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**TRU Waste Cyclone Drum Incinerator
and Treatment System: April-June 1977**

Don F. Luthy, Toby C. Elswick and Jay W. Doty

January 25, 1978

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Contract No. EY-76-C-04-0053

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Task I: Cyclone incinerator development

Abstract

Activities conducted during the past quarter, in support of Cyclone Incinerator Development include the completion of an extended series of incinerator runs on radioactively contaminated wastes and the analysis of data on rates of combustion, scrubber solution generation, and feed material make-up. Sections of the exhaust line and various test samples mounted in the system are being metallographically examined. A system for continuous feeding of the cyclone incinerator was designed.

Introduction

The Cyclone Drum Incinerator program is authorized by ERDA/DWPR. The primary

purpose of the program is to investigate the feasibility of the Cyclone Incinerator in reducing the volume of combustible TRU waste. In conjunction with this investigation, experiments are being performed so that the incinerator can be adapted to burn combustible wastes at other ERDA sites. Among these experiments are the determination of methods to treat scrubber liquids, incineration rates for different feeds, and the continuous burning of waste. A milestone chart for the program is given in Table 1.

Operational Capabilities (Milestone B)

VOLUME THROUGHPUT AND INCINERATION RATES FOR DIFFERENT FEEDS

Mass throughput for several feeds was determined. Solid, combustible waste generated in Mound's plutonium processing building and containing less than 10 nCi per gram of waste was incinerated. A

Table 1

MILESTONE CHART OF TASK I: CYCLONE INCINERATOR DEVELOPMENT

ACTIVITY	CURRENT YEAR			
	FY-1977			
A. Demonstration of Cyclone Incinerator				
B. Definition of Operational Capabilities				
C. Determination of Overall Volume Reduction				
D. Determination of Equipment Life				
E. Determination of Method to Treat Liquids				
F. Demonstration of Chamber Containment System				

total of 1574 kg was incinerated over a 66.16-hr period with an average throughput of 23.6 kg/hr (52 lb/hr).

During experiments performed on burning liquids in the Cyclone Incinerator (see Liquid Feed Section of this report), mixtures of tributyl phosphate and kerosene were burned at a rate of 4 gal/hr. Spent vacuum pump oils were also incinerated.

Liquid Feed To fulfill commitments incurred under the "Volume Reduction System for Solid and Liquid TRU Waste from the Nuclear Fuel Cycle" project, a series of experiments was performed to demonstrate the ability to burn liquids in the Cyclone Incinerator. Mixtures of tributyl phosphate (TBP) and kerosene up to 30 wt % TBP were successfully burned for periods approaching 7 hr without exceeding the capacity of the scrubber or off-gas handling components. Vacuum pump oil was also burned satisfactorily. For more detail see the April-June 1977 quarterly report for the "Volume Reduction System for Solid and Liquid TRU Waste from the Nuclear Fuel Cycle."

Continuous Feed An experimental system to investigate the effects of continuous feed to the Cyclone Incinerator System has been designed and is now being fabricated. The primary goal, at this time, is to determine whether continuous feed can exceed the performance of the batch feed operation in the following areas:

- 1) Quality of the off-gas, particularly hydrocarbon emissions.
- 2) Overall throughput by increasing on-stream time.
- 3) Equipment life by reducing large temperature fluctuations.

The equipment consists of a hopper from which feed flows by gravity through a rotary valve and a pneumatic feeder into the combustion chamber which is a 55-gal SS drum modified with a tangential chute to admit the feed/air mixture. The hopper is designed to be fed either manually or by a pneumatic conveyance system. No continuous ash handling or feed preparation systems are included in the system at this time because this experiment does not require their use. However, these functions will be added at a later date if the results, after initial experimental work is completed, justify investigation of a truly continuous system.

Determination of overall waste reduction (Milestone C)

Although one of the ultimate goals of waste reduction is to achieve a maximum reduction of the original volume regardless of weight reduction, the performance of waste reduction processes cannot be accurately measured by using volume reduction alone. Waste densities vary considerably and directly affect reduction measurements. For instance, a drum of wadded sheets of paper has the same volume as a drum of solidly-packed paper, but has a far lower weight. Naturally, the processing time for the wadded paper would also be much shorter. Therefore, both weight and volume reduction measurements are necessary to fully evaluate the performance of a volume reduction system. As a consequence of this recognition of the need for measurements of both volume and weight reduction, calculations of both reductions were made for the Cyclone Incinerator. A long-term series of incineration runs was used as a basis of data to reduce the

Table 2 - DETERMINATION OF OVERALL VOLUME REDUCTION

Feed Input	Material	Output Weight (kg)	Volume (m ³)
1574 kg in 9.172 m ³	Incinerator ash	86.9	0.153
	Solids in Scrubber Solution	76.6	0.086
	Solids from Waste Treatment	3.3	0.004
	Totals	166.8	0.243

variability encountered in individual runs. Forty-six drums of waste were incinerated during the series which extended over four months. These data are summarized in Table 2.

The weight of the waste was reduced from 1574 to 166.8 kg giving a reduction factor of 9.4 to 1, thus 89 wt % of the original feed was converted to gas. The volume reduction realized was 97%, a reduction factor of 37.8 to 1.

Determination of Equipment Life (Milestone D)

Corrosion samples and holders were fabricated and installed in the incinerator offgas system (see Figures 1 and 2). The samples include welded and nonwelded examples of stainless steel: types 304, 321, 347 and Carpenter 20; Hastelloy "C"; and a titanium alloy containing 5% aluminum and 2.5% tin. The first set of samples was exposed to off-gas containing phosphoric acid, which resulted from the combustion of a tributyl phosphate and kerosene mixture. This set was replaced and submitted for analysis.

A welded joint in a section of stainless steel exhaust line that had been preferentially attacked by the hot gas stream was metallographically analyzed. Electron microprobe analysis of the welded area showed a concentration of chromium at the surface. This concentration was a result of apparent sensitization of the stainless steel. The sensitized stainless steel was eroded and swept away by the gas stream.

A metal more resistant to this particular environment would naturally have had performance superior to the original exhaust line. The tests being run on the samples of metals which were selected to be superior to type 304 stainless steel are expected to indicate which are superior and to what degree in the incinerator environment. Subsequent to exposure in the incinerator, the metal samples are subjected to tensile strength comparisons with unexposed samples. Metallographic analyses are also performed to determine the method of deterioration, if any, and deterioration rates are calculated by the measurement of erosion as a function of the exposure time.

FIGURE 1 - Corrosion sample and holder.

FIGURE 2 - Corrosion sample being placed in the incinerator offgas system.

Methods to treat scrubber liquids (Milestone E)

A solution of sodium carbonate and water is used to scrub the incinerator off-gas. This solution is cycled through the system repeatedly and collects chlorides, sulfates, plutonium, and fly ash. The primary objective of this part of the incinerator development project is to remove these contaminants from this solution to permit continuous recycle. The contaminants and their concentrations in the solution must be determined to establish acceptable methods of removal.

Used scrubber solutions were analyzed to determine the concentration of the constituents, both before and after passage through bone char. The results of these analyses are presented in Table 3.

