

1987-2013

	NUMBER OF CONTAINERS	VOLUME OF CONTAINER (M^3)	AVE. PACK. EFF. OF CONTAINERS	VOLUME OF WASTE (METERS^3)	VOLUME OF WASTE CONT. (METERS^3)
CH-WASTE					
DRUMS					
GAL-30	0	1.136E-01	0.0000	0.000E+00	0.000E+00
GAL-55	0	2.082E-01	0.0000	0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
BOXES					
74.5"X50.5"X38.5"	0	2.374E+00	0.0000	0.000E+00	0.000E+00
88"X54"X54"	0	4.205E+00	0.0000	0.000E+00	0.000E+00
112"X68"X77"	0	9.601E+00	0.0000	0.000E+00	0.000E+00
68"X54"X38.5"	0	2.317E+00	0.0000	0.000E+00	0.000E+00
88"X48"X48"	0	3.323E+00	0.0000	0.000E+00	0.000E+00
THREE METER CUBED	0	3.000E+00	0.0000	0.000E+00	0.000E+00
NON-STANDARD BOX*	0	0.000E+00	0.0000	0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
BINS					
M III	0	3.398E+00	0.0000	0.000E+00	0.000E+00
M-4	0	3.323E+00	0.0000	0.000E+00	0.000E+00
120 CU FT BIN	0	3.398E+00	0.0000	0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
RH WASTE					
ONE GALLON	0	3.785E-03	0.0000	0.000E+00	0.000E+00
FIVE GALLON	0	1.893E-02	0.0000	0.000E+00	0.000E+00
THIRTY GAL	0	1.136E-01	0.0000	0.000E+00	0.000E+00
FIFTY FIVE GAL	0	2.082E-01	0.0000	0.000E+00	0.000E+00
CAN 12"X60"	0	3.707E-02	0.0000	0.000E+00	0.000E+00
CYLIND. 1'X 6'	0	4.448E-02	0.0000	0.000E+00	0.000E+00
FIVE CUBIC FT	0	1.416E-01	0.0000	0.000E+00	0.000E+00
LONG RH-CANISTER	0	0.000E+00	0.0000	0.000E+00	0.000E+00
SHORT RH-CANISTER	0	3.851E-01	0.0000	0.000E+00	0.000E+00
				0.000E+00	0.000E+00

Table 8.7a. NG Special-case TRU waste that will become available for shipment

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	NUMBER OF CONTAINERS	VOLUME OF CONTAINER (M^3)	AVE. PACK. EFF. OF CONTAINERS	VOLUME OF WASTE (METERS^3)	VOLUME OF WASTE CONT. (METERS^3)	RAD LEVEL AT CONTACT: MAXIMUM RAD LEVEL (mR/hr)	RAD LEVEL AT CONTACT: AVERAGE RAD LEVEL (mR/hr)
	0	1.136E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
	0	2.082E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
.5"X38.5"	0	2.374E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
54"	0	4.205E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
577"	0	9.601E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
18.5"	0	2.317E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
18"	0	3.323E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
TER CUBED	0	3.000E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
ARD BOX*	0	0.000E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
	0	3.398E+00	0.0000	0.000E+00	0.000E+00		
	0	3.323E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
' BIN	0	3.398E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
N	0	3.785E-03	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
ON	0	1.893E-02	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
L	0	1.136E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
E GAL	0	2.082E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
0"	0	3.707E-02	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
"X 6"	0	4.448E-02	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
C FT	0	1.416E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
ANISTER	0	0.000E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
CANISTER	0	3.851E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
				0.000E+00	0.000E+00		

Table B.7b. Stored special-case TRU waste that will become ava

(pre-1987)

