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HANDLING AND PACKAGING OF PLUTONIUM-CONTAMINATED WASTE

RADIOACTIVE WASTE

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The Rocky Flats Plant generates significant quantities of waste materials and equipment which are contaminated with plutonium. Management systems and techniques have been developed and are in use which reduce both the volume of waste generated and the quantity of plutonium involved. Containers have been developed and are in use which meet the 20-year retrievability requirement of Immediate Action Directive (IAD) 0511-21.

The U.S. Atomic Energy Commission's (USAEC) Rocky Flats Plant is located northwest of Denver, Colorado, about midway between the cities of Boulder and Golden and against the front range of the Rocky Mountains. The plant was constructed in 1952 and has been operated on a continuous basis by the Dow Chemical Company, Rocky Flats Division, under prime contract AT(29-1)-1106 which is administered by the Rocky Flats Area Office and Albuquerque Operations Office. Major expansions of the plant took place in 1957 and 1969.

The plant handles hundreds of kilograms of plutonium each year (Fig. 1). The work is performed in glove boxes and at the present time generates slightly more than 200 000 ft³ of solid waste contaminated with plutonium each year.

Solid wastes are removed from the glove boxes utilizing standard bag-out techniques supplemented by on-the-spot ventilation, personalized respiratory protection, close health physics surveillance, and protection from external radiation sources as required. Because of their origin all wastes of this type are deemed to be contaminated to $>0.1 \mu\text{Ci/g}$ which is the Department of Transpor-

tation (DOT) definition of low specific activity (LSA).

Other solid wastes result from materials which are used by the employees in the process or controlled areas but outside the glove boxes, such as surgeon's gloves, clothing, and paper. These wastes are considered to be LSA wastes providing no significant x or gamma radiations are noted by health physics surveys and providing no plutonium is indicated by drum counting techniques.

All the previously described wastes are sorted and packaged in 55-gal drums which are manufactured under a quality control program to ensure compliance with DOT specification 17C.

The plutonium content of each drum is determined by placing the drum into a shielded counter which has been calibrated for the type of waste which the drum contains. This counter utilizes a sodium iodide detector. The design and operation of the counter is described by Bright et al.¹

Solid wastes such as glove boxes, large equipment, and construction materials which are too large to fit into a 55-gal drum are disassembled to reduce the volume, cleaned to remove gram quantities of plutonium, and packaged into $\frac{3}{4}$ -in.-thick plywood boxes which are manufactured under a quality control program to ensure equivalence with DOT specifications 19A or 19B. Each item placed into the plywood box is monitored with a calibrated portable sodium iodide detector to estimate the plutonium remaining.

Liquids which are contaminated with plutonium are transferred to a process waste treatment plant where the plutonium and other chemical contaminants are removed as solids for disposal as radioactive waste.

Most of the liquids are treated at least three times by neutralization and by the addition of ferric hydroxide to form a precipitate which is collected on drum filters and removed as a sludge



Fig. 1. Rocky Flats handles hundreds of kilograms of plutonium in glove boxes each year.

to 55-gal drums. Dry cement is added, as required, to the 55-gal drum to absorb free liquids.

Liquids containing hydrochloric acid or complexing agents are processed separately by mixing with Portland cement to form a solid in 55-gal drums. Liquids containing acids are neutralized prior to mixing.

Organic solutions and oils are blended with an absorbent to form a solid in 55-gal drums.

Effluent from liquid treatment which is low in radioactivity but high in soluble chemical contaminants is evaporated in solar ponds or by forced evaporation. Salts from the evaporation are packaged in 55-gal drums. Effluent from liquid treatment, which is lower than the drinking water standards for both radioactivity and chemicals, is retained in holding ponds.

On March 20, 1970, the USAEC issued Immediate Action Directive (IAD) 0511-21 which required that

wastes resulting from its operations and with known or detectable contamination of transuranium nuclides be segregated and packaged in such a fashion that they can be readily retrievable as contamination free packages within an interim period of 20 years. Rocky Flats has developed, tested, and put into use containers which in our judgment meet the requirements of IAD 0511-21.

A $\frac{1}{8}$ -in.-thick coating of fire-retardant fiber-glass-reinforced polyester is applied to the previously mentioned $\frac{3}{4}$ -in.-plywood box (Fig. 2). This coating improves the seal on the box, increases the impact strength, makes the box less susceptible to fires both internal and external to the box, and resists the effects of weathering, ultraviolet radiation, and aging.

A thick walled polyethylene drum is now used to contain the wastes inside of the 55-gal DOT-17C steel drum (Fig. 3). The polyethylene drum



Fig. 2. Large items are packaged in $\frac{3}{4}$ -in.-thick plywood boxes coated with $\frac{1}{8}$ in. of fire retardant fiberglass-reinforced polyester to meet USAEC 20-year retrievability requirement.

provides added resistance to corrosion from the contents, increased resistance to tear or puncture, and containment even if corrosive failure of the steel drum occurs.

USAEC Manual, Chap. 0511, "Radioactive Waste Management," requires that solid wastes generated at AEC sites and containing transuranium nuclides in excess of 10 nCi/g must be stored in a readily retrievable manner. Rocky Flats ships all radioactive and chemical wastes to the National Reactor Testing Station (NRTS) for storage. The previously mentioned evaporator salts contain <10 nCi of plutonium per gram of salt and are shipped to NRTS in commercial semitrailers for not readily retrievable storage. Wastes in 55-gal drums which contain plutonium >10 nCi/g but <0.1 μ Ci/g are also shipped to NRTS in this manner but are placed into retrievable storage. Wastes in 55-gal drums which contain more

than 0.1 μ Ci of plutonium per gram of waste and all wastes in boxes are shipped to NRTS in 600 Series ATMX railcars in accordance with DOT Special Permit 5948.