Table 3 - EFFECT OF BONE CHAR
ON SCRUBBER SOLUTIONS

	Unfiltered	Filtered Through Bone Char
Chloride (g/liter)	89.1	85.7
Carbonate (g/liter)	11.5	7.4
Sodium (g/liter)	65	63
Sulfate (g/liter)	14.6	5.4
Potassium (mg/liter)	280	290
Phosphate (mg/liter)	0.0	100
Calcium (mg/liter)	<25	<25
Cyanide (mg/liter)	3.4	2.5
Nitrate (mg/liter)	2.2	0.9

The value of bone char is limited, in the case of scrubber solution at least, to removing plutonium but little else from

the solution. After consideration of the concentration of the dissolved solids, it became clear that the removal of the water from the solids would be more economical and easier to accomplish than the removal of the solids from the water. In pursuit of this development direction, experiments will be conducted next quarter to ascertain possible difficulties with the proposed method.

Chamber containment (Milestone F)

Additions were made to the fume hood enclosing the combustion chamber to improve containment. Sliding metal doors were installed over the hand ports near the combustion chamber (Figure 3), and hinged Lexan* doors were added to the section of the fume hood which receives incoming drums of waste. These doors will be closed during burning to reduce the potential of dust spreading and to protect operators from hot particles in case a leak should occur in the combustion chamber.

A fire extinguishing system for the incinerator is being designed. The system will comprise a primary, dry extinguisher and a secondary, wet extinguisher. The dry system will be a manual, remotely operable system (probably using carbon dioxide as the extinguishing agent), and will be used to quickly extinguish normal combustion in the burning chamber in the event of an off-gas system failure. The wet system will also be manually and remotely operated and will use water to handle a situation involving an "in situ" combustion drum failure. The system is expected to be installed during the next quarter.

*Trademark of General Electric Corporation

FIGURE 3 - Sliding metal doors were installed over the hand ports.

Task II: Waste immobilization studies

Abstract

Cast concrete samples doped with plutonium-238 have been subjected to leach rate studies. Leach rates varied from a maximum of 66×10^{-12} g/cm²-day for an unrinsed sample during its first day of testing to a minimum of 3.28×10^{-12} g/cm²-day over an eight-week test.

Introduction

The objectives of this task are to evaluate various immobilization methods and to determine the existing and newly developing criteria for accepting immobilized waste product forms (low/intermediate level TRU-contaminated waste) for interim storage and terminal isolation. In addition, this program has as its objective the development of processes to effectively immobilize various waste residues such as sludges, resins, adsorbents, and incinerator ash.

Leach rate studies

A total of eleven concrete samples (Table 1) have been doped with plutonium-238 for measurement of plutonium leach rates. The samples were prepared by mixing Portland type 1A cement and distilled water with either incinerator ash, bone char, or sludge.

The doping process was conducted by adding plutonium nitrate to the dry ash or bone char, followed by heating in a furnace to expel the nitrate and oxidize the plutonium. After cooling, the cement and water

were mixed with the doped ash or bone char. The plutonium nitrate in the sludge samples was not oxidized because sludge is eighty percent water by weight, and drying would distort any comparison with undoped samples. Cement is simply added to the sludge to form concrete. All samples were cast in sealed plastic vials. They were cured for 28 days, removed from the plastic vials, measured for diameter, height, and weight, then suspended in a glass jar of distilled water. The water was changed after 24 hr, and weekly thereafter. Plutonium leach rates are shown in Table 2.

The sample surfaces were not rinsed prior to beginning the leach tests. Consequently, a relatively large amount of plutonium was leached at the end of the first day compared to the average leached in subsequent days (Table 3).

Geometric surface areas were used for calculating the leach rates shown in Table 1. Surface areas of four samples have been determined by gas absorption (Table 4). Table 5 shows plutonium leach rates of 30 wt % ash/70 wt % cement concrete samples, using surface areas as determined by gas absorption. Additional surface area data, as determined by gas absorption, will be collected next quarter from samples of both concrete and pressed pellets.

Pressed pellets

Portland type 1A cement and Lumnite* cement are mixed with incinerator ash, bone char, and sludge in cement ratios of 20 through 80 wt %, in increments of 10 percent. The resulting mixtures are either cast into concrete samples or

*Trademark of Atlas Cement Company.

cold pressed into pellets. Concrete and pressed pellets will then be compared with respect to leachability, density, crush strength, mechanical strength, and waste loading factors. Data have been collected for the waste loading factors of several concrete and pressed pellet ash mixtures (Table 6). The maximum loading for concrete fixation

appears to be 30 wt % if a reasonable crush strength is to be maintained. A much higher weight percent loading can be obtained with pressed pellets. Pressed pellets are virtually void of water, reducing the problem of gas buildup caused by radiolysis of water. Crush strength data will be presented next quarter.

Table 1 - SAMPLES FOR STUDY OF PLUTONIUM LEACH RATES

Sample	Waste (g)	Cement (g)	H ₂ O (g)	²³⁸ Pu
DCA-1	Ash III - 3.8	9.11	6.80	5.3 µg
DCA-2	Ash I - 4.0	16.0	8.00	1.12 mg
DCA-3	Ash I - 4.2	9.8	7.30	1.12 mg
DCA-4	Ash II - 4.0	16.0	8.00	1.12 mg
DCA-5	Ash II - 4.2	9.8	7.40	1.12 mg
DCA-6	Ash III - 4.0	16.0	8.00	1.12 mg
DCA-7	Ash III - 4.2	9.8	7.35	1.12 mg
DCA-8	Bone Char - 4	6.0	3.0	1.12 mg
DCA-9	Bone Char - 5	5.0	2.90	1.12 mg
DCA-10	Sludge - 10.54 ^a	5.64	-	2.24 mg
DCA-11	Sludge - 6.15 ^a	14.35	-	2.24 mg

^aEighty percent water by weight.

Table 2 - PLUTONIUM LEACH RATES
[g/(cm²-day) x 10⁻⁷]

Sample	1 Day	4 Weeks	8 Weeks
DCA-1	5.39	2.29	0.762 ^a
DCA-2	9.76	1.32	0.213
DCA-3	12.50	1.31	5.724
DCA-4	1.68	3.49	1.680
DCA-5	19.50	11.10	3.960
DCA-6	40.40	5.43	1.207
DCA-7	9.63	14.80	1.046
DCA-8	34.60	4.79	0.475
DCA-9	43.00	52.10	6.056
DCA-10	424.00	47.40	1.908
DCA-11	15.40	1.68	0.252

^aLeach rate at end of 12 weeks for this sample only.

Table 3 - COMPARISON OF PLUTONIUM
LEACHED PER DAY

Sample	Average Grams Plutonium Leached per day x 10 ⁻⁹		
	Day 1	Day 2 Thru Day 28	Day 29 Thru Day 56
DCA-2	6.29	0.89	0.27
DCA-3	5.59	1.66	1.00
DCA-4	7.71	0.76	0.40
DCA-5	9.64	1.68	8.78
DCA-6	19.10	1.88	0.73
DCA-7	4.43	2.01	1.63
DCA-8	21.30	1.20	1.23
DCA-9	13.60	5.42	3.66
DCA-10	448.00	41.00	185.94
DCA-11	14.90	0.56	0.91

Table 4 - SAMPLE SURFACE AREA DATA

Sample	Surface Area (m ² /gm)
Concrete - 30 wt % Ash	13.00
Concrete - 50 wt % Ash	16.43
Pressed Pellet - 30 wt % Ash ^a	5.44
Pressed Pellet - 40 wt % Ash ^a	4.92

^aPressed at 20,000 psi.

