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TRANSURANIC WASTE PROJECTIONS AT SRS FOR LONG RANGE PLANNING (U)

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STRATEGIC PLANNING AND ANALYSIS

MAY 1994

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Transuranic Waste Projections for Long Range Planning

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SUMMARY

This report predicts 30 year receipts of solid transuranic (TRU) wastes from eventual plutonium facility deactivation and cleanup, and combines them with the existing TRU waste holdings to provide a technical and quantitative basis for interim and long range TRU waste management planning.

The current TRU waste holdings have been characterized based on data from the Computerized Radioactive Waste Burial Records Analysis (COBRA) system. Six TRU waste disposition categories have been identified for existing TRU waste as shown in Table 1. An additional category has been quantified that includes projected waste volumes from the Decontamination and Decommissioning (D&D) of TRU waste generating facilities. These projections are based on COBRA data from D&D of the original plutonium finishing facilities in F and H Areas that were replaced in the 1970's and 80's.

The predominant sources of TRU solid wastes at SRS are the plutonium contaminated processing and laboratory facilities. The projected waste volumes shown in Table 1 more than doubles the current TRU waste holdings and results in over one million cubic feet of retrievably stored TRU waste. The projected waste quantities indicate the need for an additional 6 TRU storage pads for low activity waste if only waste greater than 100 nCi/g is stored on pads. If waste greater than 10 nCi/g is stored on pads, an additional 11 pads will be needed. Space for about 282 culverts of high activity waste will also be needed. This additional storage will be needed if offsite shipments to a national repository do not begin before completion of plutonium facility D&D.

Total projected TRU wastes in the year 2023 are shown in Table 2 assuming current retrievable waste distributions. TRU waste volume projections are considered important in long range planning because DOE strategy is to transport this waste to a national repository. After offsite shipment of repository qualified TRU waste, about 70 percent of the TRU waste volume and activity will remain onsite. Therefore, a more durable long term storage mode should be considered for the pad stored waste that will remain at SRS. Figure 3 shows that the radioactivity of the current retrievably stored TRU waste holdings will decay by 98 percent to a residual 10,000 Curie level, predominantly Pu-239, in a thousand years. Planned shipment of the Pu-239 TRU wastes to an offsite national repository will further reduce the residual level by a factor of 20.

All COBRA data used in this alpha waste analysis is available in a separate Appendix.

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INTRODUCTION

The mission emphasis at SRS has changed from production to managing inventories of nuclear materials, disposing of nuclear wastes, and stabilizing and deactivating surplus production facilities. Uncertainties exist in the timing, extent of stabilization, and D&D required for the contaminated production facilities. Detailed analyses of the risk, costs, and engineering feasibility are needed to define production facility end states to ensure expected reduction in health and environmental risk. In the meantime, scoping projections are required to satisfy DOE requirements for 30 year plans, and to indicate where detailed analysis should be funded.

DISCUSSION

Background

The methodology used in this study for projecting future TRU waste generation used past experience and current DOE programmatic guidance as a basis for predicting future waste generation. SRS has several facilities that generate TRU waste as a result of processing, storage, analytical work, and R&D. Plutonium processing facilities (221-FB-Line and 221-HB-Line) are located on the roof of each of the two canyon buildings. A separate facility (Building 235-F) is located outside the 221-F canyon and was used to process Pu-238 and Np-237. Both of the laboratories (772-F and 773-A) generate low amounts of TRU waste. There are also plans for the SED Facility in 773-A to undergo D&D in the near future. These facilities are highly contaminated with plutonium which is extremely toxic when inhaled. For personnel protection, processing takes place inside gloveboxes or cabinets with controlled ventilation. Containment and ventilation must be maintained to avoid plutonium release. These facilities have generated all of the TRU waste in current retrievable storage and will be the major source of future TRU waste. Total dismantlement of these plutonium facilities will probably be required within the next two decades.

Facility deactivation or decommissioning can be considered to be made up of five different stages: shutdown, stabilization, decontamination, dismantling and disposal. Between facility stabilization and decontamination and dismantling stages, a facility can undergo an indefinite period of surveillance and maintenance (S&M) depending on the assessment of risk and cost for further action. A lengthy S&M period for these plutonium facilities after shutdown could involve relatively high risks and costs. Experience has shown that the cabinet/hood interiors cannot be

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adequately decontaminated to reduce risk to acceptable levels. For these reasons, the D&D of these facilities should be of the highest priority at SRS. Previous D&D of similar facilities at SRS has demonstrated effective methods of performing the work and has resulted in the development and application of practical technology and equipment (Reference 2). Total dismantlement of the plutonium facilities will probably be required.

Tables 4 and 5 show past TRU waste volume generation as a function of source facility for high activity culvert stored waste (> 0.5 Curie per drum) and low activity non-culvert stored waste (< 0.5 Curie per drum). The predominant sources of TRU solid wastes at SRS can be seen to be the plutonium contaminated processing and laboratory facilities.

Waste Generation Predictions Based on Past D&D Projects

The strategy of this study is to use past experience as a basis for predicting future waste generation. Three types of solid waste are generated in the D&D of plutonium facilities: TRU waste containing transuranic isotopes of greater than 20 year half-life at concentrations more than 100 nanocuries per gram (nCi/g) alpha, low level waste (LLW) containing less than 10 nCi/g alpha, and mixed waste that may be either TRU or LLW combined with a hazardous material. In this analysis, attention is limited to the alpha waste. LLW is not subject to off-site shipment as is the case with alpha bearing wastes. Projected waste volumes and activities used in this analysis are based on the experience gained in previous dismantlement and decontamination projects.