	NUMBER OF CONTAINERS	VOLUME OF CONTAINER (M^3)	AVE. PACK. EFF. OF CONTAINERS	VOLUME OF WASTE (METERS^3)	VOLUM WASTE (METE
CH-WASTE					
DRUMS					
GAL-30	0	1.136E-01	0.0000	0.000E+00	0.0
GAL-55	0	2.082E-01	0.0000	0.000E+00	0.0
				0.000E+00	0.0
				0.000E+00	0.0
				0.000E+00	0.0
				0.000E+00	0.0
BOXES					
74.5"X50.5"X38.5"	0	2.374E+00	0.0000	0.000E+00	0.0
88"X54"X54"	0	4.205E+00	0.0000	0.000E+00	0.0
112"X68"X77"	0	9.610E+00	0.0000	0.000E+00	0.0
68"X54"X38.5"	0	2.317E+00	0.0000	0.000E+00	0.0
88"X48"X48"	0	3.323E+00	0.0000	0.000E+00	0.0
THREE METER CUBED	0	3.000E+00	0.0000	0.000E+00	0.0
NON-STANDARD BOX*	0		0.0000	0.000E+00	0.0
				0.000E+00	0.0
				0.000E+00	0.0
				0.000E+00	0.0
				0.000E+00	0.0
BINS					
M III	0	3.398E+00	0.0000	0.000E+00	0.0
M-4	0	3.323E+00	0.0000	0.000E+00	0.0
120 CU FT BIN	0	3.398E+00	0.0000	0.000E+00	0.0
				0.000E+00	0.0
				0.000E+00	0.0
				0.000E+00	0.0
				0.000E+00	0.0
RH-WASTE					
ONE GALLON	0	3.785E-03	0.0000	0.000E+00	0.0
FIVE GALLON	0	1.893E-02	0.0000	0.000E+00	0.0
THIRTY GAL	0	1.136E-01	0.0000	0.000E+00	0.0
FIFTY FIVE GAL	0	0.000E+00	0.0000	0.000E+00	0.0
CAN 3.75"X24.625	0	0.000E+00	0.0000	0.000E+00	0.0
CAN, 3.5"X10"	0	0.000E+00	0.0000	0.000E+00	0.0
Fe DRUM, 55 GAL	0	2.082E-01	0.0000	0.000E+00	0.0
LONG RH-CANISTER	0	8.976E-01	0.0000	0.000E+00	0.0
SHORT RH-CANISTER	0	3.851E-01	0.0000	0.000E+00	0.0
CONCRETE CASK, 4.	0	0.000E+00	0.0000	0.000E+00	0.0
CONCRETE CASK, 6"	0	0.000E+00	0.0000	0.000E+00	0.0
CONCRETE CASK, 12	0	0.000E+00	0.0000	0.000E+00	0.0
				0.000E+00	0.0

e B.7b. Stored special-case TRU waste that will become available for shipment

	NUMBER OF CONTAINERS	VOLUME OF CONTAINER (M^3)	AVE. PACK. EFF. OF CONTAINERS	VOLUME OF WASTE (METERS^3)	VOLUME OF WASTE CONT. (METERS^3)	RAD LEVEL AT CONTACT MAXIMUM RAD LEVEL (mr/hr)	RAD LEVEL AT CONTACT AVERAGE RAD LEVEL (mr/hr)
	0	1.136E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
	0	2.082E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
K38.5"	0	2.374E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
-	0	4.205E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
	0	9.610E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
5"	0	2.317E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
	0	3.323E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
: CUBED	0	3.000E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
D BOX*	0		0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
	0	3.398E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
	0	3.323E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
IIN	0	3.398E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
				0.000E+00	0.000E+00		
	0	3.785E-03	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
I	0	1.893E-02	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
	0	1.136E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
GAL	0	0.000E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
M.625	0	0.000E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
0"	0	0.000E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
; GAL	0	2.082E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
IISTER	0	8.976E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
NISTER	0	3.851E-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
SK. 4.	0	0.000E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
SK. 6"	0	0.000E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
SK. 12	0	0.000E+00	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00
				0.000E+00	0.000E+00		

