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7. Abstract

Solid TRU retrieval, Phase 1 is scheduled to commence operation in 1998 at 218W-4C-T01 and complete recovery of the waste containers in 2001. Phase 2 Retrieval will recover the remaining buried TRU waste to be retrieved and provide the preliminary characterization by non-destructive means to allow interim storage until processing for disposal. This document reports on researching the characterization documents to determine the types of wastes to be retrieved and where located, waste configurations, conditions, and required methods for retrieval. Also included are discussions of wastes encompassed by Phase 2 for which there are valid reasons to not retrieve.

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INTRODUCTION

Since about 1989 when solid transuranic (TRU) waste retrieval engineering studies were begun, several iterations in the overall strategy for the Hanford TRU retrieval program have occured. This document is to report on an investigation and organization of buried TRU waste data in a manner primarily related to retrieval. From this, in context with other solid waste management program elements, an updated strategy for recovery of the retrievable, buried, solid TRU waste is developed and proposed. The retrieval scope is limited to the segregated, post-May 1970 TRU (with one exception), addressed as the preferred alternative in the Hanford Defense Waste Environmental Impact Statement Record of Decision (HDW-EIS ROD). The exception is the TRU contained in caissons in the 618-11 burial ground and the ROD includes the possibility that additional pre-1970 TRU retrieval could be added later on the basis of additional study and evaluations.

The retrievable buried storage containers are located in 25 trenches in the low-level waste burial grounds in the Hanford 200 East and 200 West Areas. Some of the trenches contain retrievable TRU waste in distinctively separate locations with disposed waste (waste not buried for retrieval) buried between. One LLW disposal trench contains only one TRU waste drum and several other trenches have very small quantities of TRU drums or boxes. Three trenches contain mostly boxed waste, one trench contains only six casks stored for retrieval, several others contain only drums for retrieval, and others while primarily storing drums contain a significant number of boxes and other TRU containers.

The first phase of retrieval has been defined and is a FY 1994 Line Item Project, with start of retrieval scheduled for 1998. The Project, W-113, consists of the equipment and facilities for the recovery of the waste in one trench in 200 West Area containing only buried waste containers stored for retrieval. The Project W-113 trench (218W-4C-T04) contents are no longer of interest in terms of strategy and planning for the remaining retrieval project(s).

This report also does not deal with the waste stored in four large, buried concrete "caissons" (Alpha Caissons) in Burial Ground 218W-4B. Engineering reports have been completed for Alpha Caisson Retrieval (proposed Project W-156) and a retrieval methodology and concept are recommended. It is also planned to retrieve similar wastes from "caissons" in the 618-11 burial ground site (located near the Washington Public Supply System) as part of the remediation of this site.

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1.0 SUMMARY

By means of records and characterization documents, the wastes that were catagorized as TRU solid waste and buried in trenches at Hanford for future retrieval, characterization, and eventual disposal have been further characterized. "Mapping" of specific waste containers at specific locations was accomplished for trenches of the four Low Level-Waste burial grounds in the 200 East and 200 West Areas containing the buried TRU waste to be retrieved.

Overall, there are about 475 Kg of plutonium and other transuranic nuclides contained in the waste targeted for retrieval from 25 trenches. About 107 Kg transuranics will be removed during Phase 1 Retrieval. Of the remaining trenches containing about 370 Kg transuranics, the largest amount contained in a single trench is almost half of the 370 Kg. This trench is located next to the Phase 1 trench in Burial Ground 218W-4C. Table 1-1 summarizes the waste by quantity of transuranics by burial ground and by trench (Phase 1 not included).

It may be noted that 47 Kg of transuranics are contained in casks. These contain irradiated reasearch fuels and related materials (Reactor Irradiated Nuclear Material). This material is easily retrievable without disrupting any of the other containers in the trenches. The casks in 218W-4C-T01 are stored in the open on the uncovered portion of the asphalt floor of the trench. Also readily accessible are other waste containers stored in the open on asphalt in trenches 218W-4C-T01, T20, and T29. There are over 1000

TABLE 1-1
SUMMARY OF TRANSURANIC NUCLIDES
BY BURIAL GROUND AND TRENCH

BURIAL GROUND	TRENCH	TOTAL DRUMS	TRU IN Kg	TOTAL BOXES	TRU IN Kg	TOTAL TRU - Kg
218E-12B						0.2
	17	2660	0.13	60	0.03	0.2
	27	240	0.014			0.01
218W-3A						28.7
	S6			6 CASKS	9.8	9.8
	S9	70	0.027			0.03
	01	4	0.00004			0.00004
	04	143	0.011			0.01
	05	360	1.2			1.2
	06	2182	3.25	7	0.186	3.4
	08	460	2.0	53 22 CASKS	0.43 4.7	7.1
	10	3	0.00003			0.00003
	15	7	0.00007			0.00007
	17			112	7.06	7.1
	23	6	0.0006	8	0.003	0.004
	30	29	0.019	5	0.0024	0.02
	32			2	0.0013	0.001
	34			5	0.0008	0.0008
218W-4B						56.0
	V7	1320	3.0			3.0
	07	8080	47.3	67	1.0	48.3
	11	3140	3.26	106	1.46	4.7
218W-4C						286.6
	01	5080	142.4	124 46 CASKS	3.7 32.7	178.8
	07	67 13 CASKS	0.16 0.013	73	8.46	8.6
	19	1	0.00015			0.0002
	20	613	37.0	29	2.4	39.4
	29	2544	58.5	10	1.25	59.8
GRAND TOTALS			298.4 Kg		73.2 Kg	371.5 Kg

drums, 15 boxes, and about 80 "PR Cans" stored in this manner. These containers account for an additional 12 Kg of transuranic nuclides in drums and about 2 Kg in boxes.

It can be seen from the table that drum retrieval from trenches 01, 20 and 29 in burial ground 218W-4C and from trench 07 and V7 in burial ground 218W-4B accounts for 288 Kg of the 300 Kg transuranics contained in the drums to be retrieved (96%). It will also account for 15,000 of the 27,000, (55%) drums to be recovered.

Two trenches in 218W-4C and one trench in 218W-3A account for 270 mostly very large boxes out of 620 boxes total, or about 45%. According to burial records boxes contain about 26 Kg TRU and the boxes in these three trenches contain about 18 Kg TRU (70%).

The basis for the retrieval strategy includes a framework of current planning dates of availability of facilities that will process or store the waste containers to be retrieved. The containers are contact handled (CH) 55 gallon drums; CH containers other than 55 gal drums which include larger drums, boxes of various sizes and materials, and miscellaneous shapes such as culverts (capped) and tanks; remote handled (RH) containers of all types; and casks and other containers with RH contents to be processed for disposal. The facilities are WRAP Module 1 for processing and characterization of the TRU and low-level waste (LLW) 55 gallon drums from retrieval; WRAP Module 2B for processing and characterization of the boxes, RH containers, and containers containing shielded RH contents; Phase V Storage for receiving CH drums and a

limited number of CH boxes for interim storage until batched into WRAP Module 2B. All of the planning dates are consistent with 2020 WIPP closure.

Within the framework of planning dates the crux of the strategy is keep uncontained plutonium contamination from the retrievably stored buried containers to a minimum and worker safety at a maximum. This is consistent with Phase 1 Retrieval recovering a large number of mostly low dose rate drums containing almost one-fourth of the total post 1970 transuranium nuclides to be retrieved with low potential of contamination release and a quantity of boxes that will not exceed the planned box storage capacity.

Continuing to retrieve from the trenches with containers least likely to be degraded by long term buried storage coincidentally yields about 95% of the post 1970 transuranics, providing the largest return on investment in cost, environmental risk reduction, and worker safety.

Most of the remaining 5% of the TRU is in containers already potentially degraded and the most likely to have released radiological contaminants. The distribution of the transuranic nuclides is such however, that nuclear safety or criticality is not at issue during continued storage. This is also the waste that will require special handling and containment systems during retrieval that can't be acquired until about 2005 within the framework of the current planning dates.

The key elements of the retrieval strategy are:

1)..Descoping of seven trenches from the TRU waste to be retrieved with levels of gamma radiation so intense or contamination potential so high and the quantities of TRU so low that the risk of retrieval outweighs the incremental risk of not retrieving. This assumes burial ground closure without identification and recovery of pre-1970 TRU waste.

2)..As soon as equipment and manpower are available, disinter and remove for CWC storage, the low-level mixed waste containers in 218W-3A-TS3 and TS6. The 5 EBR II casks in 218W-3A-TS6 could be moved to another location at this time to facilitate future recovery.

3)..In the near term, place as many of the burial ground 218W-4C uncovered TRU waste drums into central waste complex storage as allowed by TRU storage limits for the buildings.

4)..Review with WIPP Waste Acceptance organization the Hanford records for identifiable "batches" of TRU drums that are acceptable or that would be negotiable for acceptance based on records characterization verified by retrieval NDA/NDE and could be loaded directly into the WIPP/Trupact-II Standard Waste Box (SWB) or other approved overpack box.

5)..Utililization of the Phase 1 Retrieval Project facilities and equipment for the first years of Phase 2 Retrieval (Project W-221) while recovering about 95% of the waste drums left after Phase 1.

6)..Design modifications for the Phase 1 Retrieval Facility so that the facility can be modified or a new facility procured for retrieval of older drums with higher potential of degradation which are stored in the Phase 1 configuration.

7)..Placing a box characterization and storage facility at the emptied trench of the Phase 1 Project to allow removal of boxes from trenches being retrieved without excessive large box storage capacity required in the Phase V Storage facility.

8)..Relocate the box characterization facility to 218W-3A-T17 or provide a second facility for the retrieval of this trench and to support retrieval of boxes from other trenches in the 218W-3A burial ground.

9)..Retrieval of boxes in the open during meterological windows of opportunity, except for box retrieval from trenches with high potential of contamination.

10)..Prepare a place in the burial grounds for cask storage. Casks can be relocated at any time without interference from other containers stored for retrieval. However, the casks in 218W-4C-TO1 require removal prior to retrieval of the other containers in the trench.