Table 5 - PLUTONIUM LEACH RATES
USING SURFACE AREA AS DETERMINED
BY GAS ABSORPTION

Sample	[g/(cm ² -day) x 10 ⁻¹²]		
	1 Day	4 Weeks	8 Weeks
DCA-3	33.45	11.40	5.18
DCA-5	66.00	11.48	13.42
DCA-7	30.21	13.88	3.28

Table 6 - LOADING RATES - CONCRETE
VS PRESSED PELLETS

Weight % Ash	Concrete (g Ash per cc Waste)	Pressed Pellets (g Ash per cc Waste)
20	0.30	0.50
30	0.44	0.62
40	0.56	0.82
50	0.71	1.0
60	-	1.15
70	-	1.33
80	-	1.50

Pellets pressed at 20,000 psi.

Task III: Acceptable TRU packaging for interim storage and/or terminal isolation

Introduction

The objectives of this task are to define acceptable TRU waste packaging for interim storage and/or terminal isolation. Information received on the TRU Packaging Questionnaire from solicited contractors has now been evaluated, and, along with timely follow-up site visits, an integrated contractor consensus has been formulated.

The basic application and criteria checklists have been prepared. These checklists, after review and finalization, will provide the information necessary to judge the acceptability of the TRU waste containers.

The ERDA TRU package transport system, which is a logical extension of the MRC's packaging studies, has continued as scheduled. This project will provide a consistent, unified, systematic approach to the entire ERDA TRU waste packaging and transportation picture.

Site visits

The MRC Project Team has been actively engaged this quarter in follow-up site visits with the low-level TRU waste generators, who supplied information to the TRU waste questionnaire. These follow-up visits were completed to clarify responses and to discuss significant program concerns.

A precise analysis of the information exchanges with the contractors dictate that both a drum configuration and a box geometry

(modular concept) are needed. This analysis and mutual packaging consensus is based on the following contractor requirements:

- 1) Present material handling systems
- 2) Current and future waste processing systems
- 3) Present material assay systems
- 4) Available modes of transportation

Of course, cost of any new packaging system is of extreme importance to the contractors, who have requested that the new system be lower and/or comparable to present packaging economics.

All of the contractors expressed interest in the study and offered full cooperation in any area determined to be of benefit in the accomplishment of TRU low-level packaging program goals.

Contractor questionnaire

The contractor questionnaire was transmitted to appropriate operations offices and contractors by ERDA/ALO in early February, 1977. The participating contractors whose data has been extracted and consolidated into this report are shown in Table 1.

Of the total low-level TRU waste generated during FY-1976A, significant differences in waste volume generation are noted at each site as illustrated in Table 2.

The TRU isotopes associated with the low-level waste are shown in Table 3. The predominant isotopes are, of course, plutonium-238 and plutonium-239. Other isotopes were reported in trace quantities; however, they are reported in the low-level waste volumes as required by ERDAM 0511.

Table 1 - THE FOLLOWING CONTRACTORS HAVE RETURNED THEIR TRU WASTE PACKAGING QUESTIONNAIRES TO MRC

AI	LASL
ANL-E	LBL
ANL-W	LLL
BMI	MRC
ARCHO	RI
EG&G	SRP
ORNL	

Table 2 - THE LOW-LEVEL TRU WASTE VOLUME VARIES SIGNIFICANTLY BETWEEN CONTRACTOR SITES

Contractors	Volume (ft ³)
RI	89,262
ARCHO	53,988
MRC	13,286
LASL	11,700
SRP	7,000
ANL-E	4,700
ORNL	3,850
LLL	2,535
LBL	395
BMI	287
AI	134
EG&G	7
TOTAL	187,144

Table 3 - THE ISOTOPES BELOW ARE BEING GENERATED IN LOW-LEVEL TRU DEFENSE WASTE

plutonium - 238, 239, 240, 241, 242
 curium - 244
 californium - 252
 berkelium - 249
 uranium - 233
 americium - 241, 243
 neptunium - 237

As noted in Table 2, the contractors reported a total low-level TRU waste generation volume of 187,144 ft³ for the period FY-1976 and FY-1976A. However, of that total volume, only 21.6% of this waste is categorized as combustible (hydrogenous) TRU waste. It would appear at this time, based on this composite information, that 78.4% of the low-level TRU waste generated in the FY-1976, 1976A period, is not combustible waste and would meet the present WIPP Acceptance Criteria dated June 17, 1977.

The transportation of the low-level TRU waste generated in FY-1976, 1976A is heavily dependent upon the ATMX railcar.

As shown in Table 4, of the total 187,144 ft³ of low-level TRU waste generated, 57.5% of the waste is stored at INEL (107,542 ft³), 40.9% of the waste is stored by contractors onsite, (76,538 ft³), and 1.6% of the waste is stored at NTS (3,064 ft³). One interesting and important observation obtained from the data was the large amount of low-level TRU waste generated during this period and stored onsite. One question becomes quite apparent: "If this on-site stored waste had to be shipped, could the present transport systems accommodate the increased volumes?"

The data received also support the fact that 71% of the low-level TRU waste generated in FY-1976, 1976A was packaged in a box geometry as shown in Table 5. Regarding drums, it was noted that 48,500 ft³ of waste is contained in 55-gallon drums. However, only 28,300 ft³ of the low-level TRU waste was contained in a DOT 17C drum with a high-density polyethylene (HDPE) liner. Approximately 14,500 ft³ of waste was packaged in a DOT 17C drum, and the remaining portion of the waste was packaged

Table 4 - TRANSPORTATION OF THE LOW-LEVEL TRU WASTE IS HEAVILY DEPENDENT ON THE ATMX RAILCAR

Poly Panther (truck)	4,740 ft ³
Supertiger (truck)	3,351 ft ³
ATMX Railcar	100,508 ft ³

Table 5 - SEVENTY-ONE PERCENT OF THE LOW-LEVEL TRU WASTE IS CURRENTLY PACKAGED IN A BOX GEOMETRY

55-gallon Drums

DOT 17H	5,750 ft ³
DOT 17C	14,500 ft ³
DOT 17C/HDPE Liner	28,300 ft ³

Boxes

FRP	125,100 ft ³
Steel	8,200 ft ³

Others

Corrugated Metal Pipe	4,500 ft ³
30-gallon Drums	800 ft ³

Table 6 - THE FY-1976, 1976A LOW-LEVEL TRU WASTE BREAKDOWN

<u>Waste Type</u>	<u>Ft³</u>
Equipment	81,568
Combustibles	40,438
Glovebox/Laboratory	39,785
Cemented Wastes	10,765
Dry Sludges	7,832
Absorbed Liquids	6,697
Others	59

in DOT 17H drums. A small volume (800 ft³) of low-level TRU waste was also packaged in DOT 17H 30-gallon drums.

In Table 6, the FY-1976, 1976A low-level TRU waste generation by type is shown.

The equipment and glovebox/laboratory waste types comprise approximately 65% of the TRU waste volume generated. Waste type categories were developed by consolidation of definitions supplied by the participating contractors. The low-level TRU waste type definitions are listed in Table 7.

The physical and chemical properties of low-level TRU waste types, physical forms, and hazardous properties are shown in Table 8. From the abstracted data, no major chemical or physical problems exist, and no hazards are foreseen in the packaged low-level TRU waste generated by the surveyed contractors.