Table 8.9. Soil contaminated

		RAD LEVEL AT CONTACT		(ACTIVITY)		
	VOLUME OF WASTE (m^3)	MAXIMUM RAD LEVEL (mR/hr)	AVERAGE RAD LEVEL (mR/hr)	TOTAL Pu CURIES	TOTAL OF ALL ACTIVITY (Ci)	TOTAL OF TRU-ALPHA (Ci)
CH-WASTE						
NOT CONTAINED	<60000	UNK	UNK	UNK	UNK	UNK
RH-WASTE						
NOT CONTAINED	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

aminated with TRU nuclides

	WEIGHT DIST.					
TAL OF NON-ALPHA Ci)	TOTAL WEIGHT (Kgs)	AVERAGE DENSITY (Kgs/m^3)	AVERAGE HEAT OUTPUT (W/m^3)	FINES CONTENT (YES/NO)	NON-RAD HAZARDOUS MATERIAL	SS MATERIAL DESIGNATION
UNK	UNK	UNK	UNK	NA	UNK	
0.00E+00	0.000E+00	0.000E+00	0.000E+00			

SPECIAL CASE TRU WASTE

Table

	NUMBER OF CONTAINERS	VOLUME OF CONTAINER (M^3)	AVE. PACK. EFF. OF CONTAINERS	VOLUME OF WASTE (METERS^3)	VOLUME OF WASTE CONT. (METERS^3)
CH-WASTE					
DRUMS					
GAL-30	0	1.136E-01	0.0000	0.000E+00	0.000E+00
GAL-55	0	2.082E-01	0.0000	0.000E+00	0.000E+00
				0.000E+00	0.000E+00
BOXES					
74.5"X50.5"X38.5"	0	2.374E+00	0.0000	0.000E+00	0.000E+00
88"X54"X54"	0	4.205E+00	0.0000	0.000E+00	0.000E+00
112"X68"X77"	0	9.610E+00	0.0000	0.000E+00	0.000E+00
68"X54"X38.5"	0	2.317E+00	0.0000	0.000E+00	0.000E+00
88"X48"X48"	0	3.323E+00	0.0000	0.000E+00	0.000E+00
THREE METER CUBED	0	3.000E+00	0.0000	0.000E+00	0.000E+00
NON-STANDARD BOX*	0		0.0000	0.000E+00	0.000E+00
				0.000E+00	0.000E+00
				0.000E+00	0.000E+00
RH-WASTE					
OTHER CONTAINER	0	0.000E+00	0.0000	0.000E+00	0.000E+00
WOOD OR METAL BOX	0	5.644E+00	0.0000	0.000E+00	0.000E+00
LONG RH-CANISTER	0	8.976E-01	0.0000	0.000E+00	0.000E+00
SHORT RH-CANISTER	0	3.851E-01	0.0000	0.000E+00	0.000E+00
CONCRETE CASK, 4.	0	1.658E+00	0.0000	0.000E+00	0.000E+00
CONCRETE CASK, 6"	0	1.658E+00	0.0000	0.000E+00	0.000E+00
CONCRETE CASK, 12	0	6.569E-01	0.0000	0.000E+00	0.000E+00
SS CAPSULES (WT)	54	1.253E-01	1.0000	6.766E+00	6.766E+00

Note: SS-wells' Material Activity %

Co-60	12.28
Cs-137	1.77
Pu-239	0.23
Pu-240	0.17
Pu-241	1.82
Sr-90	68.42
MFP	14.72
UNID	0.59

Table 8.8. Stored and newly generated waste to be left on-site:
waste deemed not to be certifiable through the year 2013

	RAD LEVEL AT CONTACT		(ACTIVITY)			WEIGHT DIST.		
VOLUME OF WASTE CONT. (METERS^3)	MAXIMUM RAD LEVEL (mr/hr)	AVERAGE RAD LEVEL (mr/hr)	TOTAL Pu CURIES	TOTAL OF ALL ACTIVITY (CURIES)	TOTAL OF TRU-ALPHA (CURIES)	TOTAL WEIGHT (Kgs)	AVERAGE DENSITY (Kgs/m^3)	AVER HEA (WA
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00							ERR	
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00							ERR	
0.000E+00							ERR	
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	ERR	0.
6.766E+00	>10000	>200	3.25E+02	7.38E+04	3.01E+02	2.552E+03	3.772E+02	7.