11)..Provide a temporary facility with containment features for the above ground retrieval of 218W-4B-TV7.

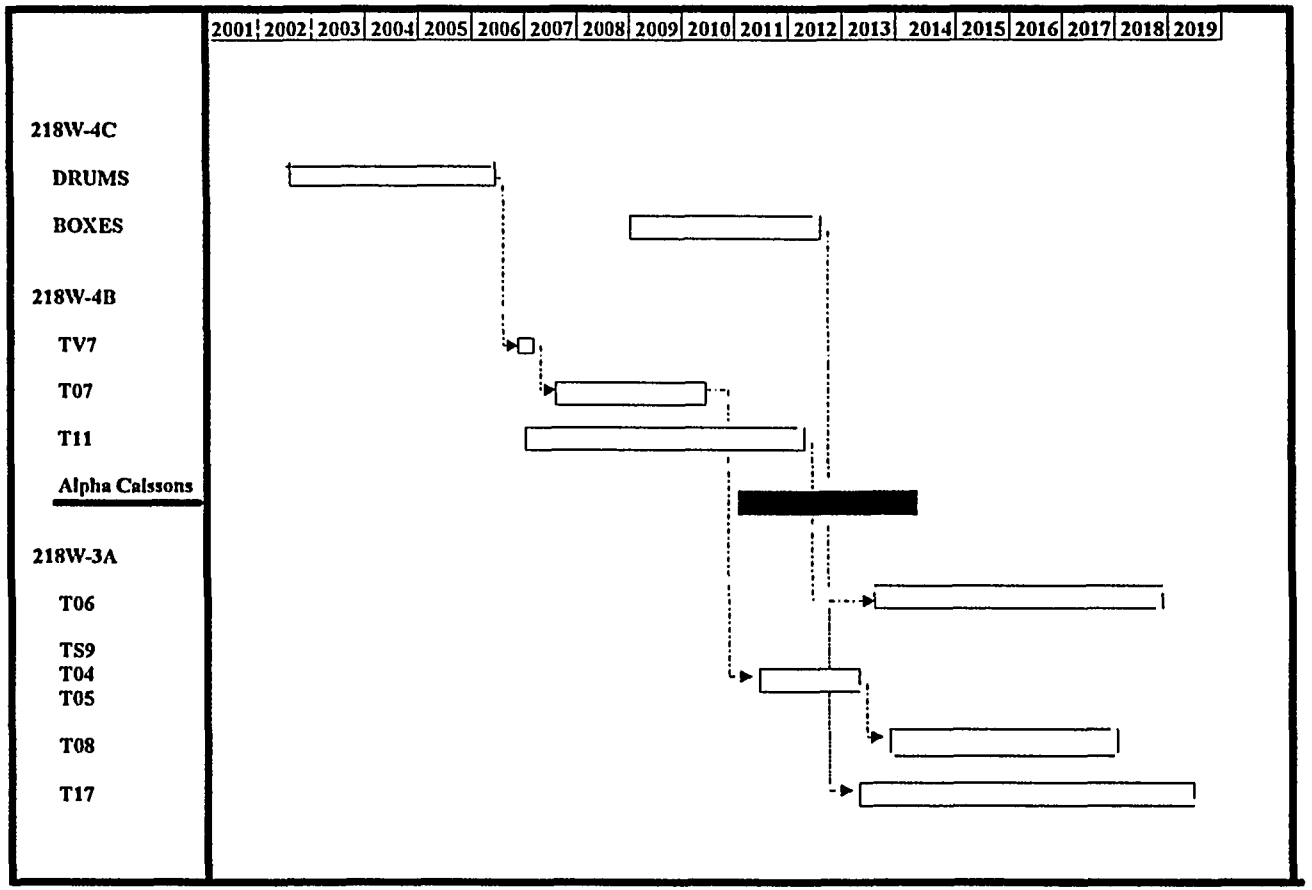
12)..Provide two facilities designed to access and retrieve buried containers from grade (vertical recovery) - one designed to retrieve and repackage contaminated containers and package contaminated soils as required and the other utilizing the presumably uncontaminated assay and inspection equipment carried over from Phase 1 to retrieve the remaining trenches expected to contain "good" drums.

13)..Petition the WDOE and EPA to treat all waste as low-level waste that does not assay to be TRU, or that is accepted as non-TRU by burial record quantities that represent less than 100 nCi/g, and is not characterized by the records or labels to contain hazardous waste.

14)..With the present projection that there will not be an RH facility until at least 2010, and since there is presently no storage capability defined for retrieved RH it is now assumed that the low-level waste burial ground closures included in the Part B Permit application will be extended where required.

Figure 1-1 is a timeline for phase 2 retrieval and Alpha caisson retrieval assuming funding will be available to complete the functional criteria documents in FY 2000.

Figure 1-1
SOLID TRU RETRIEVAL PHASE 2



2.0 DISCUSSION

Strategy elements five and six, utilization of the Phase 1 retrieval equipment and facility, encompasses seven trenches containing 345 Kg TRU of the 372 Kg in the trenches designated for Phase 2 retrieval of TRU solid wastes. If the casks are considered separately the numbers are 312 Kg of 324 total. Thirty-three out of 47 Kg of transuranics in casks are in this group of seven trenches.

Of the other seventeen remaining trenches designated for retrieval, four do not contain enough transuranics in any of the very few containers recorded as TRU waste to qualify as TRU containers by the present day standard of 100 nCi/g and are no longer considered for retrieval. These are trenches 01, 10, 15 and 34; all located in burial ground 218W-3A.

Another eight trenches altogether contain only 260 grams of transuranics or 0.05 % of the total targeted for retrieval (including Phase 1). Six of these exhibit attributes, including high dose environments, justifying a proposal to redesignate and descope from the TRU retrieval program. These are 218E-12B trenches 17 and 27; 218W-3A trenches 23, 30 and 32; and trench 218W-4C-T19.

Burial ground 218W-3A has two trenches containing drum modules managed as TRU but with low-level wastes only, according to the information supplied with shipping records from Rocky Flats ("0" listed for the plutonium quantity). These are drums showing separate "disposal" dates in the burial records and are distinctly separate modules based on correspondence in the files describing the requirement for same-day cover placement (including the plastic tarp) for Rocky Flats waste. These modules could be treated the same as shipments of disposed of LLW in the same trenches.

When TRU Waste segregation began in May 1970 by order of the Atomic Energy Commission per Immediate Action Directive 0511-21 it was required that all AEC sites would segregate wastes with known or detectable contamination of transuranium nuclides. In 1973 a limit of 10 nCi/g was established to segregate transuranic (TRU) waste from low-level waste. In 1982 the present value of 100 nCi/g of alpha emitting isotopes higher than Atomic Number 92 and with half-life greater than 20 years was established as the segregation limit. Hanford also manages ^{233}U and Radium sources as TRU.

Many of the containers in the early burials for TRU retrieval no longer meet the TRU definition. It is estimated that about 60% of the drums to be recovered during Phase 1 retrieval are actually low-level waste. For the remainder of the waste which is under consideration here as Phase 2 Retrieval, approximately 11,600 of a total of 27,000 drums (43%) would be low-level waste. Also, approximately 230 of the 650 boxes to be retrieved in Phase 2 (35%) would be low-level waste. Table 2-2 shows the approximate distribution of the TRU containers and LLW containers by trench.

Trenches 01 and 29 in burial ground 218W-4C will yield a large number

of TRU drums compared to LLW and show good potential for generating reasonably sized TRU drum batches for WRAP 1 processing, except for 700 drums in 218W-4C-T01 containing plutonium-rich soils mined from the Z-9 crib which will need special processing. However, they are the last drums at the east end of the trench and could be isolated for later retrieval. These two trenches in burial ground 218W-4C and a portion of 218W-4B-T07 have common storage module and trench configuration, containers assumed to be in generally good condition with minimal or no contamination, and low gamma dose rates. These are the characteristics of 218W-4C-T04 which will be retrieved during Phase 1, suggesting that Phase 2 Retrieval (Project W-221) can begin by utilizing the equipment and facilities developed for Phase 1, when Phase 1 is completed some 3 1/2 years after start-up.

The logical place to begin Phase 2 with the existing facilities would be at 218W-4C-T01, the next trench to the north of 218W-4C-T04. The Phase 1 support buildings could remain in place and the utilities could be easily redistributed. Only the trench enclosure which is designed for relocation and the in-trench mobile equipment need be moved. Reasonably quick access to another 5100 drums would thus be achieved with minimal cost of preparation. The next trench in the retrieval sequence that could employ the Phase 1 systems, following relocation, is 218W-4C-T29 which will yield another 2500 TRU drums with minimal interference to drum retrieval by boxes.

It is recommended that retrieval of boxes from the burial grounds be deferred until a facility is available for processing them, if possible, as a storage economy. A portion or all of 218W-4C-T04 could be left open (or provided with a protective structure) following Phase 1 Retrieval to be used as an interim storage facility for the boxes so as to remove them away from interferring with drum retrieval as quickly as possible. Phase 1 Retrieval experience will provide data for evaluation of the need for overpacks for the large steel and FRP boxes. Trench 20 in burial ground 4C is primarily a box trench with 200 of the 400 TRU drums (at the back of the trench) those from EXXON with plutonium oxide, processed mixed oxide, and fabricated fuel wastes. These have multiple layers of containment and a birdcage configuration with the implication that they will be WRAP 2B candidates. All of the other drums in trench 20 can be retrieved without disturbing the buried boxes. Also principally a box trench in burial ground 4C, trench 07 has 67 drums and 13 concreted drums ("casks") containing irradiated fuel from the Oregon State University TRIGA research reactor. These can be recovered at any time without disturbing the other buried containers in this trench.

