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ITSA - ABOVE GROUND RETRIEVABLE STORAGE METHOD
FOR LOW-LEVEL TRANSURANIC WASTES

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**ITSA - ABOVE GROUND RETRIEVABLE STORAGE METHOD
FOR LOW-LEVEL TRANSURANIC WASTES**

Abstract

The storage method for low-level transuranic wastes employed at the Idaho Transuranic Storage Area (ITSA) is discussed in detail to show its effectiveness in meeting the requirements of AECM-0511. Storage costs of \$1.04/cubic foot of waste are explained. The safety, efficiency and adequacy of this storage method are presented.

I. Introduction

The National Reactor Testing Station (NRTS) is located on 572,000 acres in Southeast Idaho, and is one of the centers for the AEC's active test reactor and reactor safety research and development programs. In connection with NRTS reactor development, solid wastes contaminated with radioactivity have been handled at the site's Solid Radioactive Waste Disposal and Storage Area (Burial Ground) since 1952. This waste management area is located as shown in Figure 1, and is operated for the Idaho Operations Office (ID) of the AEC by Aerojet Nuclear Company (ANC). At the 88 acre Solid Radioactive Waste Disposal and Storage Area, radioactive wastes are presently handled by three different methods depicted schematically in Figure 2. Wastes contaminated with fission products and neutron activation materials generated at the NRTS during reactor operations are buried in pits or trenches within the Burial Ground. Alpha wastes handled at NRTS come primarily from AEC's Rocky Flats Plant. Alpha wastes contaminated with uranium or with transuranic elements containing less than 10 nanocuries of transuranic material per gram of waste are disposed of on an asphalt pad above the ground surface within the Burial Ground and covered with earth. Other alpha wastes contaminated with transuranic elements containing greater than 10 nanocuries of transuranic material per gram of waste are stored retrievably at the Idaho Transuranic Storage Area (ITSA), located adjacent to the Burial Ground. This paper will present the basic features of the ITSA above-ground retrievable storage methodology.

II. Philosophy and Motivation for ITSA

Wastes contaminated with transuranic elements must be segregated from the environment due to their high radiotoxicity and long half lives. The predominant constituent of transuranic wastes at the NRTS is plutonium-239, which has a 25,000 year half life. If control of wastes contaminated with plutonium-239 is to be maintained until radioactive decay has rendered them innocuous, ten half lives or 250,000 years are involved. Since neither an ultimate Federal Repository nor a final treatment method for transuranic wastes have yet been identified, some form of interim storage for these wastes is necessary. The interim storage method should provide for easy and efficient retrieval of the wastes for future treatment and ultimate disposition.

Due to this concern, a new method was developed at the NRTS and in November of 1970, transuranic wastes were segregated from other wastes and isolated from the environment with 20-year integrity containers and retrievable storage.

III. ITSA Today

The need for a safe and efficient method of transuranic waste storage, which will provide retrievable packages of wastes that are contamination-free after 20-year storage periods, prompted the development of ITSA. It was decided to store the transuranic wastes on asphalt pads using earth for a protective covering. The alternative of placing the asphalt on the floor of the pits was disqualified because of potential flooding and ground water problems, and because of the variability

in pit floor depths due to the underlying basaltic rocks. The ground level asphalt pads also afford greater operational flexibility, especially during those seasons when bare earth becomes too muddy to support traffic. Figure 3 shows the general construction of a typical storage pad. The 3-inch thick asphalt is applied over a 4-inch thick gravel base. The ITSA pads have a 6-inch slope toward the center and a one percent slope from one end to the other to prevent puddling of rain or snow that may accumulate before the stack of waste is covered with soil. The slopes also allow sampling of any runoff liquids to assure that no radioactivity is present or escaping from the stored wastes to the environment. To date no contamination has been detected. The hard asphalt surface is excellent for utilizing mechanized unloading and drum stacking equipment. It was decided to construct the asphalt pads in a location adjacent to the existing waste disposal area where the underlying basalt formation precluded waste burial operations. The pad is 150-feet wide which allows adequate space for using mechanized equipment in the waste handling operations.