Old 221-HB-Line D&D Experience

The old HB-Line operated from 1963 to 1984 producing radioisotopic heat source Plutonium-238 material for NASA programs. The facility cleanup effort was begun in 1984 and has continued intermittently to today. Approximately 108,000 cubic feet of solid TRU waste was generated for the 5,000 square feet of facility cleaned thus far or about 21 cubic feet of waste per square foot of empty facility floor area. This basis was chosen because most plutonium facilities require a comparable operating and maintenance area to support the enclosed processes. About half of the solid waste generated was transuranic (TRU) waste, an equal amount of low level waste (LLW) was also generated. Although the elapsed time for the cleanup has been 9 years, the effort was intermittent, and it is estimated it would have required the equivalent of about 5 years of continuous effort. It is estimated that 3 more years will be required to complete D&D of the facility. Records of the

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amount of liquid decontamination waste generated to date are unavailable. The contaminated wash water was pumped to the adjacent canyon for evaporation and transfer to the area waste tanks. This information is now being documented for future reference. Table 6 itemizes TRU solid waste receipts from the COBRA data. Total retrievable TRU (Pu-238) waste volume is the sum of culvert and non-culvert wastes.

Old 221-FB-Line Experience

The old FB-Line facility, operated from 1959 to 1968, consisted of processing equipment located in gloveboxes on the third level of the 221-F Canyon facility. This facility was dismantled and decontaminated from about 1972 to 1976. Approximately 97,151 cubic feet of solid TRU waste was generated from cleanup of the 7,500 sq. ft. facility or about 13 cubic feet of waste per square foot of empty facility floor area. Table 7 itemizes TRU waste receipts from the COBRA data from the old 221-FB-Line cleanup. Total retrievable TRU (Pu-239) waste volume is the sum of culvert, non-culvert, concrete pours, and low level alpha (LLA) wastes. Pours and LLA waste volumes were considered to be non-culvert waste by current definition.

TRU Waste Generation Projection Assumptions

A previous study in 1986 (Reference 3) attempted to estimate D&D waste generation by estimation by knowledgeable peer teams, but their estimates of 20,000 cubic feet of TRU waste generation for each of the HB and FB Lines appears a factor of five low compared to COBRA data. Projected waste volumes in this analysis are based on data shown in Table 8. The methodology proposed derives TRU waste volume from estimation of contaminated facility floor area multiplied by waste generation factors, 13 or 21 cubic feet of waste generated per square foot of contaminated floor area for Pu-238 or Pu-239 facilities respectively. The different factors for Pu-238 and Pu-239 facilities is due to the higher specific activity of Pu-238. The waste was further classified as culvert and non-culvert since the data indicates about 4 percent of the waste generated is culvert waste. Finally, the waste radioactivity in Curies can be estimated by multiplying the waste volume by characterization factors (e.g., 0.84 g Pu-238/ft³ of culvert waste times 17.2 Curies per gram of Pu-238).

Current DOE plans forecast completion of the deinventory and flushing operations in F and H Canyons by FY 1996 and FY 2000, respectively. It is assumed that deactivation and stabilization of plutonium operations starts in 2000 and extends for 5 years. Cleanout and deinventory of 221-FB-Line,

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221-HB-Line, and 235-F is assumed except for vault storage until the new Complex 21 vault is in operation in 2005. Upon completion of the new Complex 21 vault, around 2005-2010, the remaining unirradiated nuclear materials will be stabilized and repackaged for shipment and/or stabilized for disposal, depending upon economic value and evolving criteria. TRU wastes generated in 772-F are associated with continuing analysis of Environmental Remediation characterization samples.

Facility D&D Sequence and Waste Generation

The D&D sequence of plutonium contaminated facilities is assumed to utilize a common source group of work crews and are scheduled in the following semi-succession. If funding and manpower are available, several facilities may undergo D&D simultaneously. However, the same amount of waste is anticipated in either case.

Old HB-Line will complete present D&D in 1994-96

Approximately 3400 sq. ft. of contaminated facility area remains to be cleaned out. Using the generation factor of 21 for Pu-238 facilities from Table 8 yields approximately 72,000 cubic feet of TRU waste. Four percent of the TRU waste (from Table 8) will be stored in culverts, about 2900 cubic feet, with an activity of 81,000 Curies. The 69,000 cubic feet remainder will contain 6,000 Curies to be stored in drums or boxes on the storage pads. It is assumed about three years are required to complete D&D of the facility.

SED in 773-A will undergo D&D in 1995-8

This experimental facility at SRTC is a high priority candidate for complete D&D because it is situated near the site boundary and will be transitioned to EM-40. The floor area of SED is about 3000 square feet. Approximately 40,000 cubic feet of TRU waste are estimated to be generated using the waste generation factor of 13 for Pu-239 waste from Table 8. Four percent of the TRU waste will be stored in culverts, the remainder is non-culvert waste to be stored in drums or boxes. It is assumed about four years will be required to complete D&D of the facility, therefore, 400 ft³ of culvert waste and 9600 ft³ of non-culvert waste are shown under 773-A on Tables 10 through 13 respectively.

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235-F PUFF and Thoria Line will undergo D&D in 1996-2003

The PUFF facility operated from 1978 to 1986 providing Pu-238 heat source fuel forms for NASA programs. The facility first floor contaminated area is 5,200 sq. ft.. The Thoria Line that produced oxide billets for extrusion of Pu-238 target assemblies is about 1500 square feet. Using the waste generation factor of 21 for Pu-238 facilities, about 140,000 cubic feet of TRU waste will be generated cleaning up these facilities. Four percent of the TRU waste will be stored in culverts, the remainder is non-culvert waste stored in drums or boxes. It is assumed about seven years are required to complete D&D of these two facilities

221-HB-Line will undergo D&D in 2003-2010

The new HB-Line is located atop the H-Canyon building. This facility has just begun to operate this year. This HB-Line is used to convert neptunium and plutonium to oxide forms after passing through ion exchange columns. Assuming about 6700 square feet of contaminated area, approximately 140,000 cubic feet of TRU waste will be generated using the Pu-238 waste generation factor of 21 ft³ of waste per ft² of contaminated floor area. Four percent of the TRU waste will be stored in culverts, the remainder is non-culvert waste stored in drums or boxes. It is assumed about seven years are required to complete D&D of the facility. Operational wastes are estimated in the period prior to D&D.

221 FB-Line will undergo D&D in 2010-2017

This facility is designed to process low concentration plutonium solution from the canyon into plutonium metal or oxide. Extensive restoration of the new FB-Line facility has been in progress for the last decade. Assuming 7800 square feet of contaminated area, approximately 100,000 cubic feet of TRU waste will be generated using the generation factor of 13 ft³ of waste per ft² contaminated floor area for Pu-239 facilities. Four percent of the TRU waste will be stored in culverts, the remainder is non-culvert waste stored in drums or boxes. It is assumed about seven years are required to complete D&D of the facility. Operational wastes are estimated in the period prior to D&D.