The next trench in the suggested sequence utilizing the same retrieval facilities and equipment is 218W-4B-T07 which contains 8000 drums, of which about 40% will be TRU. The retrieval facilities should be modified for recovery of the earliest drums buried in this trench to accommodate drum deterioration and potential contamination. There will be drums in this trench likely to have exceeded 35 years buried when they are retrieved. Assuming a 1998 start of Phase 1 Retrieval it is estimated 4B-T07 will be finished in 2009. At this time about 26,000 drums will have been recovered including

TABLE 2-2
SUMMARY OF WASTE CONTAINERS BY WASTE TYPE
BY BURIAL GROUND AND TRENCH

BURIAL GROUND	TRENCH	TRU DRUMS	LLW DRUMS	TRU BOXES	LLW BOXES
218E-12B					
	17	320	2340	8	52
	27	70	170		
218W-3A					
	S6			5 CASKS	1 CASK
	S9	6	64		
	01		4		
	04	11	132		
	05	205	155		
	06	1733	449	1	6
	08	225	235	34[1] 22 CASKS[1]	19
	10		3		
	15		7		
	17			77	35
	23	6		8	
	30	29		4	1
	32			2	
	34				5
218W-4B					
	V7	405	915		
	07	3174	4906	37	30
	11	1826	1314	77	29
218W-4C					
	01	4370	710	101[2] 46 CASKS[2]	13
	07	18[3] 13 CASKS[3]	49	39	34
	19	1			
	20	425	188	26	3
	29	2532	12	10	
GRAND TOTALS		15,360	11,640	416	222

1.....Concrete blocks with cylindrical cask liners.
2.....34 are Stainless Steel EBR II casks, one is Zircalloy, and 11 are Hulls Disposal Casks.
3.....55 gallon drums - void space concreted.

Phase 1, of which about 14,000 will be TRU drums. Also 405 Kg of the 475 total retrievable transuranic inventory will be retrieved including that in the Phase 1 boxes and the 218W-4C-T01 casks.

Of the remaining trenches, 218W-4B-TV7 is a special case which can be retrieved from the concrete structure without below grade excavation. A minimal temporary facility is proposed which will be designed to fit to the storage structure after the soil and the roof are removed so as to provide containment during drum retrieval. Only 1300 drums are stored in this structure of which 400 are expected to assay as TRU drums.

Two more trenches have waste containers stored as TRU in a manner conducive to entry to the trench at one end and continuously excavating and removing waste horizontally along the trench floor (Phase 1 Retrieval method). These trenches, 218W-3A-T06 and 218W-4B-T11, however are "V" trenches which would require considerable excavation beyond the original excavation to create working space on the trench floor. The original bottom width of 4B-11 was eight feet and 3A-06 was dug with no bottom dimension and a slope of 1:1. This complicates the excavation and would require shoring just to avoid intrusion into the neighboring trench. The recommended retrieval procedure is to utilize facilities on grade and dig down to retrieve the containers. These two trenches contain some of the oldest drums, stored directly in soil, and laid on their sides. It must be expected that many of these will be badly deteriorated and the retrieval operations will have to be prepared for general contamination. The alpha contamination will probably not be extreme in that none of the drums contain more than a few grams transuranics except one drum in 4B-11 with 117 grams plutonium recorded. There does not appear to be any significant gamma radiation doses in these trenches nor any potential atmospheric releases that would approach the off-site and on-site dose limits, so the principal safety consideration will be to contain the spread of contamination for worker safety. The other major criterion is the ability to repackage breached containers and contaminated soils. An effective means of continuous or frequent soils sampling and analysis should be sought through technology development for the retrieval of these trenches, in particular.

The TRU waste drums in trenches 218W-3A-TS9, T04, T05, and T08 are from Rocky Flats except for 100 drums in T08. T08 also contains a number of boxes including the 22 concrete casks containing cask liners with irradiated fuel materials from research facilities. These are separately retrievable. The drums from Rocky Flats are supposedly draped in plastic for protection from the soil and should be in good condition, are not recorded as having high dose rate, and contain no high levels of TRU in any of the containers. The TRU waste in these trenches occurs in isolated batches with soil and/or batches of disposed low-level waste between. Also they are all "V" trenches with no width at the bottom, driving the choice of retrieval system for these trenches to one that digs vertically exposing only the containers to be retrieved. The design should be such that a contaiment system could be accommodated but it will probably not be neccessary.

Box retrieval will begin when WRAP 2B is available or when burial ground closure schedules require that work in the trenches be completed, whichever

happens first. By 2009 there would be 250 boxes relocated to 218W-4C-T04. It is proposed that the function of storing relocated boxes in 218W-4C-04 include TRU assay and box opening and characterization for those that are low-level waste to determine if they are mixed waste or can be directly disposed in an active LLW trench. Based on the burial records this would eliminate the need for performing this characterization in WRAP 2B on about 165 boxes from this trench and trenches 4C-07 and 4C-20. After box retrieval from the two burial ground 218W-4C box trenches with assay and characterization, as applicable, performed in trench 4C-04, this facility will be available to perform the pre-characterization on boxes from the 218W-4B trenches by appropriate scheduling. The characterization equipment can then be relocated to a facility at 218W-3A-T17 for those boxes and boxes retrieved from other 218W-3A trenches, principaly trench 08. If desireable or necessary the characterization equipment could be kept at 218W-4C-T04 and a new facility provided at 218W-3A-T17 with both operating simultaneously.

The recommendation for the method for box retrieval is to reverse the method used to place them in the trenches: remove the overburden, remove the boxes with a crawler crane placing them on a flatbed trailer, overpack the box if necessary and transport them to trench 4C-04 or 3A-17 for assay, inspections and overpack. When Wrap 2B is available, transport them for continued processing or if they must be removed earlier, transport to Phase V Storage. Whether the pre-processing occurs in the field or at WRAP 2B, it is estimated that retrieving and characterizing the boxes as described will require about ten years.

3.0 BACKGROUND

A strategy plan was developed in Fiscal Year 1993 for "Phase 2" retrieval (W-221) of the TRU solid wastes presently stored in a number of trenches in the low-level waste burial grounds. This plan identified the requirement for a large amount of research into chararacterization documents and solid waste records to try to organize the data into catagories and by individual trenches to provide an easy to use base for developing the what, how and when of ththe retrieval strategy.

The results of the data reorganization and compilations have been included in a separate document which supports the conclusions in this document which are based on evaluations of records. This principal reference for the Phase 2 Retrieval Strategy development is *Phase 2 Solid Waste Retrieval Trench Characterizations*, WHC-SD-W221-DP-01 REV 0.

4.0 RETRIEVAL PROGRAM SCOPE REDUCTION

Since 1970 when solid waste with "known or detectable contamination of transuranium nuclides" began to be segregated for placement in retrievable storage, the definition of this TRU waste was changed twice. A segregation limit of 10 nanocuries of transuranium nuclides per gram of waste was defined in 1973 and this limit raised to 100 nCi/g in 1982. Included are transuranium nuclides with half-life greater than 20 years and at Hanford, ^{233}U and Ra sources. The records and data base for the TRU waste stored for retrieval

have not been accordingly updated, resulting in a large number of containers in retrievable storage designated as TRU waste with data recorded for the contents that equate to TRU contamination less than 100 nCi/g.

4.1 Total Low-level Waste Stored as TRU

A summary of the waste containers expected to actually be TRU waste and those expected to assay as low-level waste (LLW) was shown in Table 2.Of the 27,000 drums and 640 boxes to be retrieved subsequent to Phase 1 retrieval, at least 11,640 drums and 222 boxes will be LLW according to a review of burial records data. Only a small number of the containers that will be LLW are characterized as mixed waste by the burial records, mostly by virtue of containing lead. Once verified as LLW by non-destructive assay the waste is no longer of interest in terms of WRAP 1 packaging and certification for disposal at WIPP. At this point some of the options for these LLW containers are to:

a. Perform the radiographic examination and headspace gas testing, overpack, and ship to storage for batching into WRAP 1.

b. If records indicate the presence of hazardous constituents, perform radiography to determine if there are restricted waste management requirements for WRAP 1 and if not, test the headspace gas and ship to storage for batching into WRAP 2A as mixed waste.

c. If mixed waste is not indicated by the records and radiography shows no indication of restricted waste management requirements by WRAP 1 and headspace gas screening shows no indicators for organics, ship a batch sample to WRAP 1 for verification to dispose of the batch as LLW.

d. Bypass the batch sample verification described above and dispose of all waste that qualifies.

e. Bypass the headspace gas screening and the batch sample verification and dispose of the waste as LLW based on the lack of any indicators from radiography.

f. Treat all LLW (including that determined by assay) without recorded hazardous constituents as 1987 pre-land ban disposed waste to be left in the burial ground.

Option "e" above is based on the belief (which will be verifiable during Phase 1 Retrieval or sooner) that the headspace sampling and testing in general will not disprove the presence of hazardous waste. Headspace gas testing should be limited to screening for high concentrations of ignitables.

Many of the LLW containers that were stored as TRU will be in trenches also containing disposed of LLW. A significant reduction in waste handling risks and costs can be realized if upon the determination that the waste is

not TRU and there are no indicators or reason to assume mixed waste, the container can be returned to a trench for eventual final disposal.

4.2 Waste Designation Updates

In order to compile applicable and meaningful data for evaluating waste designations a review was made of facilities' operating histories, the facilities' waste stream characterization reports prepared by Los Alamos Technical Associates (LATA) for WHC, compilations of Pu waste isotopics (high ^{240}Pu), and so on. A review was also made of the timeline of different Hanford production activities from which generalizations can be drawn about the isotopics of Pu wastes associated with operations to produce weapons material, versus experimental fuel, versus FFTF fuel, versus power generation only.

The isotopics of the Pu contamination in Hanford solid waste stem from why the Pu was generated; weapons grade (about 6% ^{240}Pu in the reprocessed product), fuels grade (about 12% 240), or byproduct from N fuel used in BPA power generation (also about 12%); when the Pu was generated, establishing the decay time for ^{241}Pu; and when the spent fuel was reprocessed at PUREX, thereby seperating and removing fission and activation products and ingrown ^{241}Am from the Pu isotopes and establishing the length of time for new ingrowth of ^{241}Am.

