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**ATMX-600 RAILCAR
SAFETY ANALYSIS REPORT
FOR PACKAGING (SARP)**

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**U. S. ATOMIC ENERGY COMMISSION
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ATMX-600 RAILCAR
SAFETY ANALYSIS REPORT
FOR PACKAGING (SARP)

Product
PRODUCT ENGINEERING

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SUBJECT DESCRIPTORS

Criticality
Plutonium Packaging
Shipping Containers
Waste Transportation

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for the
Albuquerque Operations Office
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ATMX-600 RAILCAR SAFETY ANALYSIS REPORT FOR PACKAGING (SARP)

Frank E. Adcock and John D. McCarthy

Abstract. The ATMX-600 Series Railcar is used by the Rocky Flats Division of Dow Chemical U.S.A. for shipping low-level radioactive waste under the provisions of DOT Special Permit 5948. Fissile Class I shipments are authorized with the car loaded to capacity with drums containing up to 200 grams of ^{239}Pu . Inner packaging may be polyethylene-lined steel drums or fiber glass-coated plywood crates.

These massive double-walled steel cars provide the equivalent protection of a Type B package. Rapid loading and unloading of the 9- by 9- by 50-foot cargo space is accomplished by prepackaging the waste in standard 20-foot steel cargo containers. The ATMX-600 railcar will hold two cargo containers, each carrying 70 55-gallon drums and up to 44,800 pounds gross weight.

INTRODUCTION

Purpose of Report

AEC Manual Chapters 0529 and 5201 require a Safety Analysis Report for Packaging (SARP) for each container to be used for shipping radioactive material. This report constitutes the required SARP.

Background

As many as eight ATMX-600 railcars (Figure 1) have been in routine use since 1969, moving radioactive waste from Rocky Flats, Colorado to the National Reactor Test Station (NRTS) near Arco, Idaho. Through March 1974, 404 carloads

FIGURE 1. Overall View of ATMX-600 Series Railcar.

14705-9

have been shipped with no reportable incidents, loss of contents, or external contamination. Shipments are made under the provisions of Department of Transportation (DOT) Special Permit 5948.

DESCRIPTION OF RAILCAR

General

ATMX-600 Series cars were designed and built for the AEC for use in transporting radioactive materials and explosive ordnance. The design criteria called for "... the maximum practical structural and fire resistant qualities for preventing or mitigating damage to the contents being shipped in the event of a train wreck."¹ By using a heavy, cast-steel underframe and strong superstructure, including cross-bracing of the sides, the car can structurally withstand major catastrophies.

These cars are all-steel, fully enclosed, and incorporate many safety devices. These include roller bearings, shock-absorbing draft gear, interlocking couplers to prevent uncoupling in a derailment, and locking-type center pins to prevent loss of the trucks under any circumstance.

Some useful railcar specifications are:

Overall Dimensions

Length over end sills	59 feet, 10 inches
Width over frame	10 feet, 0 inches
Height of top of car from rail	13 feet, 10 inches

Usable Inside Dimensions

Length	50 feet, 0 inches
Width	9 feet, 4 inches
Height	9 feet, 2 inches

Weights

Allowable weight at rail	220,000 pounds
Light weight	118,700 pounds
Capacity	101,300 pounds

Definition

The documents listed below constitute the specifications and procedures applicable to construction and use of the ATMX-600 railcar. Drawings from Sandia Corporation and General Steel Castings Corporation define the basic car structure. The Dow Chemical Company documents define the modification of the car for carrying radioactive waste, and give necessary operating procedures.