The New Special Recovery (NSR), a new facility located in a hardened structure adjacent to FB-Line, is the replacement for FB-Line special recovery portion of the FB-Line. Due to mission changes, startup activities in the new facility were halted. NSR is currently maintained in a

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contamination free standby condition. No D&D of this facility is necessary.

Miscellaneous Facilities

Plutonium storage vaults and analytical laboratories will be operated continuously during the future projection period. Plutonium is stored in two vaults within FB-Line and three vaults in Building 235-F. Two additional F-Area vaults (PSF and 247-F) could be started up over the next two years for materials storage. The Plutonium Storage Facility (PSF) is a new partially automated stacker retrieval vault capable of storing plutonium bearing materials in shipping containers. This facility has a wide range of nondestructive assay equipment for confirmatory and accountability measurements of feed materials as well as advanced accountability features. At present, there are no current plans for startup PSF.

An allowance was assumed for TRU waste generation for vault storage activities that is related to continual assay and isotopic quality tracking. Laboratory waste generation (772-F & 773-A) indicated in Figure 2 and Table 9 is related to restoration and remediation sample analyses. The Building 247-F vault and 221-HB-Line may provide additional plutonium storage capability where shipping containers will be stored manually. The plutonium stored in these separate vaults may be consolidated in a new Complex 21 vault during the period 2005-2010.

The method used to calculate the projected waste activities was to total the waste generation volumes in Pu-238 and Pu-239 facilities separately, use the appropriate multipliers, and combine the results. The operational wastes were assumed to be essentially the same as the predominant D&D wastes with the exception that 10% was assumed to be the culvert waste fraction, otherwise characterization factors given in Table 8 were used.

Analysis of the Current TRU Waste Holdings

The current TRU waste holdings were characterized from COBRA data. Computer printouts were obtained for waste receipts from all TRU generating facilities since 1964 for culvert stored waste and since 1974 for pad stored TRU wastes. The information included in this analysis represents all of the current retrievably stored TRU waste up until mid CY 1992.

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In 1974, when retrievable transuranic waste pad storage was initiated, alpha waste greater than 10 nanocuries per gram was considered TRU waste. In about 1984, the lower limit defining TRU waste was changed to greater than 100 nanocuries per gram. Therefore, retrievably stored TRU waste falls into three different categories: less than 10 nCi/g, between 10 and 100 nCi/g, and greater than 100 nCi/g.

Long before retrievable storage, in 1959, alpha waste greater than 0.1 Curie per package at SRS was stored in concrete culverts. Later, a comparable definition of high activity alpha waste of 0.5 Curie per drum was established to differentiate high level activity alpha waste storage that required secondary containment by concrete culverts. Low activity alpha waste storage was in earthen trenches until 1974 when these wastes were pad stored in drum or boxes.

Figure 1 shows the current TRU Solid Waste Strategy (Reference 1) that defines the conceptual TRU waste processing facilities and waste streams. Table 14 quantifies the current TRU waste holdings feeds and outputs to the planned low and high activity transuranic waste facilities that will condition the waste for transfer to a national transuranic waste repository. Further analysis of the COBRA data was required to define the components of the different waste streams. First, the data was sorted by isotope, activity and container type. The gram quantities were converted to Curies of activity at the time that the waste was received, and then decayed to the year 1994. Future decay was also calculated 30, 100, 500 and 1000 years into the future to allow assessment of future waste holdings activity in Figure 3. Curie values used in the calculation of nCi/g and Ci/ft³ for waste stream segregation are for CY 1994. A nominal waste density of 7 pounds per cubic foot of waste was used to convert waste volume to weight. All COBRA data used in this analysis is included in a separate Appendix.

Combined Current and Projected TRU Waste Holdings

Table 1 summarizes the current and projected TRU waste disposition categories derived from past and present definitions of transuranic waste. It appears that these waste streams can be more effectively allocated into seven waste disposition categories that are described in Table 3.

Projected TRU wastes up until the end of the 30 year planning period ending CY 2022 are shown in Figure 2 and Table 9. Tables 10 to 13 show projected waste volumes assuming the same distribution of activities as the current wastes and no offsite shipment of TRU waste in the interim. Table 10 shows

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projected culvert stored high activity (>0.5 Curie per drum) TRU waste volume predictions as a function of source facility. Projected culvert waste volumes show only a 28 percent increase over the current culvert stored wastes shown in Table 4. The reason for the smaller growth of the high activity waste is that operating processes generate more high activity waste than do cleanout and D&D activities.

Tables 11, 12 and 13 show low activity (<0.5 Curie per drum) TRU waste volume predictions as a function of source facility. Comparison of the projected non-culvert waste volumes to the present non-culvert waste holdings shows a 237 percent increase in the alpha waste. The increase is due to the increase in job control waste from D&D.

The volume distribution of the activity in culvert and non-culvert projected wastes was treated independently, but was assumed to be the same as the current waste holdings volume distributions. Table 2 shows the effect of the redistributed projected waste as a hypothetical alpha waste holdings in 2023. Therefore, the total SRS waste that can be sent to the Waste Isolation Pilot Plant (WIPP) under the current waste acceptance criteria without extensive rework is Category 1 which constitutes 27% of the volume and 25% of the activity of all the alpha waste stored in E-Area.

The projected holdings indicates the need for about 282 culverts (Table 10), and an additional 6 TRU storage pads (for non-culvert storage greater than 100 nCi/g in Table 11). If wastes greater than 10 nCi/g are placed on the TRU pads, 11 pads will be required instead of 6 pads (Table 12). These estimates assume offsite shipments to a national repository do not begin before completion of plutonium facility D&D. These requirements were calculated by assuming all of the culvert waste is in equivalent drums of 7 cubic foot volume. A culvert will hold 14 drums, and a pad will hold about 3456 drums (triple stacked with provision for aisles). Even after offsite shipment, about 73 percent of the TRU waste volume and 75% of the activity will remain onsite.