On reprocessing the spent fuel to remove the Pu, new ingrowth of ^{241}Am begins from the decay of the relatively short half-life ^{241}Pu which is produced during reactor operation from neutron capture by ^{240}Pu which is produced from neutron capture by ^{239}Pu. Almost all waste streams from activities current during the time period which the waste containers to be retrieved were being buried (1970 to 1987) involved contamination by Pu with 12% ^{240}Pu. Waste streams associated with cleaning up after early activities, mostly related to weapons materials production, generated most of the waste contaminated with only weapons grade Pu. This does not appear to be predominant in retrievable storage.

There was also waste during this period contaminated with higher than 12% ^{240}Pu. Records have been provided by PFP listing all waste drums from PFP by Package Identification Number (PIN) which contain this high ^{240}Pu. The 231Z facility produced experimental fuels with high ^{240}Pu, but well before 1970, so the 1970 to 1987 waste probably didn't have any of this contamination (at least not before irradiation). An interesting aspect of the PFP compilation of high ^{240}Pu is that it was packaged in relatively large quantities (mostly 150 grams and over). Since the use of a conversion factor for grams to curies is for milligram quantities in redesignation of waste containers to LLW it appears that the greater than 12% ^{240}Pu is not a factor.

It is felt a conservative but not unreasonable basis for the TRU specific activity was selected for the waste represented by the data base. This included using reactor fuels grade Pu (ORIGEN II N Reactor spent fuel) processed in PUREX 120 days after discharge. Additional conservatism was achieved by assuming a decay period since reprocessing of 40 years (based on

the first reprocessing of high burnup Al clad fuel slugs for FFTF grade Pu). The specific activity, using MICROSHIELD for the decay/buildup calculation, is projected to be about 0.177 Ci/g.

Because of the uncertainty of the net weights of drums recorded to weigh the "standard" 68 kg the first LLW screening assumed 20 kg net weights for the waste contained in 55 gallon drums. Drums weighing over 180 kg are assumed to contain lead or other shielding so the 20 kg net weight is assumed. Drum gross weights betwen 40 kg (about 20 net) and 180 kg are reduced by 20 kg for the net weight, except those recorded at the standard 68 kg. Using the 0.177 Ci/g and 20 kg net drum weight, 100 nCi/g is equivilant to 11 milligrams.

4.3 Retrieval Scope Reductions Based on TRU Activity

There are three trenches in which the recorded gram quantities of plutonium are believed to be very accurate and by applying the above formula contain only LLW. These are 218W-3A-T01, 10 and 15 which together contain 14 "TRU" drums from PNL laboratory experiments with animals. The Pu quantities represent known experimental doses. One other trench (218W-3A-T34) contains five wooden boxes from 105 KE basin containing basin water filter spools. These were originally sent for burial as LLW but were later redesignated TRU based on extrapolations from basin sludge testing. However, they were redesignated on the basis of 30 to 37 nCi/g, prior to 1982.

One off-site waste shipper appears to have shipped waste for disposal based on waste form and in the process included a great number of drums recorded as "0" Pu on the shipping records. Burial records show 0.0001 g TRU for these drums. This is classified waste from Rocky Flats. Receiving information in the files state that when these wastes arrived at the burial trench at Hanford the rule was they would be placed in the trench (2 high) with plywood between and on top, draped with a vinyl tarp, and buried on the same day. Two 35 drum modules created this way had no plutonium and can be redesignated to LLW. These are in 218W-3A-T05 and 218W-3A-T08 as isolated modules and should not be retrieved.

There is also a 20 drum module in trench 3A-05 from Rocky Flats designated as LLW. There are 138 drums designated as low-level mixed waste also in this trench (mostly from Lawrence Laboratory, Berkeley) and 100 additional Rocky Flats "TRU" drums that will be LLW located with 45 actual Rocky Flats TRU drums at 5 locations. There are also five more 32 drum modules from Rocky Flats, all TRU.

218W-3A-T08 has three separated 35 drum modules of Rocky Flats waste to the west of the redesignated module. These three modules contain only 13 TRU drums with 46 grams plutonium total. Two more locations farther west and adjacent to one another, are shown to contain 50 TRU drums in a 52 drum module and 65 TRU drums in an 164 drum module all from Rocky Flats.

218W-3A-TS9 has retrievable waste only from Rocky Flats (two 35 drum modules) which contains 6 drums TRU with 27 grams total. 218W-3A-T04 has 143 drums from Rocky Flats of which only 11 are actually TRU with one gram

recorded for each drum. These drums are located in a 20 foot space between groupings of disposed LLW. If priorities need to be established in the future based on funding limitations these two trenches would be very good candidates for descoping. The 38 grams in these two trenches represents only 0.0008 % of the targeted inventory for retrieval and about the same in incremental burden that would be added to the pre-1970 plutonium contamination not targeted for retrieval. This is in context with the LLW burial ground closures occuring without identifying and retrieving the pre-1970 wastes containing 100 nCi/g transuranium nuclides. If, as the HDW-EIS ROD leaves open, studies are performed leading to a decision to retrieve all the TRU waste on the site the subject of funding constraints for these two trenches is moot.

Twenty-one Rocky Flats TRU drums are shown to be located in the concrete "V" trench, 218W-4B-TV7, and another 45 drums of which 31 are LLW in 4B-T07. It is suggested that in addition to the two full modules that could be redesignated LLW other Rocky Flats drums can be redesignated without verification assay and left undisturbed or reburied during retrieval.

4.4 Retrieval Descoping Based on Risk

There are six trenches containing both "Retrievable TRU" containers and disposed low-level waste with what appears to be some mixing with a great deal of both remote handled (RH) LLW and RH TRU even after taking into account a dose reduction of more than 50% due to radioactive decay by the time these would be retrieved. All of the waste containers in these six trenches appear to be buried in direct contact with soil, so there is at least a somewhat higher likelyhood of deteriorated containers and contamination than in most of the other retrievable trenches.

The retrieval capability for these trenches would include protection of the operators from direct gamma radiation and alpha contamination during activities which would encompass repackaging deteriorated RH containers into containers shielded to contact handled (CH) levels and shielding intact RH containers (including medium size wood boxes) for CH removal and storage. The requirements would also include the capability to deliver uncontaminated containers to storage and WRAP 2B.

In addition to an expected very high cost of retrieval per gram or curie of Pu from these six trenches (198 grams) it can be argued that regardless of how much is spent for worker safety or environmental protection an increase in worker or environmental risk cannot be avoided. The value of retrieving less than 0.05% of the estimated post-retrieval TRU burden in terms of risk, while subjective, would seem miniscule compared to the cost of retrieval in terms of risk.

As indicated this argument is in context with the LLW burial ground closures occuring without identifying and retrieving the pre-1970 wastes containing 100 nCi/g transuranium nuclides. If, as the HDW-EIS ROD leaves open, studies are performed leading to a decision to retrieve all the TRU waste on the site these six trenches would require inclusion. The proposal is

however, to descope these trenches from the post-1970 TRU Phase 2 solid waste retrieval.

Descriptions of the six trenches follow.

4.4.1 218E-12B-T17

Of the 2660 drums designated as TRU waste in this trench, 320 drums contain about 130 of the 160 grams of transuranium isotopes in the trench and the remainder of the transuranics are contained in 8 HEPA filters. The highest gram loading of any drum shipment is 27 (19 drums in the shipment). None of the other 2340 drums or 52 boxes (23 cardboard and the rest metal) recorded to be TRU waste are shown to contain any significant quantities of transuranics and are expected to assay as low-level waste.

This is one of the "V" trenches where the containers were buried with direct soil contact (drums laid horizontally) starting in May 1970 through October 1972. Also starting in May of 1970 the Atomic Energy Commission required segregation and retrievable storage of solid waste with "known or detectable levels of contamination with transuranium nuclides".

The waste buried as TRU in this trench occupies the southern 280 feet while the northern 600 feet except for two locations contains LLW. The northernmost placement of waste (N45453) consists of eight metal waste boxes designated as TRU but actually reported to contain only 0.0004 g transuranics each. About 45 feet to the south with 16 LLW items between are eight HEPA filters containing 29 grams. The remainder of the trench to the south up to the start of the "TRU" burials contains LLW. Table 3-1, derived from RSWIMS, is an approximate description of the waste locations.

RSWIMS data indicated that among the waste designated as TRU one metal box, two Hanford Standard Cartons, and 88 drums are remote handled with dose rates up to 30 Rem/hr at the time of burial and that the LLW at about the N45425 coordinate, near the location of the HEPA filters, contains metal scrap with 5 Rem/hr dose rate. The RH drums appear to be evenly distributed over the trench.

Except for 19 drums from PNL 209E the TRU waste is from PUREX (202A) and the PUREX lab (202AL). It appears that all of the PNL waste will assay as LLW. It also appears that all of the 1,340 waste drums from 202AL and about 980 of the 1,300 drums from 202A will assay as LLW. The number of drums estimated to actually be LLW is based on TRU waste having greater than 100 nCi transuranium nuclides per gram waste using a conservative specific activity of 0.175 Ci/gram of the transuranium isotopes to convert from grams to nCi/g of the waste matrix.

TABLE 4-1
LOCATION OF WASTE IN 218E-12B-T17
North to South

NORTH COORDINATE	NO. DRUMS	NO. BOXES	GMS TRU	ACTIVITY nCi/g	COMMENTS
45453		8	-	0.04	1 Box Has 1.5 R/hr
45425		16	-	LLW	Up to 5 R/hr Listed
45418		8	29	1300	HEPAs 30 mr/hr
44846-45400	27	741	-	LLW	2.5 R/hr at N45400
44840	33		-	0.25	1 drum 20 R/hr
44818	131		3.4	70	7 RH, 1.5 R/hr max
44810	205		4.1	50	2 RH drums
44798/44806	202	4	3	40	13 RH, 30 R/hr max
44788/44793	409	2	6.7	40	16 RH, 4 R/hr max
44763	159		6	97	7 RH, 4 R/hr max
44728	123	12	0.2	4	6 RH, 5 R/hr max
44713	184		3.9	60	15 RH, 5 R/hr max
44703	21	16	1.5	40	3 RH, 5 R/hr max
44688/44694	150	3	1.4	30	6 RH, 26 R/hr max
44678	32		-	0.25	3 RH, 3.5 R/hr max
44662/44644	177	1	-	0.30	2 RH
44638	147		14	240	No RH
44633	115		42	940	No RH
44626	9		-	0.30	No RH
44610	126		7	140	No RH
44598	40		-	0.30	1 RH, 300 mrem/hr
44590	113	5	2.7	60	1 RH, 1 R/hr
44570	126	1	7	140	2 RH, 5 R/hr max
44558	131		27	530	5 RH, 2.5 R/hr max
TOTALS	2,660	60	158		

4.4.2 218E-12B-T27

Of the 240 drums in this trench about 170 have contamination by transuranics at extremely low levels and are expected to assay as low-level waste (This is another of the trenches containing waste stored as retrievable TRU waste prior to a numerical segregation limit). Three shipments (71 drums) contained the all of the 14 grams of transuranium isotopes in this trench.