Transuranic wastes arrive at the NRTS under permits authorized by Department of Transportation (DOT) regulations. Low Specific Activity (LSA) wastes as defined by DOT, contain relatively small amounts of radioactive elements, and may be shipped in either common truck carriers or regular gondola railroad cars. Wastes containing greater amounts of radioactive materials must be shipped in specially designed containers, such as the "Super-Tiger" container carried on truck bed or in ATMX railroad cars utilizing universal cargo carrier. Figure 4 shows a cargo

carrier being unloaded from an ATMX railroad car at NRTS. Incoming railroad shipments are presently off-loaded onto truck beds at Central Facilities Area (CFA) about eight miles northeast of ITSA. This summer a rail spur leading directly to ITSA will be complete, which will eliminate the double-handling of wastes presently necessary. Truck shipments proceed directly to ITSA where they are unloaded.

Since the transuranic wastes arriving at the NRTS are shipped in accordance with DOT regulations, it was decided to use the DOT shipping containers as the basic 20-year integrity containers for storage at ITSA. This decision necessitated cooperation with the waste generators (mainly Rocky Flats) to upgrade the DOT shipping containers so they would be suitable for 20-year retrievable storage. The shipping containers in use in 1970 were DOT 19A wooden boxes, and DOT 17H (18 gauge steel walls) 55-gallon steel drums. The search for better integrity containers for 20-year storage at ITSA led to a 1/8-inch thick fiberglass reinforced polyester coating over the 4 x 4 x 7-foot 19A wooden boxes, and the use of 17C (16 gauge steel walls) 55-gallon drums containing 8 percent cross-linked rigid polyethylene inner liners 0.09-inches thick. Figure 5 shows a cross-section of a fiberglass coated box and a 17C drum with its 90-mil polyliner inside. DOT 6M 55-gallon containers, which have a 2R steel center container 5-inches in diameter, 20-inches long solidly supported inside a 55-gallon 17C drum, have also been approved for storage at ITSA. It should be noted that both the 17C and 6M containers provide double containment.

In order to qualify as DOT shipping containers, the storage containers must pass rigid quality and endurance tests to insure that their integrity will be retained during transit and storage. In order to assure that they will be able to contain their radioactive contents intact, contamination free, and be identifiable after 20 years of storage, additional requirements are imposed. These include painting all drums to be stored on ITSA white to prevent heat buildup before covering by reflecting as much heat from the sun as possible, and attaching identification tags to all drums that will remain readable for 20 years.

Exclusion of free liquids and other free corrosive agents in the wastes is also required. The improvement of storage containers is a continuing goal.

Once the asphalt pads were constructed and the storage containers chosen, the actual storage of waste could commence. Figure 6 is a drawing of the ITSA storage method. Stacking progresses down the length of the pad. The fiberglass coated wooden boxes are used to define the edges of the stacks of waste containers. Wastes are stacked in 150 x 80-foot cells on the pad separated by a earth firewall 3-feet thick. Boxes are used to define the cell perimeters and contain the stacked drums. All drums are stacked vertically in a close-pitched array with a sheet of 3/8-inch, fire retardant plywood separating each layer of drums added for rigidity and to provide a solid stacking surface. A thin plastic covering is also placed on top of each layer of drums to act as a barrier for any moisture that may fall before final covering.

The array of waste containers on ITSA is stacked to a height of about 16-feet in the center 90 feet of the 150-foot width (four boxes or

five drums high) and is 12-feet high for the remaining 30 feet on each side. This allows a sloping of the final cover to prevent puddling on the top of the covered array and to maximize drainage. As the waste containers are stacked across the width of the pad, a final cover consisting of 3/4-inch thick plywood, a tough nylon-reinforced polyvinyl cover and 2 to 3 feet of soil is applied progressively over the containers. Two feet of soil was chosen since that depth of cover allows operation of earth moving equipment on top of the stacked containers by spreading the weight over more area. Two feet is also a sufficient depth of soil on which to establish a good vegetative cover to provide for transpiration of the annual 8-inches of rainfall. Sodar streambank grass has been chosen as the present dryland soil building vegetative cover.

A concern related to covering the final stack of waste containers with soil by earth-moving type equipment was investigated. At Rocky Flats the fiberglass-coated boxes have been tested to loadings in excess of 20,000 pounds with no visible distortion or leakage(1). Testing by Gaynes Engineering Laboratory has shown that single, empty, 17C drums can withstand vertical loadings averaging 17,500 pounds before a side deflection of 0.5-inches occurred. Filled drums with 0.09-inch thick polyethylene liners closely stacked to neighboring drums in a storage array will be able to withstand even greater forces. Since boxes are stacked only four high and drums five high, with nominal loaded weights of 2,500 pounds/box and 400 pounds/drum, these vertical crushing resistances are adequate to insure that container integrity is not compromised during storage at ITSA. To date no problem has been experienced.