Accuracy of the Scoping Study

The COBRA data was analyzed on the basis of annual receipts from the TRU waste generating facilities. This expedient was employed because the data was hand transferred by the author and thousands of entries would be involved in separate item receipt. The use of annual waste receipt summaries instead of individual container receipt data tends to allow more marginal culvert waste to meet the WIPP waste acceptance criteria,

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however, it also tends to increase the marginal non-culvert waste fraction that is less than 100 nCi/g and remains at SRS. A review of the data in the Appendix will show few entries that are marginal.

The activities of the Pu-238 wastes may be 10-20 percent high because the isotopic contents of the wastes are variable, and a half-life of 87.7 years and a specific activity of 17.2 Ci/g for pure Pu-238 was assumed. The activities of the Pu-239 wastes may be 2-6 percent low because the isotopic contents of the wastes are variable, and a half-life of 24,100 years and a specific activity of 0.0623 Ci/g for pure Pu-239 was assumed.

CONCLUSIONS

This scoping study is a further step in the continuing process of characterizing current and future TRU waste holdings. Reference 4 was an early attempt to characterize and document TRU waste retrievably stored in E-Area. This current study supplements that information, and effectively brings the previous study up to date.

The predicted TRU waste generation volume indicates that about 6 additional TRU storage pads will be required to store non-culvert waste greater than 100 nCi/g and 11 storage pads will be required to store non-culvert waste greater than 10 nCi/g. About 282 culverts will be needed for future high activity waste storage with the necessary pad space. This waste characterization is also necessary input for conceptual design of any waste future waste processing facility. Several of the waste disposition categories (Categories 1, 3, 4, & 5 in Table 3) need further consideration and definition of long term treatment, storage and disposal (TSD) alternatives. Since low level alpha waste is to be placed in low level beta-gamma waste vaults, it appears to be more protected in the long term than the much higher activity pad-stored wastes.

The total SRS waste that can be sent to WIPP under the current waste acceptance criteria without extensive rework in Category 1 is about 27%. Since 73% of the volume and activity remain at SRS, one may ask what is the point of sending TRU waste to WIPP? Figure 3 shows that after 500 years decay, the Pu-239 activity dominates the residual activity. The WIPP shipments will reduce the residual activity from the current Pu-239 holdings from about 10,000 to 500 Curies or a factor of 20. The lower residual activity in the retrievable TRU waste is comparable to the decayed residual activity in the non-retrievable TRU waste in the old burial ground.

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The results of this scoping study can be used in the Preliminary Environmental Impact Study for Waste Management. The results shown in Tables 10-13 might also be used by the Interim Solid Waste Task Team. The mission of this team is to prepare a plan for interim storage of TRU and mixed-TRU wastes on the E-Area storage pads and those being generated in the next decade. Waste stored since 1974 on surface storage pads are approaching their planned 20-year storage design limit. Corrosion is suspected on drums in sod covered pads, and water inleakage is suspected in drums on uncovered pads. The Interim Solid Waste Task Team is charged with defining storage options for safe and compliant storage of pad stored TRU wastes for the next decade.

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3. W. P. Martin, "SRP Decontamination and Decommissioning Scoping Study, DPST-85-793, June 1986.
4. H. E. Hootman, "Characterization of Solid Transuranic Wastes Being Stored at SRP", DPST-78-326, June 14, 1978.

Table 1 Alpha Waste Categories

Category	Type	Volume, cu.ft.	Activity, Ci	% Volume	% Activity
1. WIPP Qualified (Alpha wastes have Half-life > 20 years and are > 100 nCi/g)	Drums	7563	1311		
	Boxes	55851	10660		
	Culvert	53424	97618		
	Sub-Total	116838	109589	11.33	13.04
2. Less than 10nCi/g	Drums	104536	76		
	Boxes	39407	12		
	Culvert	949	11		
	Sub-Total	144892	99	14.05	0.01
3. Between 10 and 100 nCi/g	Drums	20621	271		
	Boxes	17983	145		
	Culvert	1398	85		
	Sub-Total	40002	501	3.88	0.06
4. Exceeds WIPP Waste Acceptance Criteria	Non-Culvert	0	0		
	Culvert	10005	234370		
	Sub-Total	10005	234370	0.97	27.89
5. Unaddressed Concrete Pours Cm, Cf, high Pu-238.	Non-Culvert	0	0		
	Culvert	62192	231930		
	Sub-Total	62192	231930	6.03	27.60
6. Non-TRU Induced Activity Fission Products	Non-Culvert	23213	0		
	Culvert	11963	0		
	Sub-Total	35176	0	3.41	0.00
Retrievable TRU	Total, FY1994	409105	576489	39.68	68.61
7. Projected D&D and Operations Generated Wastes, 1994-2023	Non-Culvert	594424	33800		
	Culvert	27610	230007		
	Sub-Total	622034	263807	60.32	31.39
Retrievable TRU	Total, FY2023	1031139	840296	100.00	100.00

NOTE: The alpha waste categories are more fully defined in Table 3.

Table 2 Alpha Waste in 2023

Category	Type	Volume, cu.ft.	Activity, Ci	% Volume	% Activity
1. WIPP Qualified Alpha wastes have half-life > 20 years and > 100 nCi/g	Drums	24294	4859		
	Boxes	179404	39543		
	Culvert	72392	165240		
	Sub-Total	276090	209642	26.78	24.95
2. Less than 10nCi/g	Drums	335490	282		
	Boxes	126335	44		
	Culvert	1348	11		
	Sub-Total	463173	337	44.92	0.04
3. Between 10 and 100 nCi/g	Drums	66027	1005		
	Boxes	57580	528		
	Culvert	1832	145		
	Sub-Total	125439	1678	12.17	0.20
4. Exceeds WIPP Waste Acceptance Criteria	Non-Culvert	0	0		
	Culvert	13558	396709		
	Sub-Total	13558	396709	1.31	47.21
5. Unaddressed Concrete Pours Cm,Cf, high Pu-238	Non-Culvert	0	0		
	Culvert	62192	231930		
	Sub-Total	62192	231930	6.03	27.60
6. Non-TRU Induced Activity Fission Products	Non-Culvert	74475	0		
	Culvert	16212	0		
	Sub-Total	90687	0	8.79	0.00
TOTAL		1031139	840296	100	100

NOTE: The Alpha Waste Categories are more fully defined in Table 3.