TABLE 4-2
LOCATION OF WASTE IN 218E-12B-T27
North to South

NORTH COORDINATE	NO. DRUMS	NO. BOXES	GMS TRU	ACTIVITY	COMMENTS
45438 to 44582				ALL LLW	3 R/hr @ N44582
44578	22	45 Ctns LLW	0.0022	LLW	50 millirem/hr
44573	42		0.0042	LLW	150 millirem/hr
44568	65 22		11.7 0.0104	1350 nCi/g LLW	428 millirem/hr
44563	6 5		2.1 0.0005	900 nCi/g LLW	
44533	39	4 Iron Drms	0.0039	LLW ?	Probable LLW Activity
44525	38		0.0038	LLW	
TOTAL	239		13.835	150 nCi/g	

Included between north coordinates 44525 and 44582, where all of the recorded TRU is contained, are four 3'x3'x4' iron drums with no transuranic content listed and 45 cartons of LLW. According to the burial records eleven of the drums in this portion of the trench were remote handled but should decay to CH level by the timw of retrieval.

All of the waste was put in this trench during the period when waste was placed directly on soil and directly covered with soil. This implies that a great deal of container deterioration will have occurred by the time they can be retrieved. If this is the case much of the waste will have to be repackaged in the trench during retrieval which will cause dilution of the TRU content with waste from the degraded LLW cartons and soil that will have to be packaged along with the suspect TRU waste.

All the recorded transuranium isotopes in this trench are contained in drums of TRU waste from 202A. The remaining 105 drums from 202A contain very small amounts of transuranics (0.0001 g recorded for each) and the four iron drums also from 202A do not have a quantity of transuranics recorded. Fifty-two drums from 202AL and six drums from 209E also contain very little TRU and should assay as LLW.

The LLW in cardboard cartons is from 200 East Tank Farms and 221B.

4.4.3 218W-3A-T23

This trench contains 105KE waste consisting of storage basin filters in wooden boxes and drums, and one carton of bagged miscellaneous waste. See Table 4-3.

TABLE 4-3
LOCATION OF WASTE IN 218W-3A-T23
FROM WEST TO EAST

WEST COORDINATE	DRUMS TRU	DRUMS LLW	BOXES	GRAMS TRU	COMMENTS
78046	4	8 8	130 Boxes/Other 122 Boxes/Other 4X4X4 Wood Box*	0.26	LLW DISPOSAL ON 6/3/76 LLW DISPOSAL ON 6/10/76 TRU STORAGE ON 6/10/76 *Box calculates to be LLW Dose rate for TRU drums and Wood Box Recorded 2 R/hr each
78027-77738					LLW DISPOSAL
77714	2	13	9 Boxes/Other 91 Boxes/Other 1 Cardboard and 2 Wood Boxes	1.02	LLW DISPOSAL ON 10/11/76 LLW DISPOSAL ON 10/12/76 TRU STORAGE ON 10/12/76 200 mrem/hr each
77694-77650					LLW DISPOSAL
77627		1	107 Boxes/Other 2 Wood Boxes	1.02	LLW DISPOSAL ON 10/26/76 TRU STORAGE ON 10/26/76-1.75 R/hr ea
77608-77395					LLW DISPOSAL
77370		1	2 Wood Boxes 188 Boxes/Other	1.3	TRU STORAGE ON 11/24/76-1.25 R/hr ea LLW DISPOSAL ON 11/30/76
77340-77208					LLW DISPOSAL
TOTALS	6	31*	647 LLW* 8 TRU	3.6	

*** Only those containers indicated to be co-located with TRU**

The wooden boxes are 1.8 m^3 each and the carton, 0.13 m^3. From correspondence in the burial records it appears that this waste, and other waste containers in 218W-3A-T30, 218W-3A-32 and 218W-3A-34 were buried as low-level waste. A subsequent basin sludge analysis indicated significantly higher plutonium activity in the filters than first estimated. Calculated nCi/g levels were assigned and the 105KE waste containers were designated for retrieval. The calculated activity of the containers in this trench range from 118 to 210 nCi/g.

Four drums and one box, containing a total of 0.26 g TRU and with recorded dose rates of 2000 mr/hr when buried, are located about at West Coordinate 78046. The carton, two drums, and two wood boxes are located at about coordinate W77714. These are recorded as containing a total of 1.02 g TRU and reading 200 mr/hr, each. Two more wood boxes with 1.02 g TRU and 1755 mr/hr dose rates are located at about coordinate W77627. The final two boxes containing 1.3 g TRU and with dose rate of 1250 mr/hr are shown to be at coordinate W77370.

There is no indication that the TRU containers were seperated from the low-level waste disposal listed for the above coordinates. Most of this waste is contained in cardboard cartons and much of it is indicated to be loose, i.e., "truck loads".

At coordinate W78046, taking into account the LLW shown to be disposed of at that location, the total weight is 14,300 Kg. At W77714 the total is 10,900 Kg and at W77627 there is 4,900 Kg. The two boxes at W77370 are shown in the records to be buried in a group with total weight about 3,800 Kg although the LLW disposal took place on a different day, so there probably is some physical separation in the trench of these shipments.

4.4.4 218W-3A-T30

This trench contains more storage basin filters from 105KE in 55 gallon drums (28), two 4'x4'x4' wood boxes, one 3'x3'x4' cardboard box (contents not identified in the burial records), and a 23 ft^3 truck load (contents also not identified). See Table 3-3 on previous page.

The calculated plutonium activity for the 105KE basin waste in this trench is from 80 to 145 nCi/g. Other waste in the trench recorded as TRU consists of a 55 gallon drum containing PNL lab waste from 325 Bldg (inferred from the records to be a pump or pump parts) and 845 ft^3 boxed or wrapped reactor debris with activation product contamination from 105N.

The 105N waste dose rate is recorded as 200 mr/hr and as containing 10^{-4} grams TRU. Co-located with the 105N waste at about west coordinate 77837 is the drum of PNL lab waste, recorded as containing 18.6 grams. Records show that LLW was disposed at this coordinate with the total waste weighing about 12,500 kg.

Two high dose rate TRU drums from 105KE (1500 mr/hr) are buried at about coordinate W77648. Low-level waste recorded buried at this coordinate amounts to about 5,200 kg.

Six more 1500 mr/hr TRU drums are recorded buried at coordinate W77484 which, along with LLW containers, amounts to about 3,200 kg. Four feet farther east another four TRU drums are buried, each with a dose rate recorded as 375 mr/hr. Also tied to this coordinate is about 7,900 kg of LLW.

The four 105KE drums buried at coordinate W77437 are co-located with 3,400 kg of LLW.

At west coordinate 77415 there are 6 drums with dose rate recorded as 200 mr/hr. The total waste, including LLW, amounts to about 3,100 kg.

The four 105KE drums at coordinate W77385 are located with LLW for a total weight of nearly 14,300 kg.

The two 4'x4'x4' wooden boxes are located with 5 LLW containers at W77306 for a total weight of 2,600 kg.

TABLE 3-4
LOCATION OF WASTE IN 218W-3A-T30
WEST TO EAST

WEST COORDINATE	DRUMS TRU	DRUMS LLW	BOXES	GRAMS TRU	COMMENTS
77847-78065					LLW DISPOSAL 7/23/75 - 10/27/75
77837	1		22 Boxes/Other Cannon Wagon	18.6 .0004	LLW DISPOSAL ON 10/28/75 TRU STORAGE ON 10/28/75 200 mrem/hr Reactor Debris, Not planning to retrieve
77805-77657					LLW DISPOSAL
77648	2		98 Boxes/Other	0.14	LLW DISPOSAL ON 4/13/76 TRU STORAGE ON 4/13/76 1.5 R/hr
77627-77497					LLW DISPOSAL
77484	6	4	173 Cartons	0.18	LLW DISPOSAL ON 5/27/76 TRU STORAGE ON 5/27/76 1.5 R/hr
77481			Concrete Plug		LLW DISPOSAL
77480	4		163 Boxes/Other	0.21	LLW DISPOSAL ON 6/1/76 TRU STORAGE ON 6/1/76
77460					LLW DISPOSAL
77437	4	5	135 Boxes/Other	0.21	LLW DISPOSAL ON 6/24/76 TRU STORAGE ON 6/24/76 2.5 R/hr
77431					LLW DISPOSAL
77415	6	5	160 Boxes/Other	0.26	LLW DISPOSAL ON 7/8/76 TRU STORAGE ON 7/8/76 1.2 R/hr
77390-77408					LLW DISPOSAL
77385	4	21	102 Boxes/Other	0.26	LLW DISPOSAL ON 7/29/76 TRU STORAGE ON 7/29/76 700 mrem/hr
77318-77365					LLW DISPOSAL
77306			5 Other 2 Wood Boxes	0.65	LLW DISPOSAL ON 8/23/76 TRU STORAGE ON 8/23/76 2 R/hr
77297-77228					LLW DISPOSAL
77210	2	3	84 Boxes/Other Lg Cardboard Box Truck Load	- 0.8 -	LLW DISPOSAL ON 9/1/76 TRU STORAGE ON 9/1/76 1.5 R/hr
TOTALS	29	38*	943 LLW* 4 TRU	21.3	

* Only those containers indicated to be co-located with TRU

The remaining two drums, cardboard box, and truckload from 105KE will be found near W77210. These were recorded to contain a total of 0.86 grams TRU. This was divided equally between the four containers for data entry into the RSWIMS data base. The LLW shown to be located at this coordinate includes 3 "truckloads-misc." also, as well as 81 cardboard cartons and the three drums. The total weight of the waste at this coordinate is 18,900 kg.