Another major concern is criticality safety of large arrays of stored waste which contain transuranic materials (which are fissile). Careful analyses of all proposed shipping containers with maximum fissile content limits are performed to assure criticality safety and compatibility with other stored wastes. The current criticality safety limits at ITSA are no more than 200 grams of fissile material in any one 17C 55-gallon drum, no more than 500 grams of fissile material in any one 6M 55-gallon drum, and no more than 350 grams of fissile material nor more than 5 grams of fissile material per any one cubic foot within the wooden boxes. These limits have been conservatively established to provide criticality safety for infinite arrays of waste, so that future expansions of ITSA operations will not cause criticality hazards.

Radioactive decay heat limitation imposed by the DOT have restricted the plutonium-238 content to not more than 10 watts (about 20 grams) per 55-gallon drum. Heat transfer calculations performed for the storage array at ITSA dictated that an administrative control be imposed to limit the total quantity of plutonium-238 stored in an 80-foot storage cell. The control was established conservatively to assure that temperatures within closed cells at ITSA will not rise above a design temperature of 176°F, precluding any increase in fire hazard.

The mechanized handling equipment at ITSA, shown in Figures 4 and 7 through 10 includes the following items:

1. Cranes at the railroad siding for unloading the special ATMX railroad cars used for shipping waste to the NRTS.
2. A mobile ramp for driving a telescoping mast forklift into the waste container carriers on truck beds.

3. Special drum handling tongs attached to the forklift tines for lifting drums two at a time from their carriers and placing them on the stack. This equipment is used in the waste unloading and stacking procedure to minimize handling time and reduce the potential hazards of smashed toes and strained backs. The mobile truck ramp and propane-driven forklift make stacking of drums basically a one-man operation, although one additional man is required to lay the plywood layer and plastic covering between levels of drums. All equipment has been selected to provide optimum industrial and radiological safety in handling the transuranic wastes.

As of December 31, 1973, 725,000 cubic feet of transuranic waste has been stored in 6 cells on ITSA. This total is comprised of 46,000 55-gallon drums and 3,200 wooden boxes.

Constant air sampling is provided during all unloading and stacking operations at ITSA. Surface contamination and direct radiation levels are checked prior to unloading any drums. These measures have been instituted to insure that container integrity has not been breached during transit. Drums and boxes are visually inspected prior to stacking and any scuffed or rusted spots discovered are repaired. Plastic sheeting is used to cover the open face of the stack during rainy or snowy weather to keep moisture from accumulating in the tops of the exposed drums and from blowing between the stacked containers.

Cells now constructed at ITSA are provided with several monitoring devices. Three-inch PVC pipes are inserted vertically as the waste is stacked to facilitate temperature and humidity measurements within closed

cells. Beginning this summer, the temperatures and humidity in several cells will be automatically monitored and recorded. Air samples will also be extracted from the monitoring pipes to determine whether any drums have leaked contamination. These measurements will provide assurances that the 20-year retrievability requirements are being met. Eight-inch pipes are also provided for ventilation, if needed, to dry the closed cells if the humidity increases to unacceptable levels.

All environmental monitoring and sampling to date indicate that the storage conditions at ITSA are satisfactory. No leaks of any radioactivity have been detected. Temperature and humidity measurements in closed cells have been about 40-50°F and 30-40 percent relative humidity.

The solid plywood covering over the entire waste array is designed so that when the 20-year interim period has expired, or as soon as it becomes desirable to retrieve the wastes stored at ITSA, the soil cover can easily be removed without damage to the drums. The plywood cover can then be taken off and the exposed waste containers easily removed from the pad. A computerized record keeping system currently in use at ITSA contains the pertinent information for each container stored there, including: transuranic content, combustibility, identification number and storage location. Each container stored at ITSA must be listed on a Form ID-137 shown in Figure 8, with all pertinent information listed. This information will be useful and necessary when wastes are retrieved from interim storage. As an aid to future retrieval efforts, besides the identification tags used on each drum, containers are also color-coded with one or two-inch

bands of selected colors for each shipper encircling each container.