The distribution of the relative volumes and activities in the predicted alpha wastes are assumed to be the same as the stored wastes except for Category 5.

Table 3 Definition of Alpha Waste Categories

Tables 1 and 2 summarize the current and future TRU waste disposition categories derived from COBRA records of low (drummed and boxed waste < 0.5 Curies per drum) and high activity (culvert stored wastes > 0.5 Curies per drum). It appears that these alpha wastes can be effectively allocated into seven waste disposition categories as follows:

Category 1. Waste that is greater than 100 nCi/g and has a half-life less than 20 years that can go to WIPP with little or no processing if they can be fit into DOT approved containers. Qualified culvert waste and boxed waste may need to be removed from their secondary containers.

Category 2. Waste that is less than 10 nCi/g will stay at SRS. This waste might be considered mixed waste because TRU mixed waste was not segregated until about 1988. COBRA does not identify mixed wastes. Since 1988, less than 10,000 cu. ft. of all TRU wastes have been entered in COBRA.

Category 3. Waste that is between 10 and 100 nCi/g and is proclaimed mixed waste will stay at SRS. This waste category exists because the lower limit definition of TRU was changed in 1984.

Category 4. Waste that exceeds WIPP Waste Acceptance Criteria (WAC). This waste exceeds the gas generation limit of 130 Ci per drum or exceeds the 150g per container criticality limit for Pu-239. The drum limit for Pu-239 is 195 grams, however the container limit was used because of boxed wastes also being in culverts.

Category 5. Waste that WM considers an ER problem and is not addressed in the current WM strategic plan. The Curium and Californium are not considered transuranic because of their short half-lives. This waste includes offsite shipments from Mound and Los Alamos.

Category 6. Waste that is not transuranic and non alpha emitting. This waste is fission products (FP), induced activity (IA) and various forms of uranium and other reactor target matrix materials that ended up mixed in with the transuranic wastes.

Category 7. Projected TRU waste receipts during the period ending 2022 (assumes no prior shipments of TRU waste to a national transuranic waste repository). Projected waste volumes were taken from Table 5. Projected waste activities were derived from data of isotope weight per unit volume of waste from Table 8.

Table 4 Historical Culvert TRU Waste Receipts

Year	999-MSC	999-MND	773-A	772-F	235-F	221-F	221-FBL	221-FJB	221-H	221-HBL	105-K	Miscellaneous	TOTAL
Projected Waste Volume in Cubic Feet													
1964													0
1965			10										10
1966			53	255	139	586			388	70		50	1541
1967			203	172	54	199			93				721
1968			437	142		638		98	363	29			1707
1969			4442	121	329	837			205	84			6018
1970			2980	87									3067
1971	473	8805	1707	318	1109	647		788	258	390			14493
1972	498	410	2436	99	374		56	1400		471	592		6334
1973			2534	236	162			559		369	334	210	4404
1974			1863	154	80	7		512		672	120	60	3468
1975			1802	355	128			392		328	713	44	3760
1976			1265	491	46	96	42	497		445	115	3	3000
1977			364	392	23		276	314	7	615	117		2108
1978			286	406	285		895		4	354		95	2306
1979			202	667	851		810			423	908		3189
1980			248	854	1018		960	45		898	135		4154
1981			528	748	1110		1201			770	270		4628
1982			117	762	985		1162			1010	705	16	4788
1983	991		47	857	736		920			874	270	7	4702
1984			2285	483	1089		1136			1177	585	28	6763
1985			14	356	35		2184			569		21	3179
1986			7	835			3248			315	240		4645
1987				889			1809			889			3586
1988				404			1778			334			2519
1989	128			35	105		1204			742			2214
1990			26	63	309		700			805	81	7	2003
1991				14	213		343			511			1081
1992				14	14		35			448			511
Total Waste Received	2088	9215	23886	9920	9142	3010	18758	4605	1316	13588	4593	542	100663

Table 5 Historical Non-Culvert TRU Waste Receipts

Year	773-A	772-F	235-F	221-F	221-FBL	221-FJB	221-H	221-HBL	Miscellaneous	TOTAL
Waste Volume in Cubic Feet										
1974	514	102	104			805		290		1815
1975	674	370	279			1477	112	99	60	3078
1976	789	602	86		21	875	54	58	38	2523
1977	871	1043	61	7	707	946		218	77	4030
1978	1367	630	98		2492			182		4769
1979	1306	2168	360		1949			360	112	6275
1980	1895	1590	1119		3363	7		1003	203	9169
1981	1560	2101	1741		3612			1589		10603
1982	1198	1365	1653		3661			1351		9228
1983	1843	1556	439		3679	105		863		8405
1984	1914	1502	189		5866			1393		10864
1985	1484	1236			8416			4529	7	15672
1986	619	588	4		21483			6700		29394
1987	543	572			7700			10672		19487
1988	367	410			14063			3864	90	18794
1989	360	287			5845			1400		7892
1990	329	217	77		21848			10801	77	33349
1991	291	200			18320			36351	52	55214
1992	103	63			476			0		642
Total Waste Received	18127	16602	6229	7	123398	4215	166	81743	716	251203