4.4.5 218W-3A-T32

This trench contains two 4'x4'x4' 105KE wooden boxes of storage basin filters weighing 815 Kg and containing 0.65 g TRU each buried on Jan 3, 1977 at coordinate W78027. Shown by the records to be located at the same coordinates are 167 other containers totaling 40 m^3 of LLW weighing about 12,600 kg. There is a total of over 2,000 m^3 of LLW in this trench. The two TRU boxes are recorded to have had a dose rate of 450 mr/hr when buried which will probably decay to CH by the time they would be retrieved. The calculated plutonium activity is 315 nCi/g for these two boxes.

4.4.6 218W-4C-T19

There is one 91 kg drum of TRU among about 1,200 m^3 of low-level waste buried in error in this trench. The drum was shipped to Hanford from Bartlesville Energy Technology Center and contains seven americium sources six of which amount to 456 mCi contained inside of lead pigs with desicant. The other is a wire source (30 mCi) wrapped in RAD tape. The drum also includes a leather case with the source removed. The waste calculates to be about $5.4x10^{-6}$ Ci/g.

The location Coordinates for this drum is N39470-W77677. The LLW waste recorded to be buried at the same coordinate (the same day) consists of three 112 cu ft containers and 47 other drums from Bartlesville along with 16 cartons from on-site. The total LLW buried in the trench that day (Oct 8, 1981) consists of about 80 m^3 (29,000 kg) of drums, bags, miscellaneous scrap, cartons, wooden boxes, and two shipments of "trucks, flatbeds, compactor, loadlugger".

5.0 SPECIAL WASTE STREAMS

There are several uniquely identifiable batches of waste that may be of interest to single out for later or earlier retrieval, or for special handling or processing in retrieval. Only waste streams comprised of drums are mentioned except for the irradiated fuel materials discussed in 3.1 below.

Not all special streams are included nor was an attempt made to identify all potential waste batches during retrieval. The streams pointed out merely were some of the most obvious in researching data bases and burial records.

5.1 Buried and Unburied Casks

Included in inventory of retrievably stored TRU containers are 22 concrete boxes (casks) with four cylindrical aluminum shipping cask liners each. These were shipped from Valecitos and contain irradiated fuel materials from the Fast Critical Reactor (FCR) and Southeast Fast Oxide Reactor (SEFOR). Irradiated fuel materials are also contained in 39 steel casks with materials from FFTF, EBR11 (INEL and LANL), GETR, Montecello Reactor, Quad Cities Reactor, and Millstone Reactor; and in thirteen concrete filled drums each containing 6 or 7 irradiated TRIGA fuel assemblies from OSU. One zircalloy

cask from K reactor contains 12 americium target elements and 11 Hulls Casks from PNL 325 Building contain zirconium cladding hulls.

The concrete boxes are buried in Burial Ground 3A, Trench 08 at the east end and appear to be readily accessible. Five EBR II casks with EBR and FFTF fuel are located in 218W-3A-TS6. A sixth cask in this trench from Battelle, Columbus is recorded to contain only 0.0001 gram TRU, lead, and beryllium with any other contents to be determined. The remainder of the EBR II casks are stored in the open on the asphalt in 218W-4C-T01 along with the Zircalloy cask. The thirteen concreted drums are buried in 218W-4C-T07. The irradiated fuel casks account for 47,243 grams of the total plutonium recorded in retrievable storage.

218W-4C-T01 and 3A-T08 each contain 11 buried containers designated as "casks". Hull disposal casks in 4C-T01 contain four 5 gallon pails each of leached zircomium fuel rod hulls, and the "casks" in 3A-T08 are described as culverts containing ductwork and HEPA filters in metal boxes.

5.2 HTGR Fuel

There are about 75 drums of HTGR fuel in 218-4B-T07. These are carbon-coated microspheres of oxide fuel in graphite blocks. The fuel materials are PuO_2-ZrO_2 and UO_2-ThO_2 (U^{233} and U^{235}). About half of these contain concrete for shielding.

5.3 ANL LWBR Fuel

Another 118 drums of Th^{232}/U^{233} wastes from ANL are stored in Burial Ground 4C, Trench 29, recorded in SWITS to contain about 6 gram quantites each of TRU. These are described as LWBR-POB fuel solution analytical residues: Uranium-Thorium-Aluminum nitrates and mixed fission product nitrates plus cement components plus lime. The drums contain two 1.5 gal steel waste cans, sealed within a steel secondary can and enclosed within a lead cylinder. Five percent concreted waste solution, 20% lead shielding, and 75% concrete. There are no combistibles in the drums.

5.4 PRTR Fuel

There are ten drums of PRTR fuel from PNL, 325 Building buried in 218W-3A-T08. These appear to be located between Rocky Flats drum "modules". The waste form was described only as PuO_2-ThO_2 fuel rods in the burial records without a description of how they are packaged inside the drum. The 55 gallon drums are recorded to weigh 375 kg so it can be inferred the waste is grouted in the drums.

5.5 Rocky Flats Classified Waste

There are a total of about 820 (TRU) drums of waste from Rocky Flats all catagorized as "Classified" shapes. These are stored in six trenches with the largest number (356) in 218W-3A-T08 and the smallest number (21) in 218W-2B-

TV7. Overall, about 50% of these are contaminated with plutonium. The remainder contain no plutonium and are not transuranic waste.

5.6 340 Vault Sludge

Burial records show there are 87 drums of dried sludge from the 340 Vault buried in 218W-3A-T08. These are low activity and heavy. The records show less than 1 gram TRU per drum and weights of about 325 kg each.

5.7 EXXON "Gift"

About 200 drums of government owned PuO_2 and fabricated PuO_2-UO_2 mixed oxide waste in the form of rods, fired pellets and unfired pellets were shipped over from EXXON for TRU storage at Hanford. These drums are buried in the east end of 218W-4C-T20. They all contain high loadings of Pu (although none over 200 grams) in special packaging.

The material is contained in 3.5 inch diameter slip lid cans (some lead lined) with taped lids which are "bagged out" into 4.25 inch diameter tin coated food pack cans with synthetic rubber base seals. The food pack cans are inside a 4.5 inch steel tube with welded bottom plates and top plugs. These tubes are indexed to the center of the 55 gallon DOT 17H or 17C drums by top and bottom indexing buffers. The drum void space is filled with vermiculite.

5.8 Z-9 Crib Mined-Contaminated Soil

Approximately 700 drums worth of Z-9 Crib soil highly contaminated with plutonium was mined, packaged and buried at the east end of 218W-4C-T01 for TRU storage. The packaging consists of the soils taped in plastic inside of 10 liter canisters with taped on slip fit lids, which were "bagged out" to 0.3 mm polyethylene bags which were heat sealed and placed inside of slightly larger second canisters with slip fit lids then sealed. The drums were designed to contain eight canisters but may contain less to limit the total to the limit of 185 grams for this activity. The drums are provided with rigid liners with snap-on lids, catylist packs, and vent clips. Intersticial void space in the drum and space created by loading less than eight canisters per drum is filled with vermiculite.

5.9 Babcock & Wilcox and Kerr McGee

Babcock & Wilcox and Kerr McGee both fabricated FFTF cores using PuO_2 prepared and shipped from PFP. TRU wastes generated by this activity were sent for TRU retrievable buried storage at Hanford. Some 1200 drums from Kerr McGee are stored in 218W-4C-T29 and almost 1300 drums from Babcock & Wilcox are stored in 218W-4C-T01 and 218W-4C-T04 (Phase 1 Retrieval). These are singled out because for similar processes using single source plutonium there should be similarities in waste streams. In addition there is correspondence in the burial records to indicate that Babcock & Wilcox repackaged their first shipment to smaller Pu quantities per drum for what appears to be overpack

wattage limits on the order of the limits currently used for the TRUPACT-II WIPP shipping container.

5.10 ESG Canoga Park

There are 126 drums from Energy Systems Group (ESG) Rockwell at Canoga Park in 218W-4C-T29, most of which were shipped as WIPP certified late in 1984. The plutonium content is low and the waste form appears varied, but mostly seems to have originated in a facility that handled and stored cladding contaminated with activation and fission products, as well as Pu. A number of these drums weigh about 600 kg.

5.11 High ^{238}Pu Drums

There are twelve 55 gallon drums stored in 218W-4C-T01 Module #4 that contain from 227 to 524 grams Pu each, with ^{238}Pu content about 17.7% or about 19.2%. The ^{239}Pu is correspondingly about 66.6% or 62.3% and ^{240}Pu about 10% or 11.3%. ^{242}Pu is at 0.64% and 1.1%.

These are specially packaged and separated in the module so adjacent drums can act as insulation against the significant heat from the ^{238}Pu and the ^{241}Pu. The plutonium is in the form of plutonium dioxide double sealed in nesting aluminum cans, the inner can 6.5 cm diameter and 23.2 cm high which are enclosed in a stainless steel pipe with end caps. This is contained by the steel housing of a standard LLD-1 shipping container assembly in a DOT-17C 55 gallon drum.

5.12 Filter Spools from 105KE Basin

There are 28 drums in 218W-3A-T30 and six drums in 3A-T23, both trenches proposed for descoping, containing basin water filter spools from 105KE. Each drum contains quantities less than one gram based on calculations extrapolating basin sludge analyses results to the filter contents. The drums were originally sent for disposal based on fission product and activation product activity.

6.0 DOSE RATE

While the TRU in retrievable storage, other than that in the Alpha Caissons, is generally considered contact handled (less than 200 mr/hr surface dose rate), the burial records indicate some of the trenches contain a number of containers with significantly higher dose rates. At the time of burial about 140 drums and 55 boxes were remote handled (RH). Considering the radioactive decay from time of burial to the projected time of recovery about 35 years or more will have lapsed for those particular containers that were Remote handled.