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GHT DIST.

AL GHT js)	AVERAGE DENSITY (Kgs/m^3)	AVERAGE HEAT OUTPUT (WATTS/M^3)	FINES CONTENT (YES/NO)	NON-RAD HAZARDOUS MATERIAL	SS MATERIAL DESIGNATION
.00[illegible]E+00	ERR	0.000E+00			
.00[illegible]E+00	ERR	0.000E+00			
	ERR				
.00[illegible]E+00	ERR	0.000E+00			
.00[illegible]E+00	ERR	0.000E+00			
.00[illegible]E+00	ERR	0.000E+00			
.00[illegible]E+00	ERR	0.000E+00			
.00[illegible]E+00	ERR	0.000E+00			
.00[illegible]E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00			
	ERR				
	ERR				
.00[illegible]E+00	ERR	0.000E+00			
[illegible]E+00	ERR	0.000E+00			
[illegible]E+00	ERR	0.000E+00			
[illegible]E+00	ERR	0.000E+00			
[illegible]E+00	ERR	0.000E+00	0	0	0
[illegible]E+00	ERR	0.000E+00	0	0	0
[illegible]E+00	ERR	0.000E+00	0	0	0
.[illegible]E+03	3.772E+02	7.200E+00	N	N	See note below.

	NUMBER OF CONTAINERS	VOLUME OF CONTAINER (m^3)	AVE. PACK. EFF. OF CONTAINERS	VOLUME OF WASTE (METERS^3)	VOLUME OF WASTE CONT. (METERS^3)	RAD LEV MAXIM RAD LEV (mR/hr)
CH-WASTE						
DRUMS						
GAL-30	0	1.136E-01	0.0000	0.000E+00	0.000E+00	0.00E
GAL-55	0	2.082E-01	0.0000	0.000E+00	0.000E+00	0.00E
				0.000E+00	0.000E+00	
NOT CONTAINED	NOT APPLIC.	6200	NOT APPLIC.	0.000E+00	NOT APPLIC.	<900
BOXES						
74.5"X50.5"X38.5"	0	2.374E+00	0.0000	0.000E+00	0.000E+00	0.00E
88"X54"X54"	0	4.205E+00	0.0000	0.000E+00	[illegible]	0.00E
112"X68"X77"	0	9.610E+00	0.0000	0.000E+00	[illegible]	0.00E
68"X54"X38.5"	0	2.317E+00	0.0000	0.000E+00	0.000E+00	0.00E
88"X48"X48"	0	3.323E+00	0.0000	0.000E+00	0.000E+00	0.00E
THREE METER CUBED	0	3.000E+00	0.0000	0.000E+00	0.000E+00	0.00E
NON-STANDARD BOX*	0		0.0000	0.000E+00	0.000E+00	0.00E
WOOD OR METAL	0	0.000E+00	0.9000	0.000E+00	0.000E+00	1.20E
				0.000E+00	0.000E+00	
				0.000E+00	0.000E+00	
				0.000E+00	0.000E+00	
BINS						
M III	0	3.398E+00	0.0000	0.000E+00	0.000E+00	0.00E
M-4	0	3.323E+00	0.0000	0.000E+00	0.000E+00	0.00E
120 CU FT BIN	0	3.398E+00	0.0000	0.000E+00	0.000E+00	0.00E
				0.000E+00	0.000E+00	
				0.000E+00	0.000E+00	
				0.000E+00	0.000E+00	
				0.000E+00	0.000E+00	
RH-WASTE						
ONE GALLON	0	3.785E-03	0.0000	0.000E+00	0.000E+00	0.00E
FIVE GALLON	0	1.893E-02	0.0000	0.000E+00	0.000E+00	0.00E
THIRTY GAL	0	1.136E-01	0.0000	0.000E+00	0.000E+00	0.00E
Fe DRUM, 55 GAL	1	2.082E-01	1.0000	2.082E-01	2.082E-01	1.00E
OTHER	7	9.500E+00	1.0000	6.650E+01	6.650E+01	1.00E
WOOD OR METAL BOX	66	5.644E+00	1.0000	3.725E+02	3.725E+02	6.00E
CONCRETE CASK, 4.	0	1.658E+00	0.0000	0.000E+00	0.000E+00	0.00E
LONG RH-CANISTER	0	8.976E-01	0.0000	0.000E+00	0.000E+00	0.00E
SHORT RH-CANISTER	0	3.851E-01	0.0000	0.000E+00	0.000E+00	0.00E
CONCRETE CASK, 6"	0	1.658E+00	0.0000	0.000E+00	[illegible]	0.00E
CONCRETE CASK, 12	0	6.569E-01	0.0000	0.000E+00	0.000E+00	0.00E
NOT CONTAINED						