Dow Chemical USA's policy places the responsibility for all wastes on the generator and enforces a philosophy of eliminating and controlling waste at its source. Since 1970, the volume of solid radioactive waste generated at Rocky Flats has been reduced from a rate of slightly more than 300 000 ft³/yr to the present rate of slightly more than 200 000 ft³/yr (Fig. 4). This reduction has been accomplished by the following actions:

1. Special training of operating personnel with regard to waste packaging and volume reduction.
2. An industrial engineering and cost accounting system is in use which charges the full cost of

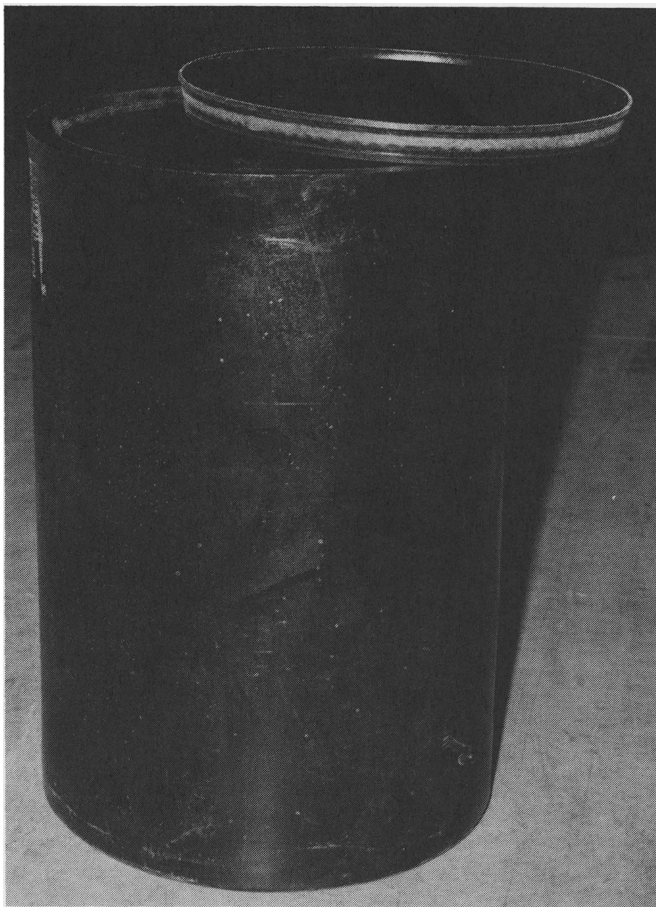


Fig. 3. Thick-walled polyethylene drum is placed inside of DOT-17C steel drum to meet USAEC 20-year retrievability requirement.

packaging and disposal of each waste container to the group that generated the waste.

3. Improved control of material entering the process or controlled areas.

4. Additional emphasis on monitoring of materials leaving the process or controlled areas.

5. Compaction of paper, rags, plastic, and similar materials.

6. Establishment of an area to perform improved techniques to recover plutonium and volume reduction including large equipment. During the last two years, this operation has recovered between 25 and 30 kg of plutonium which under previous conditions would have been shipped to NRTS with the wastes.

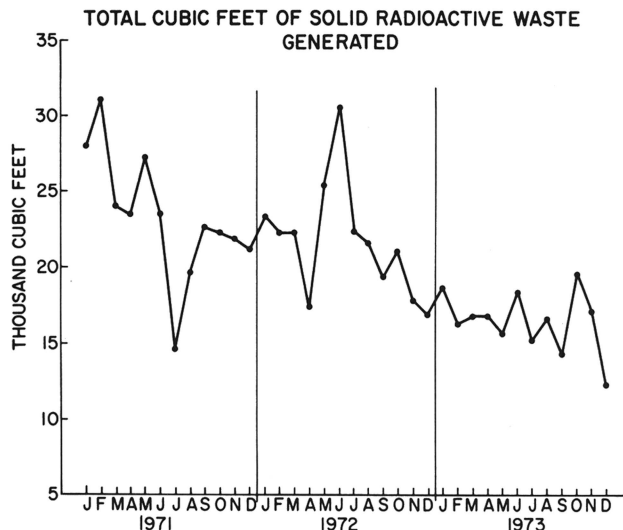


Fig. 4. Actions taken to reduce waste have reduced the generation rate from slightly more than 300 000 ft³/yr in 1970 to slightly more than 200 000 ft³ in 1973.

Rocky Flats is actively pursuing additional programs and facilities to further reduce both the volume of solid radioactive waste being generated and the amount of plutonium contained in the wastes. Major reductions will be noted in 1976 and 1977 when new chemical recovery and waste treatment facilities are scheduled to start operation. These facilities will remove more plutonium from the waste streams, provide for incineration of all combustibles, recover nitric acid for reuse, remove more water from the waste treatment sludges, and increase the density of the evaporator salts.

This discussion is intended to relate the experience in handling and packaging plutonium contaminated wastes at Rocky Flats in the hope that it may be useful to others. However, it must be emphasized that there are many problems left to be solved. With continued interest, effort, and support, these problems will be solved in a manner acceptable to all parties concerned.

REFERENCE

1. W. C. BRIGHT et al., "Research and Ecology Semi-annual Progress Report July through December 1972," RFP-2004-A, Rocky Flats Plant, U.S. Atomic Energy Commission (May 16, 1973).