Sandia Corporation Drawings

SK9-2552-1601	Side Elevation, ATMX-600 Series
SK9-2552-1603	"A" End Cover
SK9-2552-1604	Center Cover
SK9-2552-1605	"B" End Cover
SK9-2552-1611	Access Door
SK9-2552-1612	Hand Hole Cover
SK9-2552-1613	Locking Slide
SK9-2552-1614	Locking Slide Mechanism
SK9-2552-1615	Center Bracing
SK9-2552-1616	"B" End-"A" End Superstructure
SK9-2552-1623	ATMX Car (600 Series), Safety Appliances

General Steel Castings Corporation Drawings

31646	Cast Steel Underframe for Sandia Corporation
31669	Cover Plate Welding Diagram for Sandia Corporation

Dow Chemical Drawings and Procedures

P12251	Operating Procedure for ATMX-600 Railcar
P12343-1	ATMX-600 car, Cargo Container Configuration
P12343-2	Structural Adaptions for 20-foot Container
P12343-3	Floor Mount Base
P12343-4	Shear Plates
P12343-5	Corner Securing Components
P12343-6	Plywood Floor Details

P12343-7	Installation of Ladders and Guides
P12343-8	Ladder Assembly and Guide Fittings
P12343-9	End Guide Planks
P12469	Bulkhead Reinforcement for ATMX-600 Car

Reference ANSI Specifications

MH5.1 Specifications for Cargo Containers

Construction

Underframe—The strongest available underframe was selected, which was a one-piece steel casting normally used on pulp wood cars (where the frame constitutes the sole structural member). Rectangular openings in the casting are filled in by welded steel plates to produce a continuous floor. Six rows of tapped holes of 1-inch diameter are provided at 9-inch intervals along the length of the car to secure cargo mounts or other fittings.

Superstructure—Car strength is equally divided between the frame and superstructure. A heavily reinforced sloping end is a major design feature. The light-gauge top corner (Figure 2) will shear off on impact during an accident and allow deflection of a missile (such as another car) over the roof. Upper longitudinal members consist of two 6- by 3.5- by 0.5-inch angles and a 7- by 0.5-inch plate (Figure 3). These are supported by 5- by 3- by 0.19-inch T-sections on 2-foot centers. Side skin is 0.25-inch plate, reinforced at the lower end by a 0.38- by 10-inch wide strip. In addition, the inside wall is covered by 0.19-inch plate to a height of 6 feet.

Sides are braced by two massive supports that may be located anywhere within the center third of the car. These are intended primarily to prevent the sides from buckling during a roll-over.

Closure—A 2- by 3-foot personnel access port is located in one end of the car. The door is constructed of 0.25-inch plate; the door and door

frame are reinforced with 3- by 3- by 0.25-inch angle. A 1-inch steel draw-bolt and hasp is used in conjunction with a padlock and security seal to lock the port and to provide a tamper-proof closure of the car.

Three top-cover sections or hatches may be removed to provide an opening 50 feet in length. These covers are constructed of 6- by 4- by 0.38-inch angle with cross members of 6-inch channel spaced on 2-foot centers. The inner and outer skin is 10-gauge (0.135-inch) sheet.

Each cover section has 22 bayonet-type lugs that engage in corresponding rectangular notches in the car (Figure 4). A continuous sliding bar with similar notches runs down each side of the car. These bars move 1 inch to engage the roof lugs. Movement of the slide is effected by a screw and lock nut mechanism (Figure 5) located on both ends of the bars. Security is provided by a dead-bolt to prevent slide movement from the closed position. This bolt can be removed only by the combined effort of two persons, one inside and one outside the car.

Modifications for Use with Cargo Containers

To use the ATMX-600 railcar with 20-foot cargo containers, both side supports are placed in the center of the car to form two bays, each of which will receive one container.

Floor Mounts—Eight floor mounts are used to restrain the cargo containers during any anticipated accident conditions.

The basic mount is constructed using four lengths of 8-inch structural steel channel; three are welded together to form a platform, and the fourth cut to form mounting flanges (Figure 6).

Standard corner-securing fittings of cast steel are welded to the platform to provide side and end restraint for the load. A steel locking pin 1.4 inches in diameter provides the necessary vertical restraint. This basic system is used world-wide for normal rail, road, or sea movement. Application of this

FIGURE 2. End and Side Wall Construction Details.