It is felt safe to assume that the RH dose rates were in all cases attributable to cesium, cobalt, and other fission and activation products for which the decay gamma energy is of such magnitude that the buildup of gamma emiting daughters from other isotopes such as ^{241}Pu decay to ^{241}Am is masked.

On balance, it should be bounding to assume all of the dose at burial due to ^{137}Cs. Assuming this, the ^{137}Cs decay after 35 years is about 50%.

It appears there will be 108 drums and 46 boxes remaining as RH at the time of retrieval. These are shown in Table 6-1

It may be noted that by descoping the proposed trenches the RH containers to be retrieved reduces to 12 drums but the number of boxes reduces only to 33.

For the average contact handled TRU containers from PFP and PUREX low dose rates would be expected at the time of burial mostly from americium ingrowth through the decay of ^{241}Pu. This dose will grow larger over time and depending on the quantity and distribution in a container there might be a significant increase. It's unlikely that this will turn any CH drums to RH, but it will probably create a requirement for much more careful control of worker dose uptake than was neccessary when the waste was buried.

TABLE 6-1
RH CONTAINERS
2005-2010 TIME FRAME

LOCATION	DRUMS	OTHER	COMMENTS
218W-12B-T17	66	3 CARDBOARD BOXES	All recorded at 0.0001 g Pu
218W-3A-T06	1		Recorded at 0.008 g Pu
218W-3A-T08		4 FRP BOXES 7 CONCRETE CULVERTS 1 CONCRETE CASK	About 300 mr/hr or less
218W-3A-T23	4	6 WOODEN BOXES	Drums recorded at 0.05 g Pu each
218W-3A-T30	26	2 WOODEN BOXES	Drums recorded at 0.05 g Pu each
218W-3A-T32		2 WOODEN BOXES	
218W-4B-TV7	3		Recorded at 0.0001 g Pu
218W-4B-T07		1 FRP BOX	
218W-4B-T11	8	2 METAL BOXES 2 FRP BOXES 16 CONCRETE BOXES	3 recorded at 0.0001 g Pu each

7.0 WIPP INTERFACE

A potential WRAP 1 waste stream from retrieval includes TRUPACT-II-ready Standard Waste Boxes loaded during retrieval with drums which through individual assay and radiography during retrieval indicate certifiability for WIPP by the WRAP 1 box assay. This potential may require development for acceptance by WIPP.

During retrieval, especially of Burial Ground 4C, a relatively small but significant number of drums will be encountered from generators who packaged waste to WIPP criteria as understood or anticipated at the time. It is possible that upon retrieval it can be verified that the waste form and isotopics meet current WIPP/TRUPACT II criteria, or variations may be so slight as to be negotiable for a waiver from WIPP. If so, these drums may be packaged in the TRUPACT-II Standard Waste Box (SWB), for final certification by the WRAP Box Assay System without requiring WRAP 1 processing.

There are some 680 of these from Babcock and Wilcox alone in Trench 4C-04 (over 1100 total from B&W) and comparably large numbers of potentially verifiable drums from WARD (Cheswick), Kerr McGee (Crescent, OK), as well as the on-site Hanford facilities, including PFP and 300 Area hot cell, fuels, and laboratory facilities. This potential has not been addressed to date in any of the waste stream planning, and there is no firm basis for quantifying this waste prior to assay and examination during retrieval; but the possibility should be kept open as a potential cost saving alternative during retrieval the retrieval operation.

It is recommended that discussions will be held with the WIPP regarding the potential for placing certain batches of retrieved drums directly into SWBs at the trench, specifically to investigate which WIPP WAC parameters are open to waiver for what number of containers.

8.0 SCHEDULE FOR RETRIEVAL

The sequence and timing for retrieval from the various locations consider burial ground closure, the present assumptions regarding startup of the several facilities with which there is interface for the retrieved waste, the general concept of minimizing additional storage requirements beyond those facilities currently planned and optimum utilization of the existing (Phase 1) and new Phase 2 retrieval facilities. Also considered is targeting trenches with the larger amounts of TRU waste first, all else being equal. This actually pretty much turns out to be the case on balancing the other considerations.

8.1 TSD Facilities Schedules

Current planning assumptions used in modeling the Solid Waste Operations Complex and Interfacing systems from the Solid Waste Projection Model, Scenario 7.2 are:

WRAP Module 1 LLW/LLMW Glovebox	Jan 1997
WRAP Module 1 NDA/NDE	Jan 1997
WRAP 2A	Jan 2000
WRAP 2B Contact Handled	Jan 2009
WRAP 2B Remote Handled	Jan 2010
WRAP 2B Caisson Wastes	Jan 2011
Phase V Storage	Jan 1999
WIPP CH Disposal	Jan 2000

Phase 1 Retrieval is presently scheduled to begin operations in May 1988. Phase 2 Retrieval and Alpha Caisson Retrieval line item funding (or however it will be accomplished) is assumed to be able to support a start of operations with the Phase 2 remote handling facility with containment by 2008 and Alpha Caisson retrieval by Jan 2011.

8.2 Burial Ground Closure Requirements

As of the present time there has been no agreement between the State and WHC/DOE on any schedule change to the proposed placement of Low-Level Burial Ground covers for the closure plan included with the Part B Permit Application.

The applicable Part B Permit Application schedule items are:

Burial Ground 218E-12B	
Begin Retrieval	2008
Complete Retrieval	2012
Complete Closure Retrieved Part	2015
Burial Ground 218W-3A	
Begin Retrieval	2005
Complete Retrieval	2012
Complete Closure	2016
Burial Ground 218W-4B	
Begin Retrieval	1999
Complete Retrieval	2009
Complete Closure	2011
Burial Ground 218W-4C	
Begin Retrieval	1996
Complete Retrieval	1999
Complete Closure	2015

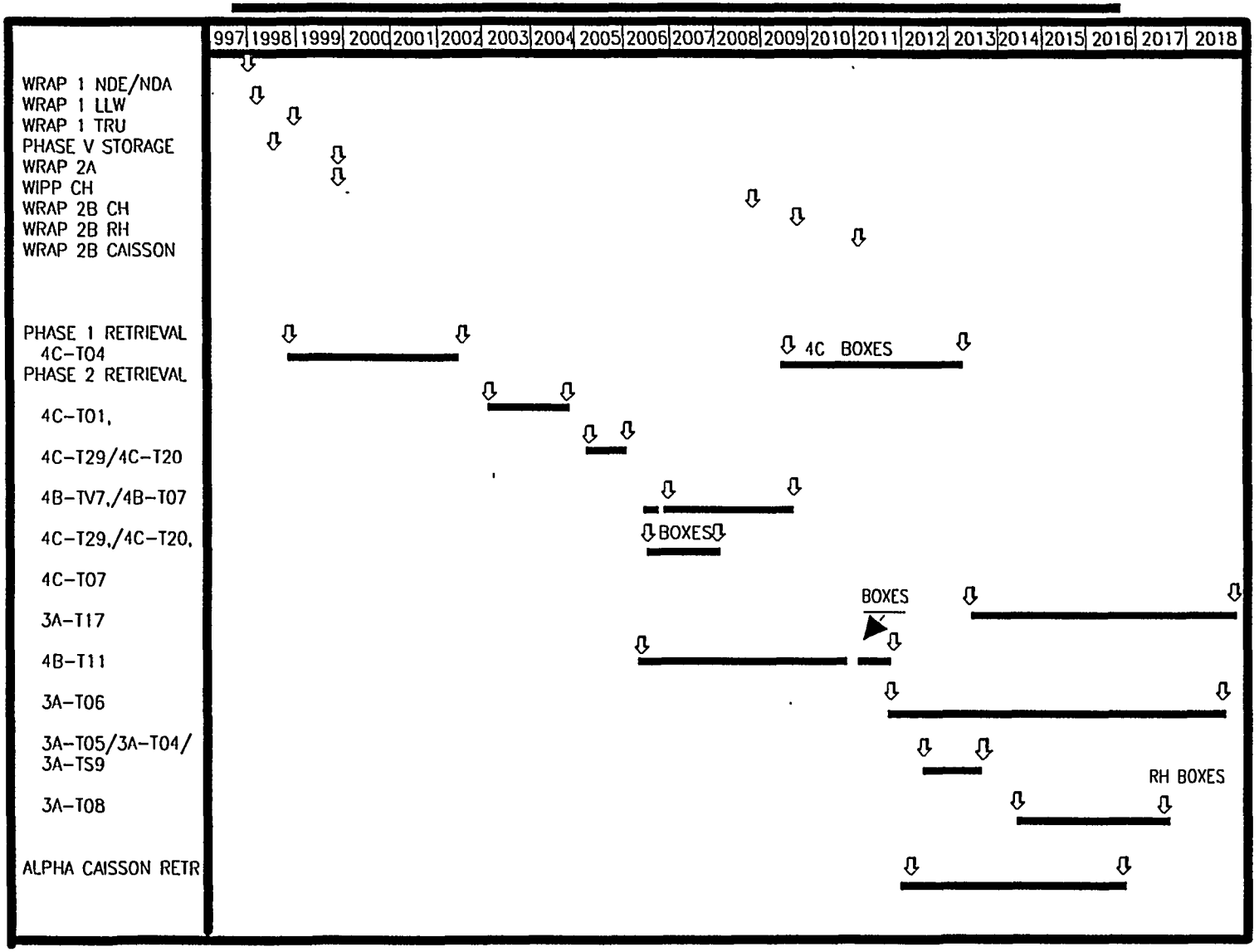
It appears to be unrealistic to let this schedule drive the retrieval schedule when taking into consideration the anticipated startup dates for the interfacing TSD facilities and, the limited amount of storage space for retrieved boxes planned for Phase 5 Storage, and the lack of RH storage, especially with respect to the Alpha Caissons and the closure of 218W-4B.

8.3 Trench Retrieval Sequence

Figure 8-1 is the timeline of retrieval in relation to availability of treatment, processing, and storage facilities; retrieval systems availability for Phase 1 (Project W113) and Phase 2 (Project W-221): and possible Burial Ground closures. This excludes the trenches included in the descoping initiative and takes into account continuing to store the boxes requiring retrieval in the burial ground until WRAP 2B or it's equivilant for large box processing is available.