Each waste category shown in Table 6 was expanded into greater detail as shown in Tables 9 through 15. The data represented in these Tables provide information on the generating agency, isotope, volume of generated waste, average concentration per package, storage, and transportation data.

Technical program meetings

Two meetings were sponsored by Mound Laboratory as part of our objective of achieving low-level TRU waste generator consensus on the TRU waste package acceptance criteria.

On May 4, 1977, Doug Turner and Bill Peachin of the Office of Waste Isolation visited Mound for a mutual exchange of information in relation to ERDA and Commercial TRU Low-Level Wastes. The meeting was informative, and from the discussions the following list of areas of mutual interest and concern was completed:

- 1) Comparable TRU low-level and intermediate level package acceptance criteria for ERDA and commercial.
- 2) The immediate need to develop and fabricate a new transport system for low and intermediate TRU waste.
- 3) Desirability of implanting a control procurement policy for quality assured waste containers for both ERDA and commercial wastes.

On June 2, 1977, MRC hosted a low-level TRU ERDA waste packaging meeting at Mound Laboratory. The meeting was attended by representatives of LASL, SLA, and OWI; it provided the opportunity for each representative to share pertinent packaging information and data in a form which was most useful in establishing preliminary TRU container acceptance criterion for application in both interim storage and terminal isolations. The results of this meeting are included in Appendix I.

Table 7 - LOW-LEVEL TRU WASTE TYPE DEFINITIONS

Equipment:	Decommissioned gloveboxes, equipment replacements, process tankage, machine tools, refractories, building rubble, ductwork, metal piping.
Combustibles:	Paper, rags, clothing, fabric, tissues, rubber gloves and tubing, wood, manipulator boots, plastics, resins.
Glovebox/Laboratory:	Process hardware, metal, glass, ceramics, small process equipment, instrumentation sources, graphite, refractories, asbestos- HEPA filters, tools.
Cemented Wastes:	Oils, caustics, neutralized solutions, organics, and sludges mixed directly with Portland Cement and/or a mixture of Portland Cement and Vermiculite.
Dry Sludges:	Process sludge resulting from treatment of aqueous waste solutions by carrier hydroxide precipitation, followed by clarification, dewatering with rotary vacuum filtration and drying.
Absorbed Liquids:	Acid and caustic solution, both neutralized and unneutralized, organic solutions and oils, absorbed on diatomaceous earth, bentonite clay, and calcium silicate.
Others:	Contaminated soil.

Table 8 - PHYSICAL AND CHEMICAL PROPERTIES AND
HAZARDS ASSOCIATED WITH LOW-LEVEL TRU WASTE TYPES

<u>Waste Type</u>	<u>Physical</u>	<u>Chemical</u>	<u>Hazards</u>
Equipment	Dry Solid Form Noncombustible	N/A	N/A
Combustibles	Dry Solid Form Combustible	Hydrogeneous	N/A
Glovebox/Laboratory	Dry Solid Form Noncombustible	N/A	N/A
Cemented Wastes	Solidified Liquid Noncombustible	Acidic Caustic Hydrogeneous	N/A
Dry Sludges	Dry Solid Form Noncombustible	Caustic	N/A
Absorbed Liquids	Absorbed Liquids	Acidic Caustic Organic	Oxidizing Reducing

Table 9 - LOW-LEVEL TRU WASTE WASTE CATEGORY - EQUIPMENT

<u>Agency</u>	<u>Isotope</u>	<u>ft³</u>	<u>Waste (nCi/g)</u>	<u>Storage</u>			<u>Transport</u>			
				<u>INEL</u>	<u>Onsite</u>	<u>NTS</u>	<u>ATMX</u>	<u>VAN</u>	<u>Supertiger</u>	<u>Polypanther</u>
ARHCO	Pu-239	43,368	325		X					
RI	Pu-239	32,500	35,000	X			X			
LASL	Pu-239	2,000	600		X					
MRC	Pu-238	200	< 100	X				X		
MRC	Pu-238	1,500	700,000	X			X			
SRP	Pu-239	2,000 81,568	5,000		X					

1. Percent of total waste 43.58% equipment in total waste volume
2. Isotope percentage Pu-239 (98%) Pu-238 (2%)
3. Average Content per package Pu-239 (325-10,000 nCi/g waste)
Pu-238 (<100-700,000 nCi/g waste)
4. Storage distribution INEL (41.9%) Onsite (58.1%)
5. Transport system ATMX (41.7%) Van (0.2%)

Table 10 - LOW LEVEL TRU WASTE
WASTE CATEGORY - COMBUSTIBLE

Agency	Isotope	ft ³	Waste (nCi/g)	Storage			Transport			
				INEL	Onsite	NTS	ATMX	Van	Supertiger	PolyPanther
ORNL	Pu-239	1925	1,000		X					
ARHCO	Pu-239	8689	2,880		X					
AI	Pu-239	67	8,100			X			X	
LLL	Pu-239	1500	21,000			X			X	
LLL	Pu-239 (U-233)	1035	4,500			X			X	
LBL	Pu-239	185	550			X			X	
RI	Pu-239	13,000	125	X			X			
LASL	Pu-239	4,000	600		X					
ANL-E	Pu-239	4,000	70	X						X
BMI	Pu-239	287	5,550	X					X	
MRC	Pu-238	380	520,000	X			X			
MRC	Pu-238	1,600	< 100	X				X		
SRP	Pu-238	2,100	> 10		X					
SRP	Pu-238	1,400	< 100		X					
		40,438								

1. Percent of total waste 21.60% Combustible in total waste volume
2. Isotope percentage Pu-239 (86.5%) Pu-238 (13.5%)
3. Average content per package Pu-239 (70-21,000 nCi/g waste)
Pu-238 (>10-520,000 nCi/g waste)
4. Storage distribution INEL (48.3%) Onsite (44.9%) NTS (6.8%)
5. Transport system ATMX (33.1%) Polypanther (10.5%) Supertiger (7.6%) Van (3.9%)

Table 11 - LOW-LEVEL TRU WASTE
WASTE CATEGORY - GLOVEBOX/LABORATORY

Agency	Isotope	ft ³	Waste (nCi/g)	Storage			Transport			
				INEL	Onsite	NTS	ATMX	Van	Supertiger	PolyPanther
ORNL	Pu-239	1,925	1,000		X					
ARHCO	Pu-239	1,872	1,080		X					
AI	Pu-239	30	8,100			X			X	
LBL	Pu-239	185	550			X			X	
EG&G	Pu-239	7	12,630	X				X		
RI	Pu-239	32,500	10,000	X			X			
LASL	Pu-239	800	100,000		X					
ANL-E	Pu-239	480	70	X						X
MRC	Pu-238	336	800,000	X			X			
MRC	Pu-238	200	< 100	X				X		
SRP	Pu-238	900	> 10		X					
SRP	Pu-238	600	< 100		X					
		39,785								

1. Percent of total waste 21.25% Glovebox/Laboratory in total waste volume
2. Isotope percentage Pu-239 (92.9%) Pu-238 (7.1%)
3. Average Content per package Pu-239 (70-12,600 nCi/g Waste)
Pu-238 (>10-800,000 nCi/g Waste)
4. Storage distribution INEL (84.1%) Onsite (15.4%) NTS (0.5%)
5. Transport system ATMX (82.5%) Polypanther (1.1%) Supertiger (0.5%) Van (0.5%)