13046-6

FIGURE 3. Interior of Railcar and Major Structural Elements.

FIGURE 4. Removing Hatch Covers from Railcar.

13703-10

FIGURE 5. Locking Mechanism for Hatch Cover.

FIGURE 6. Cutaway View of Floor Mount Showing Corner-Securing Casting, Locking Pin, and Securing Stud.

FIGURE 7. Adjusting Roof Opening by Means of Post Jacks.
13704-10

FIGURE 8. Timber reinforcement for railcar ends to permit loading noncontainerized cargo. One plywood panel has been removed to show construction.
13462-10

system at Rocky Flats necessitated additional fore and aft restraint because of the severe end-loading possible in a railroad accident situation. The additional member is a 2- by 4-inch steel stud that engages the bottom cutout on the container corner fittings. Thus, in the event of an end-impact, the front corners of the container are restrained by the corner fittings and studs, and the rear corners by the studs. The force, in turn, is carried to the car frame by six, 1-inch diameter, high-strength bolts on each mount.

The impact strength of the floor mounts exceeds that of the container to ensure positive restraint under any circumstance.

Shear Plates—Shear plates are tightly fitted between the three mounting locations of the center supports. This modification permits three times the original

fore and aft loading on a center support by distributing the load over a greater area of the car sides and floor.

Plywood Floor—Two layers of 1-inch plywood are fitted into the car floor for thermal protection. This insulation (in addition to the cargo container and surrounding air gap) provides an added measure of safety if the car is involved in a fire.

Convenience Equipment—Ladders (located between the center supports) are provided on both sides of the car. These provide ready access to the center four corner-securing fittings and lock pins. The six guide rails of timber in each bay are optional, and are intended only to aid in centering the container during loading operations.

Stress in the car sides caused them to bow in slightly when the center supports were moved. Adjustable post jacks (Figure 7) are used to obtain optimum spacing for proper fit between the car and the three removable sections of the roof.

FIGURE 9. Details of center support reinforced for non-containerized cargo. One plywood section has been removed.

13462-12

Modifications for Loading Directly in Railcar

The car is left in a 3-bay configuration if crates or drums are to be loaded directly without the use of cargo containers. In this case, modifications consist of reinforcing the car ends (Figure 8) and side supports (Figure 9) with 6- by 8-inch timbers faced with 1-inch plywood and by installing a 1-inch plywood deck.

Twenty-four 4- by 4- by 7-foot crates can be loaded with the car arranged in a 3-bay configuration. The timber and plywood reinforcing have been designed to provide a bay length of 14 feet 6.5 inches. Inflatable dunnage bags are placed in the extra 6.5-inch space (Figure 10) to securely wedge the crates in place. Inflating the bags to 5 psi air pressure provides 23,000 pounds of force per 4- by 8-foot bag. This restrains the crates under normal conditions of transport. Instead of three equal length bays, the center bay can be extended to take oversized crates up to 22-feet long and 8-feet 9-inches square.

Approximately 216 55-gallon drums can be fitted into a 3-bay configuration car as opposed to 140 when using cargo containers. The labor needed to load and block individual drums (Figure 11), however, preclude this method of shipping except in unusual circumstances.

Marking

All required marking is lettered on the car exterior using black paint on a white background (Figure 1). Besides the standard railcar identification, exterior marking includes "FOR RADIOACTIVE

MATERIALS USE ONLY," the DOT Special Permit Number, and a hinged sign reading "FISSILE RADIOACTIVE MATERIAL" on one side and "EMPTY" on the other.

Four sheetmetal brackets on the ends and sides of the car are used to display DOT Dangerous—Radioactive Material placards.