Table 8.10. Buried TRU Waste

		RAD LEVEL AT CONTACT		(ACTIVITY)			WEIGHT DIST.	
OF ^3)	VOLUME OF WASTE CONT. (METERS^3)	MAXIMUM RAD LEVEL (mR/hr)	AVERAGE RAD LEVEL (mR/hr)	TOTAL Pu CURIES	TOTAL OF ALL ACTIVITY (CURIES)	TOTAL OF TRU-ALPHA (CURIES)	TOTAL WEIGHT (Kgs)	AVERAGE DENSITY (Kgs/m^3)
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00							E
E+00	NOT APPLIC.	<9000	<200	Unk	2.70E+02	2.70E+02	Unk	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	1.20E+02						E
E+00	0.000E+00							E
E+00	0.000E+00							E
E+00	0.000E+00							E
								E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00							E
E+00	0.000E+00							E
E+00	0.000E+00							E
E+00	0.000E+00							E
								E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E-01	2.082E-01	1.00E+00	1.00E+00	0.00E+00	2.50E-01	2.50E-01	4.540E+01	2.181E+
E+01	6.650E+01	1.00E+02	1.90E+01	2.21E-02	1.14E+01	4.97E+00	7.127E+03	1.072E+
E+02	3.725E+02	6.00E+02	3.99E+01	4.90E+00	1.97E+02	7.09E+01	6.537E+04	1.755E+
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E
E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000E+00	E

DIST.

L. NT)	AVERAGE DENSITY (Kgs/m^3)	AVERAGE HEAT OUTPUT (WATTS/m^3)	FINES CONTENT (YES/NO)	NON-RAD HAZARDOUS MATERIAL	SS MATERIAL DESIGNATION
.000E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00			
	ERR				
Unk	ERR	<0.3			
.000E+00	ERR	C.000E+00			
.000E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00			
	ERR		N	N	
	ERR				
	ERR				
	ERR				
	ERR				
.000E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00			
	ERR				
	ERR				
	ERR				
	ERR				
	ERR				
.000E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00	0	0	
.540E+01	2.181E+02	3.090E-02	N	N	
.127E+03	1.072E+02	2.200E-03	N	N	c
.537E+04	1.755E+02	5.400E-03	N	N	c
.000E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00			
.000E+00	ERR	0.000E+00			