Table 12 - LOW-LEVEL TRU WASTE
WASTE CATEGORY - CEMENTED WASTES

Agency	Isotope	ft ³	Waste (nCi/g)	Storage			Transport			
				INEL	Onsite	NTS	ATMX	Van	Supertiger	PolyPanther
LBL	Pu-238	25	550			X			X	
RI	Pu-239	640	400	X			X			
LASL	Pu-239	4,900	1,000		X					
MRC	Pu-238	5,200 10,765	200	X			X			

1. Percent of total waste 5.75% cemented waste in total waste volume
2. Isotope percentage Pu-238 (48.6%) Pu-239 (51.4%)
3. Average content per package (Pu-238 (200-550 nCi/g Waste)
Pu-239 (400-1000 nCi/g Waste)
4. Storage distribution INEL (54.3%) Onsite (45.5%) NTS (0.2%)
5. Transport system ATMX (54.3%) Supertiger (0.2%)

Table 13 - LOW-LEVEL TRU WASTE
WASTE CATEGORY - DRY SLUDGES

Agency	Isotope	ft ³	Waste (nCi/g)	Storage			Transport			
				INEL	Onsite	NTS	ATMX	Van	Supertiger	PolyPanther
Ri	Pu-239	7832 7832	3500	X			X			

1. Percent of total waste 4.18% dry sludges in total waste volume
2. Isotope percentage Pu-239 (100%)
3. Average content per package Pu-239 (3500 nCi/g Waste)
4. Storage distribution INEL (100%)
5. Transport system ATMX (100%)

Table 14 - LOW-LEVEL TRU WASTE
WASTE CATEGORY - ABSORBED LIQUIDS

Agency	Isotope	ft ³	Waste (nCi/g)	Storage			Transport			
				INEL	Onsite	NTS	ATMX	Van	Supertiger	PolyPanther
AI	Pu-239	37	8,100			X			X	
RI	Pu-239	2790	1,260	X			X			
MRC	Pu-238	3870 6697	25,000	X			X			

1. Percent of total waste 3.57% absorbed liquids in total waste volume
2. Isotope percentage Pu-238 (57.8%) Pu-239 (42.2%)
3. Average content per package Pu-238 (25,000 nCi/g Waste)
Pu-239 (1260-8100 nCi/g Waste)
4. Storage distribution INEL (99%) NTS (1%)
5. Transport system ATMX (99%) Supertiger (1%)

Table 15 - LOW-LEVEL TRU WASTE
WASTE CATEGORY - MISCELLANEOUS

Agency	Isotope	ft ³	Waste (nCi/g)	Storage			Transport			
				INEL	Onsite	NTS	ATMX	Van	Supertiger	PolyPanther
ARHCO	Pu-239	59	14,000 (Soil)		X					

1. Percent of total waste 0.03% soil in total waste volume
2. Isotope % Pu-239 (100%)
3. Average content per package Pu-239 (14,000 nCi/g Waste)
4. Storage distribution onsite
5. transport system

Table 16 - MILESTONE CHART

TASK III: ACCEPTABLE TRU PACKAGING FOR INTERIM STORAGE AND/OR TERMINAL ISOLATION				
ACTIVITY	FY-1977			
A. Review ERDA Manuals, Tariff #30, Technical Alternative Document and Federal Regulations	▲	▲		
B. Review Contractor Site Plans		▲	▲	
C. Review Technical Literature	▲		▲	
D. Prepare Project PERT Network		▲	▲	
E. Prepare and Distribute Contractor Questionnaire		▲	▲	
F. Characterize Basic Constraint Criteria			▲	▲
G. Project Team Site Visits	▲		▲	
H. Prepare Information Bank for Preliminary Acceptance Criteria		▲	▲	
I. DWPR Interim Report			▲	
J. Prepare Basic Application Checklist		▲	▲	▲
K. Verify Interim and Terminal Packages			▲	▲
L. Conceptual Package Design and Specifications				▲
M. Review with Contractors and DWPR				▲
N. Prepare and Publish Document				▲

Basic application checklist

The basic application checklist (Tables 17 and 18) was completed after receiving the waste packaging questionnaires from the ERDA waste generators and subsequent site visit follow-up for additional information. The checklist was developed to compile the low-level TRU waste shipping and storage containers for interim and onsite storage; it has 16 different packaging configurations currently in use for TRU waste storage. Plywood boxes covered with fiberglass-reinforced plastic and metal drums account for 92% of the total waste placed in interim storage for FY76-76A. The checklist includes the approximate total waste volumes (ft³) stored in each package configuration. The configurations vary due to onsite storage environments, limited size-reduction facilities, lack of standards, and costs. Wastes packaged as noncombustibles inside metal drums (checklist items 1 thru 7) and metal bins (item 14) could be readily acceptable to the terminal isolation facility. The remaining packaging configurations will be required to meet DOT shipping regulations or be shipped inside a reusable overpack meeting DOT shipping regulations. The configurations must also meet the design specifications of the terminal isolation facility which presently include, but are not limited to size, weight, % combustible, and handling.

Survey of container manufacturers

A survey of container manufacturers was initiated in June 1977 to determine if any commercially available containers are applicable to the shipment and storage of low-level TRU waste. The survey will provide an overview of current packaging technology and availability. A marketing information center has supplied a mailing

list of 4191 National Manufacturers in seven major container categories who are currently engaged in the manufacture of containers used for packaging and shipment of various industrial commodities. The manufacturers will be contacted by mail and invited to submit technical information on: container types; size, shape, internal volume; weight; closures; DOT certification (if applicable); performance data; unit and quantity cost. This data collection should be completed by the first quarter of FY78.

Safe TRU transport (STRUT) system

Presently there are many methods utilized by ERDA contractors to transport packaged TRU waste. Some of these methods are ATMX railcars, Super Tigers, large overpacks, and commercial vans. All phases of the nuclear industry are being closely scrutinized by a variety of bodies - the general public, special interest groups, and regulatory agencies. The transportation of nuclear materials is no exception. None of the existing transport systems can automatically be expected to economically and functionally transport the wide variety of TRU packages currently in inventory (or the upcoming standardized TRU package being developed by Mound Laboratory). The initial objective is to clarify the future transport question, which will lead to the development of a Safe TRU Transport (STRUT) system to meet ERDA contractor TRU waste shipping requirements.