Table 6 HB-Line D&D Waste Generation Data

Year, CY	Variety	Container	COBRA Grams	Culvert Cubic Feet	non-Culvert Cubic Feet	Low Alpha Alpha Waste Cubic Feet	Low Level Beta-Gamma Cubic Feet	Number of Containers
1984	RP	B-25	0			864		10
	RP	B-25	0				672	7
	RP	BB	0				201	25
	Np-237	Drum	0	7				1
	Pu-238	BB	1.7	70				89
	Pu-238	Drum	708	469				67
	Pu-238	B-12	0			402		9
	Pu-238	B-25	0.021			6048		97
	Pu-238	BB	0			1022		128
	Pu-238	Misc	0			3234		
	Pu-238	B-25	0.003				1728	19
	Pu-238	BB	0				162	23
	Pu-238	Drum	0		1386			198
1985	Pu-238	Drum	1413	553				79
	Pu-238	Misc	2.54	16				2
	Pu-238	B-25	0.01				14880	165
	Pu-238	BB	0				162	20
	Pu-238	Drum	0		4529			647
1986	Np-237	Drum	0		7			1
	Pu-238	B-25	0				9000	100
	Pu-238	B-25	0		90			1
	Pu-238	BB	111.5		1500			1
	Pu-238	Drum	0		1050			150
1987	Np-237	Drum	0	16				2
	Np-237	Misc	0				40	
	Pu-238	Drum	671	873				125
	Pu-238	BB	0				360	45
	Pu-238	BB	264.1		6080			4
1988	Np-237	Drum	0		7			1
	Pu-238	Drum	275	334				48
1989	Np-237	Drum	0	39				5
	Np-237	Drum	0		28			4
	Pu-238	Drum	103	700				95
	Pu-238	B-25	0				8820	98
	Pu-238	Drum			712			97
	Pu-238	BB			1500			1
	Pu-238	Filter Box					128	16
1990	Np-237	Drum	1904	63				9
	Pu-238	B-25	0				18090	201
	Pu-238	BB	83		10584			7
	Pu-238	Filter Box	0				80	10
1991	Pu-238	B-25	0				8280	92
	Pu-238	BB	70		36288			24
	Pu-238	Filter Box	0				64	8
1992	Pu-238	B-25	0				360	4
	Pu-238	B-12	0				450	
	Pu-238	B-25	0				12600	140
1993	Pu-238	B-25					16920	188
1994	Pu-238	BB			40824			27
Total			5607	3778	104585	11570	92997	

Table 7 FB-Line D&D Waste Generation Data

Year	Variety	Container	COBRA	Culvert	non-Culvert	Concrete	Low Level	Low Level
			Grams	Cubic Feet	Cubic Feet	Pour	Alpha Waste	Beta-Gamma
						Cubic Feet	Cubic Feet	Cubic Feet
1972	Pu-239	Drum	21.4	6				
	Pu-239	Misc	44	50				
	Pu-239	B-12	3.2			48		
	Pu-239	B-25	24			742		
	Pu-239	BB	64			2963		
	Pu-239	Drum	12.8			27		
	Pu-239	Misc	48			703		
	Pu-239	B-12	50.6	44				
	Pu-239	BB	6.4	540				
	Pu-239	Drum	288	178				
	Pu-239	Misc	680	638				
	Pu-239	B-12	0.18				1243	
	Pu-239	B-25	0.795				1713	
	Pu-239	BB	12.12				11034	
	Pu-239	Drum	3.84				48	
	Pu-239	Misc	9.74				8639	
	Pu-239	Drum	4.72					1
1973	FP	Misc	0				27	
	FP	BB	0					302
	FP	Misc	0					80
	Pu-239	B-12	0			46		
	Pu-239	B-25	9.6			282		
	Pu-239	BB	41.6			2644		
	Pu-239	Misc	12			164		
	Pu-239	BB	6.24	160				
	Pu-239	Drum	1148	336				
	Pu-239	Misc	177	63				
	Pu-239	B-12	21.4				862	
	Pu-239	B-25	19.08				1064	
	Pu-239	BB	18.2				10784	
	Pu-239	Drum	0				14	
	Pu-239	Misc	232.5				11018	
	Pu-239	Misc	3.52					28
1974	Pu-239	Drum	1359.8	361				
	Pu-239	Misc	414.12	151				
	Pu-239	B-12	0				752	
	Pu-239	B-25	0				387	
	Pu-239	BB	0				734	
	Pu-239	Drum	0				13	
	Pu-239	Misc	26.24				8646	
	Pu-239	B-12	0					90
	Pu-239	Misc	0					244
	Pu-239	Drum	0		805			
	Pu-238	Misc	0				26	

Table 7 FB-Line D&D Waste Generation Data

Year	Variety	Container	COBRA Grams	Culvert Cubic Feet	non-Culvert Cubic Feet	Concrete Pour Cubic Feet	Low Level Alpha Waste Cubic Feet	Low Level Beta-Gamma Cubic Feet
1975	FP	Misc	0					64
	DJ	Drum	0	6				
	Pu-239	Drum	1530.18	384				
	Pu-239	B-12	0				858	
	Pu-239	B-25	0				194	
	Pu-239	BB	0				1945	
	Pu-239	Drum	0				20	
	Pu-239	Misc	0.1				5568	
	Pu-239	B-12	0					92
	Pu-239	Drum	0					9
	Pu-239	Misc	0					350
	Pu-239	Drum	19.06		1477			
	Nat. U	Drum	0	2				
1976	Pu-239	Drum	1839.34	497				
	Pu-239	B-12	0				680	
	Pu-239	B-25	0				952	
	Pu-239	BB	0				1483	
	Pu-239	Drum	0				49	
	Pu-239	Misc	0				5584	
	Pu-239	B-12	0					48
	Pu-239	Misc	0					115
	Pu-239	Drum	5		875			
1977	FP	Misc	0				126	
	OT	Misc	0				10	
	Pu-239	Drum	1255.58	301				
	Pu-239	Misc	1.86	13				
	Pu-239	B-12	0				790	
	Pu-239	B-25	0				384	
	Pu-239	BB	0				844	
	Pu-239	Drum	0				30	
	Pu-239	Misc	0				4288	
	Pu-239	Drum	0					8
	Pu-239	Misc	0					60
1977	Pu-239	Drum	0		939			
1978	Pu-239	BB	0				102	
1980	Pu-239	Drum	36.3	14				
	Pu-239	Misc	10.49	31				
	Pu-239	BB	0				108	
	Pu-239	Misc	0				86	
	Pu-239	Drum	3.5		7			
1983	Pu-239	BB	0				444	
	Pu-239	Drum	0		105			
Total			9464.49	3775	4208	7619	81549	1491

Table 8 Definition of D&D Critical Planning Parameters

A. Old HB-Line

D&D Floor Area sq. ft.	5,000
Cleanup Time, Years	8
Cost, \$ Millions	12.5
Man-years	250