It will thereby be possible to readily determine the basic type of waste and which records to consult for detailed waste identification. Drums and boxes must also be clearly labeled and marked to indicate the necessary segregation of combustible or noncombustible contents. This will further aid future treatment operations. There will be no need to open any of the transuranic waste containers in order to determine contents for determination of ultimate treatment methods.

IV. Storage Costs

Costs are based on construction of the asphalt pads and earthen berms, materials used in covering the waste containers, equipment usage expenses, and labor costs including Health Physics surveillance, handling and covering waste, instrumentation efforts and scientific support and analysis. The cost figures tabulated in Table I were taken from actual operating expenses during the past year.

The cost figures in Table I are subject to considerable variation, and are included only to provide an indication of the magnitude of the costs involved in this storage method. Packaging and transportation costs are borne by the waste generators and are not included in the above estimate. Costs of upkeep and maintenance of the covered waste should be minimal once the seeded vegetation begins to grow. No allowance for this cost has been included in the estimate.

This cost estimate does show that the ITSA method with its inherent flexibility to changing requirements is an economical and efficient response to AEC requirements and effective in protecting the environment.

V. Future Plans

It is presently planned to erect an air support structure over the unused portion of ITSA with FY-1975 funds, shown schematically in Figure 9, to provide an all-weather working surface. This building will keep the exposed face of the storage array and the asphalt pad free of rain and snow accumulations, and will also exclude the wind which at times makes operations at ITSA difficult. The present small forklift in use at ITSA is propane driven and can be safely used inside the building. Also included in the plans are provisions for fire and air pressure alarm systems, back-up generators to power the blowers supporting the building, personnel doors, and truck size airlocks to get the waste into the building. The projected costs for this project will be about \$5.00 per square foot of pad space covered. This building will be movable and will be moved down the pad as space within is filled and containers are covered. As soon as the building is moved, the final soil cover will be applied. The storage costs per cubic foot of waste will therefore not be increased significantly.

Current plans also call for the addition of more sophisticated waste monitoring equipment which will allow verification that anomalously high quantities of fissile materials are not present in waste containers, and that direct radiation levels are within established limits. Also planned is the continuation of container corrosion and waste degradation studies. These studies will determine more precisely the expected lifetime of storage containers at ITSA. The integrity of containers stored in the ITSA method may well exceed the present 20-year requirement. These studies

will also be used to formulate more general and acceptable 20-year storage container criteria.

VI. Summary

The storage method employed at ITSA has been discussed in detail to show its effectiveness in meeting the requirements of AECM-0511 and protecting the environment. Costs of about \$1.04 per cubic foot of waste stored was explained. It has been shown that low-level transuranic wastes can be handled and stored by this method safely, efficiently and adequately.

TABLE I

ITSA Cost Estimates from FY-1973 Data

Item	Cost per square foot of pad	Cost per cubic foot of storage
Construction of pad and earth berm sides	\$1.11	\$0.10
Materials including plywood, polyvinyl, plastic sheeting, monitoring pipes and instrumentation	0.76	0.07
Equipment usage fees for forklifts, cranes and earth- moving equipment used for storing and covering waste	1.18	0.11
Labor costs including waste handling, Health Physics, instrumentation, maintenance and technical support	7.74	0.76
Totals	\$10.79	\$1.04

NOTE: These cost figures do not include care during the interim storage.

REFERENCE

1. J. W. Lindsay & W. E. Domning, "Improvements to a Plywood Container Used for Shipping Alpha Emitting Transuranium Waste" CRDL-950612-001, DOW Chemical Company, April 10, 1972.

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NATIONAL REACTOR TESTING STATION

LEGEND:

- N.R.T.S. BOUNDARY
- PAVED HIGHWAY
- GRAVEL ROAD
- - - POWER LINE
- - - UNDERGROUND CABLE

0 1 2 3 4 5
APPROXIMATE SCALE IN MILES

850-104-100-12

REVISED 8-30-69

Fig. 1 - NRTS Site Map

PANORAMIC VIEW OF THE SOLID WASTE DISPOSAL AND STORAGE AREA AT THE NHTS

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CONSTRUCTION OF TYPICAL PAD

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SECTION 1
WASTE CONTAINER DATA

Fig. 8 - ID-137 form

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AIR SUPPORT STRUCTURE OVER ITSA

Fig. 12 - Proposed Air Support Structure over ITSA