The primary objectives of the STRUT Program during the previous quarter were:

- 1) Preparing data/decision base
- 2) Data analysis
- 3) Planning special support programs

Table 17 - BASIC APPLICATION CHECKLIST

Package Number	TRU Low-Level Waste Package Description	Volume ft ³ /m ³	Approx. Unit Cost
1	55-gallon steel drum, DOT 17H, zinc dipped, polyethylene (PE) bag liner	7.42 0.21	\$32.00
2	55-gallon steel drum, DOT 17H interior and exterior painted, PE bag liner	7.42 0.21	\$34.00
3	55-gallon stainless steel drum, DOT 17H, PE bag liner	7.42 0.21	\$135.00
4	55-gallon steel drum, DOT 17C, interior and exterior painted, PE bag liner	7.42 0.21	\$20.00
5	55-gallon steel drum, DOT 17C interior and exterior painted, 90 mil high density polyethylene (HDPE) liner when lead shielded \$60.00 additional	7.42 0.21	\$60.00
6	55-gallon steel drum, DOT 17C zinc dipped, 90 mil HDPE liner	7.42 0.21	\$60.00
7	30-gallon stainless steel drum, PE bag liner	4.01 0.11	\$70.00
8	30-gallon steel drum, interior and exterior painted PE bag liner, 2 each inside concrete cask	8.02 0.22	\$300.00
9	Corrugated metal pipe, zinc dipped, 2 1/2" diameter x 20' long	98 2.78	\$250.00
10	55-gallon steel drum, zinc dipped, 90 mil HDPE liner, inside concrete culvert	7.42 0.21	\$60.00
11	Welded steel box, 1/8" thick, PE bag liner, random sizes, will fit inside supertiger	Random	\$1000.00
12	Fiberglass reinforced polyester (FRP) plywood box, 4'x4'x7', PE bag liner	112 3.17	\$400.00 \$800.00
13	FRP plywood box, random sizes, PE bag liner	8-1500 .23-43	\$100.00 \$1000.00
14	Steel bin, 4'x5'x6', 12-gauge, 55 gallon DOT 17H steel drums or 1/2" thick plywood box placed inside	120 3.40	\$500.00
15	FRP plywood box, random, steel drums inside	Random	\$2900.00
16	FRP plywood boxes, cold rolled steel boxes, inside concrete culvert	Random	\$1320.00 \$8000.00

Table 18 - BASIC APPLICATION CHECKLIST

Package Numbers	RI	ARHCO	MRC	LASL	SRP	ORNL	ANL-E	LLL	LBL	BMI	AI	EG&G	ANL-W	Total Volume Per Waste Package Type
1								X	X					1430 ft ³ 40.5 m ³
2									X	X	X			421 ft ³ 11.9 m ³
3						X								1925 ft ³ 54.5 m ³
4		X		X										14561 ft ³ 412.4 m ³
5	X		X	X								X		23314 ft ³ 660.3 m ³
6					X									3000 ft ³ 85.0 m ³
7						X								1925 ft ³ 54.5 m ³
8				X										800 ft ³ 22.7 m ³
9				X										4500 ft ³ 127.4 m ³
10					X									2000 ft ³ 56.6 m ³
11								X						1500 ft ³ 42.5 m ³
12	X		X											79700 ft ³ 2257.2 m ³
13				X										2000 ft ³ 56.6 m ³
14							X							4700 ft ³ 133.1 m ³
15		X												43368 ft ³ 1228.2 m ³
16					X									2000 ft ³ 56.6 m ³
Total Volume														187,144 ft ³ 5,300 m ³

There are several fundamental questions which, when answered, will guide the STRUT development in the most productive direction.

- 1) Will rail mode be available for the transport of radioactive materials?
- 2) What regulatory changes can be expected and what will their impact be?
- 3) What are the systems/logistic features which will most effectively meet ERDA's TRU waste requirements?

These questions and many others have been pursued and the status to date is discussed in the following sections.

PREPARING THE STRUT DATA/DECISION BASE

The results of the contractor questionnaires have been compiled and are currently being used as a data base. Additional data are being gathered via a formal contact program (site visits, telecons, etc.). A consultant, Protective Packaging, Inc., is under contract to provide industrial analysis and assistance. Both the consultant and contract programs are providing continued input to the data base and have led to tentative positions on the previously listed questions.

Question No. 1: Will the rail mode be available for transport of radioactive materials?

Discussion - It appears that the ultimate answer will be yes, rail mode will be available/required to transport radioactive waste. A recent court decision was made against the railroads' "right" to "flag out" (not carry at all) radioactive materials.

Two pending court cases are expected to reinforce this decision. This isn't the end though, the question of "sole-use train" has not been answered. This is important because if "sole-use train" is required, then current economics could make rail transport unattractive with respect to highway transport. This is demonstrated in Table 19. As can be seen, the ATMX railcar is four times less expensive than the currently available highway mode (rental of Super Tiger). As long as the "sole-use train" requirement is not imposed, rail offers major economic advantages; but, as can be seen, if "sole-use train" is imposed, one has to have an eight-car train (minimum) to offer an economic advantage over highway transport. The cost of individual units, Super Tigers vs possible rail transport units, will be studied since these data will be critical in this comparison of transport economics.

Table 19 - COMPARATIVE COSTS OF TRANSPORT MODES

<u>Transport Mode</u>	<u>Cost Per ft³</u>
Highway (using Super Tiger)	\$10.80 ^a
Current ATMX Railcar	3.40
"Sole-Use Train" w/current ATMX Railcar(s)	
A) One car train	47.00
B) Four car train	14.50
C) Eight car train	8.90

^a Assumes ownership of Super Tiger - No Rental Cost. If rental is included, cost per ft³ becomes \$14.00.

Question No. 2: What regulatory changes can be expected and what will their impact be?

Discussion - Two major changes have been mentioned:

- 1) Increased length of thermal test from 0.5 hr. current to a possible 1 hr.
- 2) Increase temperature of thermal test from current 800°C to 1000°C.

In addition to present tests, a crush test is expected to be performed. This test is not expected to have a major impact on the STRUT system. The primary impact from the thermal test condition change is expected to be a reduction in volume available for transport utilization. Since the allowed widths for rail and highway are fixed, any increase in the thickness of thermal insulation required, will bring a reduction in useful volume.

Question No. 3: What are the STRUT system/logistics features which will most effectively meet ERDA's TRU waste transport needs?

Discussion - An effective STRUT system would most likely include both an approved highway and rail transport mode because not all sites generating waste have a rail siding. A combination of transport modes, e.g., highway to a railcar loading point, could prove practical and economical for small generators. This idea is being pursued.

The loading configuration of the different types of ERDA packaging (currently used) and TRU packaging being developed by Mound Laboratory are being considered.

The WIPP requirements are being analyzed to determine such items as:

- 1) Expected monthly through-put (volume).
- 2) Capacity of material handling systems, i.e., elevators, cranes, and fork lifts.
- 3) Staging plans above ground prior to disposal.
- 4) STRUT unit turn-around (unloading and return) time.
- 5) Ability of existing transport routes (roads and rail) to handle volume of the traffic.

The results of applicable OWI studies will also be analyzed for use in this study.

DATA ANALYSIS

A variety of models are presently in the conceptual design stage at Mound Laboratory. These models include different transport modes, transport systems, and packages. Conceptual designs take into consideration site needs, regulations, and WIPP capabilities for the most efficient transport and package-handling system. Special emphasis and interest are being placed on dual-purpose systems - those which work both on rail and highway. This will eliminate potential problems at sites without rail spurs and lower the transport cost for generators of small quantities of waste. Modal economics, material availability, and public relations are major bases for conceptual development.

After formalizing the conceptual models, one must be chosen for development. The data and information necessary to determine the optimum STRUT system to pursue will be compiled and an analysis begun early in FY-1978. A Modal Determination Matrix (MDM) will be implemented to determine which

STRUT system most effectively meets ERDA objectives. An outline of the technique is given in Table 20. This method identifies certain features that the STRUT system has to have - MUST's. All the MUST's need to be met for continued consideration of the model. Next, the desirable features are identified. Some will be highly desirable and some desirable, but to a lesser degree. The performance of each of the models, in fulfilling these WANTS, will be evaluated relative to one another. Thus, a performance score will result, and from the MDM will come a list of possible STRUT systems ranked in order of most-to-least effective in meeting ERDA requirements. From the MDM a ranking or first assessment can be made of the most promising STRUT system to pursue. The MDM is but one tool which will be used in making the determination of the final STRUT configuration.