TRU Waste	Isotope	Volume, cu. ft.	Grams	Curies (As generated)
a. Culvert	Pu-238	3778	3175	54,610
b. Non-Culvert	Pu-238	104,585	529	9,099
c. Total		108,360		

B. Old FB-Line

D&D Floor Area sq. ft.	7,500
Cleanup Time, Years	6

TRU Waste	Isotope	Volume, cu. ft.	Grams	Curies (As generated)
a. Culvert	Pu-239	3775	8869	552
b. Non-Culvert	Pu-239	93,376	571	36
c. Total		97,151		

C. Waste Generation and Characterization Factors

1. Culvert fraction of Waste Volume 4 percent
2. D&D TRU Waste Generation Factors:
 - a. Pu-238 is 21 cubic feet per sq.foot contaminated floor area.
 - b. Pu-239 is 13 cubic feet per sq.foot contaminated floor area.
3. Projected waste activities were derived from data of isotope weight per unit volume of waste from Tables 4 and 5 as follows:

<u>Isotope</u>	<u>Culvert</u>	<u>Non-Culvert</u>
Pu-238	0.84 g/ft3	0.005 g/ft3
Pu-239	2.35 g/ft3	0.006 g/ft3

Table 9 Projected Alpha Wastes

Year	773-A	772-F	235-F	221-FBL	221-HBL	Complex 21 Vault	TOTAL
Waste Volume in Cubic Feet							
1993	110	220		687	800		1817
1994	110	550		2000	41794		44454
1995	10000	550		2000	25770		38320
1996	10000	550	10000	2000	25770		48320
1997	10000	550	20000	2000	25200		57750
1998	10000	550	20000	2000	1900		34450
1999	110	550	20000	2000	1900		24560
2000	110	550	20000	2000	1900		24560
2001		550	20000	2000	1900		24450
2002		550	20000	2000	1100		23650
2003		550	10000	2000	10000		22550
2004		550		2000	20000		22550
2005		550		2000	20000	1000	23550
2006		330		1413	20000	2000	23743
2007		330		900	20000	2000	23230
2008		330			20000	2000	22330
2009		330			20000	2000	22330
2010		330		7200	10000	2000	19530
2011		330		14400		2000	16730
2012		330		14400		2000	16730
2013		220		14400		2000	16620
2014		220		14400		2000	16620
2015		220		14400		2000	16620
2016		110		14400		2000	16510
2017		110		7200		2000	9310
2018		110				2000	2110
2019		110				2000	2110
2020		110				2000	2110
2021		110				2000	2110
2022		110				2000	2110
2023						200	200
Total Waste	40440	10560	140000	127800	268034	35200	622034

Table 10 Projected Culvert TRU Waste Receipts

Year	773-A	772-F	235-F	221-FBL	221-HBL	Complex 21 Vault	TOTAL
Projected Waste Volume in Cubic Feet							
1993		20		200	800		1020
1994	10	50		200	970		1230
1995	400	50		200	970		1620
1996	400	50	400	200	970		2020
1997	400	50	800	200	400		1850
1998	400	50	800	200	100		1550
1999	10	50	800	200	100		1160
2000	10	50	800	200	100		1160
2001		50	800	200	100		1150
2002		50	800	200	100		1150
2003		50	400	200	400		1050
2004		50		200	800		1050
2005		50		200	800	100	1150
2006		30		100	800	200	1130
2007		30			800	200	1030
2008		30			800	200	1030
2009		30			800	200	1030
2010		30		200	400	200	830
2011		30		400		200	630
2012		30		400		200	630
2013		20		400		200	620
2014		20		400		200	620
2015		20		400		200	620
2016		10		400		200	610
2017		10		200		200	410
2018		10				200	210
2019		10				200	210
2020		10				200	210
2021		10				200	210
2022		10				200	210
2023		10				200	210
Total Projected Waste	1830	870	5600	5500	10210	3700	27610

Table 11 Projected Non-Culvert TRU Waste Receipts > 100 nCi/g

Year	773-A	772-F	235-F	221-FBL	221-HBL	Complex 21 Vault	TOTAL
Projected Waste Volume in Cubic Feet							
1993	24	48		487	0		767
1994	24	119		429	9617		10189
1995	2285	119		429	5902		8735
1996	2285	119	2285	429	5902		11020
1997	2285	119	4570	429	5902		13305
1998	2285	119	4570	429	429		7632
1999	24	119	4570	429	429		5571
2000	24	119	4570	429	429		5571
2001		119	4570	429	429		5647
2002		119	4570	429	238		5356
2003		119	2285	429	2285		5118
2004		119		429	4570		5118
2005		119		429	4570	215	5333
2006		72		313	4570	429	5384
2007		72		215	4570	429	5286
2008		72			4570	429	5071
2009		72			4570	429	5071
2010		72		1666	2285	429	4452
2011		72		3332		429	3833
2012		72		3332		429	3633
2013		48		3332		429	3809
2014		48		3332		429	3809
2015		48		3332		429	3809
2016		24		3332		429	3785
2017		24		1666		429	2119
2018		24				429	453
2019		24				429	453
2020		24				429	453
2021		24				429	453
2022		24				429	453
Sub-Total Projected Waste	8236	2262	31990	29487	61267	7508	142008

Table 12 Projected Non-Culvert TRU Waste Receipts 10 to 100 nCi/g

Year	773-A	772-F	235-F	221-FBL	221-HBL	Complex 21 Vault	TOTAL
Projected Waste Volume in Cubic Feet							
1993	22	44		108	0		174
1994	22	111		400	9063		9596
1995	2131	111		400	5506		8148
1996	2131	111	2131	400	5506		10279
1997	2131	111	4262	400	5506		12410
1998	2131	111	4262	400	400		7304
1999	22	111	4262	400	400		5195
2000	22	111	4262	400	400		5195
2001		111	4262	400	400		5173
2002		111	4262	400	222		4995
2003		111	2131	400	2131		4773
2004		111		400	4262		4773
2005		111		400	4262	200	4973
2006		67		292	4262	400	5021
2007		67		200	4262	400	4929
2008		67			4262	400	4729
2009		67			4262	400	4729
2010		67		1554	2131	400	4152
2011		67		3108		400	3575
2012		67		3108		400	3575
2013		44		3108		400	3552
2014		44		3108		400	3552
2015		44		3108		400	3552
2016		22		3108		400	3530
2017		22		1554		400	1976
2018		22				400	422
2019		22				400	422
2020		22				400	422
2021		22				400	422
2022		22				400	422
Total Projected Waste	8612	2131	29834	27155	57237	7000	131970