	NUMBER OF CONTAINERS	VOLUME OF CONTAINER M^3	AVE. PACK. EFF. OF CONTAINERS	VOL WAS MET
CH-WASTE				
DRUMS				
GAL-30, SS	11	1.136E-01	0.9000	1
GAL-55, SS	65	2.082E-01	0.9000	1
GAL-55, Fe	36	2.082E-01	0.9000	6
NOT CONTAINED	NOT APPLIC. 0	NOT APPLIC. 0	NOT APPLIC.	0
BOXES				
74.5"X50.5"X38.5"	0	2.374E+00	0.0000	0
88"X54"X54"	0	4.205E+00	0.0000	0
112"X68"X77"	0	9.610E+00	0.0000	0
68"X54"X38.5"	0	2.317E+00	0.0000	0
88"X48"X48"	0	3.323E+00	0.0000	0
THREE METER CUBED	0	3.000E+00	0.0000	0
NON-STANDARD BOX*	0		0.0000	0
				0
GAL-30, Fe	1	1.136E-01	1.0000	1
				0
				0
BINS				
M III	0	3.398E+00	0.0000	0
M-4	0	3.323E+00	0.0000	0
120 CU FT BIN	0	3.398E+00	0.0000	0
				0
				0
				0
				0
RH-WASTE				
ONE GALLON	0	3.785E-03	0.0000	0
FIVE GALLON	0	1.893E-02	0.0000	0
THIRTY GAL	0	1.136E-01	0.0000	0
FIFTY FIVE GAL	0	2.082E-01	0.0000	0
CAN 12"X60"	0	3.707E-02	0.0000	0
CYLIND. 1'X 6'	0	4.448E-02	0.0000	0
FIVE CUBIC FT	0	1.416E-01	0.0000	0
LONG RH-CANISTER	0	8.976E-01	0.0000	0
SHORT RH-CANISTER	0	3.851E-01	0.0000	0

Table B.11. Stored waste to be managed as low level

				RAD LEVEL AT CONTACT		(ACTIVITY)	ACTIVITY		WE
F R	AVE. PACK. EFF. OF CONTAINERS	VOLUME OF WASTE METERS^3	VOLUME OF WASTE CONT. METERS^3	MAXIMUM RAD LEVEL mr/hr	AVERAGE RAD LEVEL mr/hr	TOTAL Pu CURIES	TOTAL OF ALL ACTIVITY (CURIES)	TOTAL OF TRU-ALPHA CURIES	TOT WEI Kgs
[illegible]	0.9000	1.124E+00	1.249E+00	<100	<10	6.10E-03	9.83E+00	9.91E+00	5
[illegible]	0.9000	1.218E+01	1.353E+01	<100	<10	2.65E+00	6.90E+01	6.72E+01	3
[illegible]	0.9000	6.746E+00	7.495E+00	<100	<10	1.31E+03	3.18E+03	3.18E+03	1
[illegible]	NOT APPLIC.	0.000E+00	NOT APPLIC.	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
[illegible]	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
[illegible]	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
[illegible]	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
[illegible]	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
[illegible]	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
[illegible]	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
		0.000E+00	0.000E+00						
-01	1.0000	1.136E-01	1.136E-01			6.14E-01	6.14E-01	6.02E-01	3
		0.000E+00	0.000E+00						
		0.000E+00	0.000E+00						
[illegible]	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
[illegible]	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
[illegible]	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
		0.000E+00	0.000E+00						
		0.000E+00	0.000E+00						
		0.000E+00	0.000E+00						
		0.000E+00	0.000E+00						
-03	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
-02	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
-01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
+02	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
+02	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
+01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
+01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
+01	0.0000	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

Level

WEIGHT DIST.

L OF -ALPHA ES	TOTAL WEIGHT Kgs	AVERAGE DENSITY Kgs/m^3	AVERAGE HEAT OUTPUT WATTS/M^3	FINES CONTENT (YES/NO)	NON-RAD HAZARDOUS MATERIAL	SS MATERIAL DESIGNATION	PROPOSED DISPOSAL LOCATION
9.91E+00	5.000E+02	4.003E+02	2.215E-01	N	N	d	Onsite
6.72E+01	3.391E+03	2.506E+02	1.581E-01	N	N	d	Onsite
3.18E+03	1.239E+03	1.653E+02	1.243E+01	N	N	d	Onsite
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
		ERR					
6.02E-01	3.400E+01	2.993E+02	1.760E-01				
		ERR					
		ERR					
		ERR					
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
		ERR					
		ERR					
		ERR					
		ERR					
		ERR					
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				
0.00E+00	0.000E+00	ERR	0.000E+00				

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