RATE STUDY

The rate changes for the transport of radioactive waste will strongly influence the transport mode chosen. One specific project underway as part of this program is a detailed analysis of the freight rates - how they are determined, the factors of primary influence, and an analysis of how these factors will influence the future rates for highway and rail. One of the Project Team members attended a recent Executive Briefing by Drake Sheahan of Steward Dougall, Inc., on "Transportation Strategic Planning".

PACKAGE PERFORMANCE ASSURANCE PROJECT

The STRUT system will be designed for use with a specific type of packaging - DOT Specifications 7A, Type B, etc. In order

Table 20 - THE MODAL DETERMINATION MATRIX (MDM) FOR ANALYZING PROPOSED STRUT SYSTEMS

	Conceptual Models (One Optimum Model to be Chosen)			
	Model Number			
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Musts</u>				
° Capable of meeting regulatory requirements	Yes	No	Yes	Yes
° Meeting WIPP criteria	Yes	Yes	Yes	Yes
°				
°				
	<u>Go</u>	<u>No Go</u>	<u>Go</u>	<u>Go</u>
<u>Wants</u>				
° Compatibility with existing TRU packagins	80	70	40	40
° Economic Transport Rates	90	50	20	20
°	-	-	-	-
°	-	-	-	-
Total	700	-	550	400

to have a data base for transport of packages after removal from retrievable storage, dummy packages are proposed for storage in the retrieval array at all sites. These will then be removed and tested at some time in the future to demonstrate the performance characteristics of the packagings after storage. Contacts with retrievable storage sites have been initiated concerning this project and a favorable response received.

INITIAL PROCUREMENT COST STUDY

It is assumed that the STRUT units would be purchased by ERDA and/or its contractors, rather than rented. This means that the initial cost of the unit must be estimated and considered as part of the overall

economic picture. In addition, maintenance and replacement costs will also be considered.

A milestone chart for the transportation program is shown in Table 21.

Conclusions

The TRU Waste Packaging Design Criteria is placing considerable emphasis on the contractor questionnaires, literature survey, site visits, and technical meetings; however, finalization of the WIPP criteria for terminal isolation, which is still incomplete, is extremely critical to the schedule of 4 hrs project. This is particularly true in the areas of criteria for combustibles, gas-generating materials, and the pilot-plant criteria for container retrievability.

Table 21 - MILESTONE CHART

TASK III: DESIGN AND FABRICATION OF A SAFE TRU TRANSPORT SYSTEM FOR LOW-LEVEL CONTACT WASTE			
ACTIVITY	FY-1977		
A. Perform Transportation Study	▲	▲	
B. Assess NEEDS	▲	▲	
C. Investigate Transport Systems	▲		▲
D. Employ Independent Consultants	▲		▲
E. Develop Data Bank	▲		▲
F. Develop Basic Transport Criteria			▲

Appendix I

June 22, 1977

Mr. Robert Lowery
U. S. Energy Research and
Development Administration
Post Office Box 5400
Albuquerque, New Mexico 87115

Dear Mr. Lowery:

On Thursday, June 2, 1977, a meeting was held at Mound Laboratory, Miamisburg, Ohio, for the specific purpose of discussing proposed criteria for an acceptable TRU waste package for application in both interim storage and terminal isolation. A list of meeting attendees is shown in Attachment I.

Based on conversations and personal contacts with waste generators on our recent site visits, the agenda for the meeting was established (Attachment II), which provided the initial thrust for examining and discussing specific differences in the Wipp Criteria (Attachment III) and feelings shared by the contractors in relation to the criteria (Attachment IV).

The topics covered during the meeting stimulated interesting discussions by all attendees, and, after thoroughly reviewing each point with available factual data, a proposed, agreed upon definition and/or criteria acceptance was established (Attachment V) by the attendees. As you will notice, a definition for Low Level TRU Waste was proposed as was an associated definition of acceptable dose rate. These establish criteria for design of low level TRU waste containers. Combustibles were also defined. Under the proposed definition, the Fiberglass-reinforced Polyester Plywood Box (FRP) qualifies as a noncombustible package system.

Mr. Robert Lowery

June 22, 1977

All generators of low level TRU waste expressed concern about the packaging of combustible (hydrogenous) materials. A definition of Gas Generating Materials was proposed, which will permit packaging of hydrogenous solid waste in noncombustible containers under the restrictions of 0.0695 curies/liter of total TRU isotope concentration per volume of the waste container. At this concentration, gas generation (radiolysis) in the short term (20-120 yrs.) will not cause any terminal isolation facility pressure problems. This value may increase as additional experimentation is completed to provide factual documentation on the behavior of low level TRU waste in the salt environment.

Other decisions were proposed and adopted at the meeting as noted in Attachment V, however, the most important are those previously described. A complete composite of the entire meeting should be available for transmittal within the next few weeks, and will provide you with the specific information upon which these proposals were adopted.

Very truly yours,

Jay W. Doty, Jr.

JWD:wd
Attachments

cc: G. H. Daly, ERDA/DWPR
R. Glenn Bradley, ERDA/DWPR
B. L. Kelchner, Rockwell International

ATTACHMENT I

Attendees

TRU PACKAGING MEETING

Mound Laboratory
June 2, 1977

James D. Anderson	ARHCO	FTS 444-2670
H. A. Zweifel	ARHCO	FTS 444-2840
Gerald Maestas	LASL	FTS 843-7391
Dean Nelson	LASL	FTS 843-7391
John L. Warren	LASL	FTS 843-7391
Paul O'Brien	Sandia	FTS 475-9160
Bert Blanke	ERDA/DAO	FTS-774-3486
Dick Blauvelt	Mound	FTS 774-3698
J. W. Doty	Mound	FTS 774-3296
Joseph M. Garner	Mound	FTS 774-3465
Keith Gilbert	Mound	FTS 774-7239
Bernie Kokenge	Mound	FTS 774-3581
Howard Kreider	Mound	FTS 774-3309
Marshall Ledford	Mound	FTS 774-3230
Bruce Peterson	Mound	FTS 774-7288

ATTACHMENT II

AGENDA

LOW LEVEL TRU WASTE PACKAGE
PRELIMINARY CRITERIA

June 2, 1977

OS-206

- A. Welcome
- B. Definition of Low-Level Waste
- C. Dose Rate - Maximum Acceptance Value
- D. Isotope Restriction in Combustible Waste
- E. Combustible Percent in Package Material of Construction
- F. Fire Retardants - Flame Spread
- G. Absorbed Liquids
- H. Packaging Criteria - Short Term Until 1983
Long Term 1983 - On
- I. Waste Currently Stored
  - 1. Relationship to above problems
  - 2. Percentage of INEL waste that would be acceptable under conditions above
- J. WIPP Retrievable Concept - Time Period
- K. Closing Remarks

ATTACHMENT III

WIPP ACCEPTANCE CRITERIA

DEFINITIONS

A. Low-Level TRU Waste

Any solid waste material, other than high-level waste which is contaminated with long-lived alpha emitters to the extent that, under the provisions of ERDAM Chapter 0511, it is not suitable for surface burial, but which exhibits sufficiently low radiation levels that it is amenable to handling by "contact" (as opposed to remote) methods.