FIGURE 8-1

SOLID TRU WASTE RETRIEVAL PRELIMINARY TIMELINE



8.3.1 Pre-Project

There are 44 drums of LLMW in 218W-3A-TS3 and 145 drums a cask and a box in 3A-TS6, all characterized and buried in 1987. Although 3A-TS3 is not included in the retrieval scope it would be a good idea to retrieve the LLMW containers from both the trenches now in order to better disassociate this retrieval from TRU retrieval which will be done with different criteria in effect than is presently applied to mixed waste movements. The 5 TRU casks in TS6 should be able to be moved "shuffled" for storage on asphalt somewhere in the same manner as the casks currently stored in 218W-4C-T01 until a destination is established for all of the casks requiring retrieval. 218W-3A-TS6 retrieval would then be complete.

In addition, whereas a moderate level of storage is now available for TRU waste in the Central Waste Complex Phase 1 through 4 buildings and TRUSAF, an effort should be immediately started to transfer some or all of the uncovered TRU waste drums in the trenches. A minimum of over 1000 drums, 17 metal boxes, and 79 PR cans are available without disturbing the soil in the trench. It is recommended that only the drums and PR cans be retrieved now. Another 1200 partially buried drums are potentially retrievable entirely or in part with minimum disturbance to the soil in the trench.

55-GALLON DRUM SUMMARY

CONFIGURATION	QUANTITY	AMOUNT TRU
Uncovered/Unstacked	107	1.0 Kg
Uncovered/Stacked	930	10.8 Kg
Partially Buried	1220	15.8 Kg

Details of waste in the above configurations by trench are shown in WHC-SD-W221-DP-01 REV 0.

8.3.2 218W-4C-T01, 218W-4C-T20, 218W-4C-T29, and 218W-4B-TV7/T07

WRAP Module 1 is scheduled to start operations in 1997 and should be at full production by 2000-2001. Whereas current planning is for Phase 2 Retrieval to be a line item budgeted no sooner than FY 01, and whereas the Phase 1 retrieval rate will be able to support the WRAP 1 retrieved waste feed requirement of 2625 drums/year and whereas 218W-4C-T04 will be completed in 2001; it is the proposed strategy to continue using the Phase 1 retrieval system from 4C-T04 to retrieve the the drums in Burial Ground 4C trenches 01 and 29 and as many from 218W-4B-T07 that can be obtained with the same system modified to include containment features.

Since there is yet no firm definition of a facility that might be available before late in the first decade of the next century for size reduction of contact handled boxed waste for repackaging for WIPP disposal, sequencing of trenches for retrieval should minimize box retrieval or box

handling. Similarly, drums with high potential for WRAP 1 suitability should be given preference over "set-asides" for future processing.

The sequencing of trenches for retrieval following Phase 1 and utilizing the retrieval facilities and equipment from Phase 1 should start with Trench 4C-01, which contains the second greatest number of drums and which is close enough physically to Trench 4C-04 to minimize utilities relocation and movement of facilities and equipment. As boxes are removed from Trench 01 they should be moved over to Trench 04 which could be provided with a storage shelter and outfitted as a large box assay facility and possibly even a waste characterization facility for the boxes that assay as low-level waste.

Trench 01 should be completed by 2005. Trenches 4C-29 and 4C-20 are proposed to be next leaving the EXXON module and box modules in place and intact for independent relocation of the boxes to Trench 04 for assay and the drums to storage if WRAP 2B isn't available when burial ground closure drives removal of the drums.

By late 2006 work can be under way with the same NDA/NDE equipment with a temporary facility for 218W-4B-TV7 while the weather enclosure is modified for retieval of 4B-T07.

8.3.3 Breached Drum/Contaminated Soil Retrieval-218W-4B-T11 and 218W-3A-T06

The longest period of retrieval system development for RH and contamination control will be required for the full trench retrieval of Trenches 3A-T06 and 4B-T11. These trenches will have had waste containers directly buried in the soil for over 35 years years by the time a retrieval facility can be designed and procured. Included is the portion of waste buried in Trench 06 in Burial Ground 218W-3A after April, 1970 basin. The drums used for waste containers during the period of burial were painted, mild steel. Also used were mild steel boxes, cardboard boxes, plywood boxes, plywood boxes coated with fiberglass-reinforced polyester, concrete boxes, sealed tanks, culvert sections, and vent pipe sections. It is fully expected that all of the cardboard and plywood will have deteriorated so that the container and its contents will have to be repackaged, as well as some amount of surrounding soil that, even if not contaminated, will have to be included in order to assure that all of the original container is retrieved. This will also be the case with a great number of the drums, and other metal containers.

If a single retrieval system is used for both of these trenches it is estimated that it will be neccessary to have it operating by 2006 to be able to complete retrieval in both trenches by about 2019, in time to meet the assumed WIPP close down schedule. Trench 218W-4B-11 should be started first to minimize possible interference with the nearby caisson retrieval which will be able to start about 2011 with the availibility of WRAP 2B to handle caisson waste and because the original closure schedule had 218-4B closure five years earlier tha 218W-3A.

8.3.4 Vertical CH Spot Retrieval

By this time 218W-4B-T07 should be completed with retrieval, freeing the NDA/NDE/Gas Screening equipment for integration with a Phase 2 provided facility for the retrieval of drums from 218W-3A-TS9, T04, T05 and T08 to begin. Because the potential for contamination appears to be greater in 218W-3A-T08 than the other three to be retrieved from the same configuration it will be retrieved last.

8.3.5 Boxes

A facility for processing the contact handled boxes (WRAP 2B) is anticipated to be available by 2009 and it is expected to be able to handle RH boxes the following year. RH box retrievals from Trench 3A-T08 (separate from drum retrieval) will be delayed until this facility (nominaly WRAP-2B) is available in 2010. This meshes also with about the time the RH boxes in 218W-4B-11 will be gotten to since the retrieval plan is for west to east, and the RH boxes are at the east end of the trench.

Boxes previously set aside while retrieving drums, the boxes in Trench 4C-20, the 4C-07 large box trench, and the 3A-17 large box trench will be retrieved, probably in that order, starting in 2009 releasing Burial Ground 4C for closure sometime prior to 2015. It is expected to take until about 2019 until all of the boxes are retrieved on an unaccelerated schedule. There should be no problem however, with supplying as many CH boxes that processing and/or storage can handle by increasing manpower and equipment at any time, which is feasible because there are three contact handled box trenches that can be worked simultaneously, one of which could accommodate two or three crews.

9.0 RETRIEVAL CONCEPTS

9.1 Phase 1 Retrieval Facility

As described elsewhere, planning for Phase 2 Retrieval is based on the availibility of facilities and equipment utilized for Project W-113 (Phase 1 Retrieval) after Burial Ground 218W-4C, Trench 04 retrieval has been completed. The current planning for no further Phase 2 spending until FY 2000 allows no other option. It seems feasible though within these constraints a modified Phase 1 facility and equipment capable of achieving production rates of retrieval with contamination containment features in place could be acquired. This would be an alternative to the first option of modifying the existing facility.

9.2 CH Box Retrieval

Of the remaining trenches, Trench 17 in Burial Ground 218W-3A contains large boxes only (122) and Trench 07 in Burial Ground 218W-4C contains 73 boxes, 49 TRU waste drums, and 37 LLMW drums (buried September, 1985). Trench 218W-4C-20 contains 29 boxes but also about 600 drums of which 200 are the EXXON drums which probably won't be processed by WRAP 1 and are at the "back-

of-the trench" which won't interfere with box removal. Another 100 drums are in the open now, ready to be relocated. The remaining 300 would be retrieved with the Phase I facility clearing the way for box retrieval.

The boxes can be retrieved with state-of-the art equipment in the open during windows of opportunity if the size reduction and repackaging capability remains a WRAP 2B CH box capability, availabe about 2009. Weather enclosures large enough to accommodate the equipment required to lift the heavy, large boxes can be employed if a schedule driver such as agreements for closure and capping of the burial grounds should require "all season retrieval". A desireable option with box retrieval to economize on storage is to convert the Phase 1 trench when emptied to a box characterization and storage facility with environmental protection. Boxes as retrieved from 218W-4C-T01, for example, could be moved over to trench 04 to be assayed. If the assay shows that a box is not TRU (less than 100 nCi/g) it might not be neccessary to send it to WRAP 2B for processing into a WIPP ready container, but rather another facility or there in the trench storage facility for opening and sampling to determine if treatment as LLMW is required. If not it could go directly to disposal. It is recommended that this become a function of the retrieval process.

9.3 Vertical CH Spot Retrieval

A second method of contact handled drum retrieval, based on spot "vertical digs" (as opposed to the horizontal removal and total trench excavation as in Project W-113) will be required to avoid handling and/or removal of large quantities of co-located, disposed LLW. The design of a facility such as this should be straightforward with high productivity not being a major factor considering the relatively few drums to be retrieved. Major requirements are to protect against cave-ins and a security requirement during the retrieval of classified waste drums from Rocky Flats.

There is a perceived potential for having to retrieve by this method in a trench with contamination present. Confinement features would have to be adapted to the system.

9.4 Remote Handling Retrieval with Confinement

The other method for Phase 2 Retrieval uses a system with confinement and remote handling and operating capability that includes intact drum and box retrieval and overpacking; breached container repackaging;soil packaging; and application of shielding to packaging. Two trenches for which this system is assumed to be required are Trench 11 in 218W-4B, and Trench 06 in 218W-3A. The remote handling requirement is driven by the anticipated contamination problem as opposed to distance for shielding against high penetrating radiation.

Engineering Studies were performed by both PNL and WHC to define the systems and/or facilities required for retrieval with the requirements described above. These were blended together into a single report, *WHC-SD-W221-ES-001, Preliminary Engineering Study for Solid Waste Retrieval, Phase 2.*

There are some excellent concepts investigated in this design study resulting in a proposed facility that will serve as a starting point when funding becomes available to proceed with Phase 2 Retrieval.

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