Table 13 Projected Non-Culvert TRU Waste Receipts < 10 nCi/g

Year	773-A	772-F	235-F	221-FBL	221-HBL	Complex 21 Vault	TOTAL
Projected Waste Volume in Cubic Feet							
1993	48	102		258	0		408
1994	48	264		967	22039		23318
1995	5178	264		967	13386		18795
1996	5178	264	5184	967	13386		24979
1997	5178	264	10368	967	13386		30163
1998	5178	264	10368	967	966		17743
1999	48	264	10368	967	966		12613
2000	48	264	10368	967	966		12613
2001		264	10368	967	966		12565
2002		264	10368	967	535		12134
2003		264	5184	967	5179		11594
2004		264		968	10363		11595
2005		264		968	10363	480	12075
2006		157		704	10363	966	12190
2007		157		481	10363	966	11957
2008		157			10363	966	11486
2009		157			10363	966	11486
2010		157		3774	5179	966	10076
2011		157		7554		966	8677
2012		157		7554		966	8677
2013		102		7554		966	8622
2014		102		7554		966	8622
2015		102		7554		966	8622
2016		48		7554		966	8568
2017		48		3774		966	4788
2018		48				966	1014
2019		48				966	1014
2020		48				966	1014
2021		48				966	1014
2022		48				966	1014
Total Projected Waste	20904	5011	72576	65921	139132	16902	320446

Table 14 Disposition of Current Retrievable TRU Waste

Waste Stream Location	Activity	Isotope	Volume, cu.ft.	Curies (1994)
1 From Pad to LATF	non-Culvert Drums Only	Pu-238	35329	1367
		Pu-239	92373	258
		Np-237	2272	1
		Am-241	2746	32
		Total	132720	1658
2 From LATF to WIPP >100 nCi/g	non-Culvert Drums Only	Pu-238	7046	1290
		Pu-239	482	17
		Np-237	0	0
		Am-241	35	4
		Total	7563	1311
2 From LATF to LAW 10 to 100 nCi/g	non-Culvert Drums Only	Pu-238	4004	73
		Pu-239	13966	169
		Np-237	129	1
		Am-241	2522	28
		Total	20621	271
2 From LATF to LLW < 10 nCi/g	non-Culvert Drums Only	Pu-238	24279	4
		Pu-239	77925	72
		Np-237	2143	0
		Am-241	189	0
		Total	104536	76
3 From Pad to HATF	non-Culvert non Drums	Pu-238	62043	10606
		Pu-239	50692	202
		Np-237	86	0
		Am-241	420	9
		FP,IA,U, etc.	23213	0
		Total	136454	10817
3 From Pad to HATF	Culvert	Pu-238	28820	322481
		Pu-239	34610	9506
		Np-237	1108	11
		Am-241	1239	85
		FP,IA,U, etc.	11963	0
		Total	77740	332083
4 From HATF to WIPP	Culvert	Pu-238	18888	88248
		Pu-239	34537	9370
		Np-237	0	0
		Am-241	1239	85
		Total	54664	97703
4 From HATF to TBD >130 Ci Pu-238 >150g Pu-239	Culvert	Pu-238	9932	234234
		Pu-239	73	136
		Np-237	0	0
		Am-241	0	0
		Total	10005	234370

Table 14 Disposition of Current Retrievable TRU Waste

Waste Stream	Location	Activity	Isotope	Volume, cu.ft.	Curies (1994)
4 From HATF to		Culvert	Pu-238	0	0
TBD			Pu-239	0	0
<100 nCi/g			Np-237	1108	11
			Am-241	0	0
			FP,IA,U, etc.	11963	0
			Total	13071	11
4 From HATF to		non-Culvert	Pu-238	55236	10585
WIPP		Not Drums	Pu-239	604	65
>100 nCi/g			Np-237	0	0
			Am-241	11	9
			Total	55851	10659
4 From HATF to		non-Culvert	Pu-238	1251	19
TBD		Not Drums	Pu-239	16676	126
10 to 100 nCi/g			Np-237	0	0
			Am-241	56	0
			Total	17983	145
4 From HATF to		non-Culvert	Pu-238	5556	1
TBD		Not Drums	Pu-239	33412	11
<10 nCi/g			Np-237	86	0
			Am-241	353	0
			FP,IA,U, etc.	23213	0
			Total	62620	12

Inventory based on COBRA records of 99.6% of non-Culvert and 98.6% of Culvert records before mid-1992.

Might be considered all mixed waste because TRU waste that is unmixed (that generated since 1988) is less than 10,000 cubic feet.

This waste is currently considered an ER concern in the SW Strategic Plan

Waste Stream	Location	Activity	Isotope	Volume, cu.ft.	Curies (1994)
Unaddressed	Mound & LANL	Culvert	Pu-238	10315	214000
Unaddressed	SPS	Pours	Pu-238	1611	455
Unaddressed	SPS	Pours	Pu-239	9202	40
Unaddressed	SPS	Pours	Np-237	294	0
Unaddressed	SPS	Pours	Am-241	150	1
Unaddressed	SRTC	Culvert	Cm-244	12643	15485
Unaddressed	SRTC	non-Culvert	Cm-244	1198	305
Unaddressed	SRTC	Pours	Cm-244	15892	1644
Unaddressed	SRTC	Culvert	Cf-252	8788	0
Unaddressed	SRTC	non-Culvert	Cf-252	1360	0
Unaddressed	SRTC	Pour	Cf-252	739	0
			Total	62192	231930

Figure 1 Current Transuranic Solid Waste Inventory Disposition

Figure 2 Projected Alpha Waste Generation

Figure 3 Current Retrivable TRU Waste Decay

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END