B. Dose Rate

The dose rate from penetrating radiation at the surface of an individual waste package may not exceed 500 millirem/hr averaged over the waste packages in a given shipment, the surface dose rate may not exceed 200 millirem/hr.

C. Restriction in Combustible Waste

1. Combustibles

For the purpose of these criteria combustibles are defined as those materials which can be ignited in 15 minutes or less when exposed to a temperature of 1300°F (700°C) in atmospheric air. The intent of this definition is to differentiate readily incinerable materials (such as graphite) which can be incinerated only by extraordinary means.

(GAS GENERATION)
(PYROLYSIS)

2. Combustible Percent in Package Material of Construction

Waste shipments to the WIPP will be coordinated on an ERDA-wide basis so that the total amount of combustibles stored in a single storage room does not exceed 20% by volume. In the context of this criterion, the wood used in the fabrication of DOT 19A and similar containers is considered to be combustible.

D. Fire Retardants-Flame Spread

Measures which can be taken to reduce fire hazards:

1. Fireproof waste containers
2. Immediate backfill of storage rooms
3. Automatic (foam) fire extinguishers, etc.
4. Non-combustible envelope

E. Adsorbed Liquids

Waste-containing free liquids will not be accepted for storage at the WIPP. Process sludges must either be dried by heating or mixed homogeneously with an appropriate drying agent; in either case, the liquid of the product should be limited to that required to minimize dispersal of the waste in a handling accident.

ATTACHMENT IV

CONTRACTOR OPINION OF CRITERIA

DEFINITIONS

A. Low-Level TRU Waste

Wastes contaminated with TRU nuclides to levels greater than the proposed level of 10nCi of alpha activity per gram of waste, requiring no shielding for personnel protection, with radiation levels less than 500 millirem/hr measured at the package surface.

B. Dose Rate

1. Common Carrier

- a. All radioactive materials must be packaged in suitable packaging (shielded if necessary) so that at any time during the normal conditions incident to transportation the radiation dose rate does not exceed 200 millirem/hr at any point on the external surface of the package and 10 millirem/hr at three feet.

b. Sole Use Vehicle

- i. 1000 millirem/hr at 3 feet from the external surface of the package (closed transport vehicle only);
- ii. 200 millirem/hr at any point on the external surface of the car or vehicle (closed transport vehicle only);
- iii. 10 millirem/hr at 6 feet from the external surface of the car or vehicle; and
- iv. 2 millirem/hr in any normally occupied position in the car or vehicle, except private carriers.

C. Isotope Quality Restriction in Combustible Waste

Hydrogenous waste packaged in a 210 liter drum (550gallon Dot 17c), FRP Box, etc., will contain less than 0.0695 curies/liter of TRU isotope.

(GAS GENERATION)

D. Combustible Percent in Package Material Construction

Date indicate that the fiberglass reinforced 19A boxes will self extinguish after 15 minutes at 700°C in air.

E. Fire Retardants-Flame Spread

1-4 agreement with terminal criteria

F. Absorbed Liquids

Will WIPP accept acids, caustics, organics (oils)?

G. Additional Discussion Topics

1. Packaging Criteria -

- a. Short-Term until 1983
- b. Long-Term 1983 - on

2. Waste currently stored

- a. Relationship to above problem
- b. Percentage of INEL waste that would be acceptable under conditions above

3. WIPP retrievable concept-time period
4. Closing remarks

ATTACHMENT V

PROPOSED DEFINITIONS

Consensus of Meeting Attendees

DEFINITIONS

A. Low-Level TRU Waste

Any solid waste material, other than high activity waste, which is contaminated with long-lived alpha emitters to the extent that, under the provisions of ERDAM 0511, it is not suitable for surface burial and which exhibits a maximum of 500 millirem/hr surface dose rate.

B. Dose Rate

The dose rate from penetrating radiation at the surface of an individual waste package may not exceed 500 millirem/hr. The surface dose rate may not exceed 200 millirem/hr averaged over the waste packages in a transport vehicle.

C. Combustibles and Gas Generating Materials

1. Combustibles

For the purpose of these criteria combustibles are defined as those materials which will sustain combustion when exposed to a temperature of 1300°C (700°C) for 15 minutes or less in atmospheric air. The intent of this definition is to differentiate readily incinerable materials (such as paper, plastics, and pyrophoric materials) from materials (such as graphite) which can be incinerated only by extraordinary means.

2. Gas Generating Materials

Packaged hydrogenous waste will be limited to a maximum of 0.0695 curies/liter of total TRU isotope concentration per volume of the waste container.

D. Combustible Percent in Package Material of Construction

The first portion of this definition could not be related or discussed since it affects the long-term storage problems associated with terminal isolation storage. The percent value will be established after experimentation is completed which will provide information on gas generation (corrosive effect of the salt on containers), toxicity and gas permeation. A standard DOT 19A wooden box is combustible by the definition proposed, however, the FRP box by the proposed definition is now agreed to be a noncombustible container.

E. Fire Retardants-Flame Spread

No agreement was achieved in relation to this criterion. It was suggested that operations in the isolation facility be designed and implemented to reduce fire hazards to the minimum risk level. Also, engineering and construction design should be considered to reduce to the minimum risk level the possibility of water intrusion into the mine during the operation phase (35-40 years) and for long-term storage.

F. Adsorbed Liquids

Concrete waste forms cannot be excluded from storage in the isolation facility, primarily due to the quantity of this waste form already generated and stored in an interim mode. Adsorbed liquids will also be permitted, provided the waste form is totally adsorbed and the package contains no free liquids. Acid and caustic solutions were not addressed by the WIPP criteria, but the work group proposed that both acid and caustic liquid wastes be neutralized to reduce the corrosion of the waste container. If neutralized and solidified, other alternative packaging systems could be considered; e.g., elimination of the High-Density Polyethylene liners.

In relation to the subjects of explosives, pyrophorics, and toxic agents in the waste, the working group proposed that the WIPP criteria state that the generators ensure through administrative operating controls that each of these items be eliminated from the packaged low-level TRU waste containers. The TRU Packaging Questionnaire data supports the fact that generators are not packaging explosives, pyrophorics, or toxic materials in their waste.

G. Additional Discussion Topics

1. Package Criteria

Short-Term Versus Long-Term Problems

At the present time, generators of waste are in a middle situation being bound by ERDAM 0511 (intact, contamination-free for 20-year retrievability) and INEL interim storage criteria. These constraints are not required for terminal isolation, and therefore, waste packages presently used to meet interim will impose an economic disadvantage to the generator over the next 3-5 yr.

It was proposed at the meeting that data are required to characterize material types generally acceptable for construction of waste packaging containers. The materials (metal, plastic, fiberglass, fiberboard, etc.) could then be evaluated on the basis of gas generation, general strength, thermal effects, corrosion in salt, chemical resistivity and other properties in relation to significant storage parameters. Mound Laboratory will perform this study utilizing LASL and RFP data as part of the TRU Packaging Study. OWI is sponsoring a similar study for commercial waste and information can also be extracted from their efforts in container-type acceptability.

2. This item was eliminated from discussion because of the Task Force assigned to examine these parameters.
3. WIPP criteria do not specify the time of the retrievable mode concept. SLA position is that 5 yr is maximum for determining how the low-level TRU waste will behave in the salt environment.

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