Shielding

No shielding, neutron absorbers, or moderators are required for the types of material shipped in

FIGURE 10. Inflating the Dunnage Bag.

the ATMX-600 railcar, and none have been provided. DOT regulations allow up to 200 millirem per hour on the exterior surface of the car and 10 millirem per hour at a distance of 6 feet. A typical reading at the surface of the car is less than 0.5 millirem with a maximum of 1.0 millirem. Measurements made at 6 feet show virtually a background count.

INTERIOR PACKAGING AND MATERIAL LIMITS

Description of Waste

The ATMX-600 railcar is used for shipping radioactive waste to a storage site. Waste is packaged

in steel drums or plywood crates, as appropriate. There are three general categories of waste:

Line-Generated Waste—Line-generated waste consists of metal, glassware and laboratory equipment, tools, graphite molds, plastic, and other production scrap—in short, all solid or granular material taken from the plutonium glove-box system. Where possible, line-generated waste is cleaned with solvents or by acid-leach. Remaining plutonium and/or americium surface contamination is well fixed. Paper and plastic is compacted, or to the extent that incinerator capacity is available, reduced to ash prior to shipment.

FIGURE 11. Typical cargo bay showing drummed waste loaded directly into railcar. One-inch plywood sheets and 4- by 4-inch timbers are used to block the load.

13463-1

Process Waste—Process waste consists of oils, sludges, greases, and neutralized acids hardened to a solid or semisolid state using Portland cement or other suitable material. Plutonium has been removed by chemical processes to the extent feasible. The material is then precipitated and passed through a rotating-drum filter prior to packaging.

Building Scrap—Building scrap consists of pipe, equipment, machinery, concrete, cinder block, lumber, and other building materials. Plutonium is removed by the best known methods; any remaining contamination is well fixed.

Package Definition

The following Dow specifications define the components and procedures applicable to drum or crate interior packaging used with the ATMX-600 railcar system:

P12346	Specification for DOT-17H 30-Gallon Drum
P12413	Specification for DOT-17C 55-Gallon Drum
P14045	Procurement Specification for Molded Drum Liner
P14056	Cleated Plywood Box, 4- by 4- by 7-foot
P14060	Application of Fiber Glass Reinforced Polyester to Plywood Boxes
P14093	Specification for MS63056 83-Gallon Drum
P14109	Specification for Box Liner
P14111	Cleated Plywood Box 2- by 4- by 7-foot
P14131	Plastic Drum Liner (Round Bottom)
P14166	Rigid Liner-Type 1
Q2000	Radioactive Material Packaging Quality Assurance
—	Radioactive Waste Management Manual Section III—Packaging Procedures Section IV—Operating and Inspection Procedures

The latest issue of these specifications and/or possible additions to the list of controlled drawings may be obtained from the Product Engineering Department at Rocky Flats.

Construction

Drums—Drums may be DOT-17H or DOT-17C of at least 30-gallon capacity. A MS63056 83-gallon drum of equivalent construction is also authorized. Minimum gauge of metal is 0.0428 inches for drums up to 55-gallon size and 0.0533 inches for larger sizes. A 12-gauge (0.1046-inch) locking ring with drop forged lugs and 0.625-inch diameter bolt is required. Each drum must have a plastic liner per Dow Specification P14131 or an equivalent leak-tight liner at least 0.005-inch thick. Process waste with a contamination level greater than Low Specific Activity (LSA) is packaged in a liner of approximately 0.1-inch thickness as described on Drawing P14166.

Crates—Crates are constructed of 0.75-inch plywood, 1- by 3-inch cleats, and 2- by 4-inch skids as described on Drawings P14056 and P14111. When loads exceed 5000 pounds, 6- by 6-inch or heavier skids and a 1-inch plywood floor are required. DOT-7A or other crates of equal or heavier construction are also authorized. Each crate must have a plastic liner per Specification P14109 or an equivalent liner of at least 0.006-inch thickness. For plutonium-contaminated waste, crates must be coated with 0.13-inch of fiber glass reinforced polyester (FRP), per P14060, to increase package integrity and fire-resistance. Noncoated boxes must be banded in at least 4 places using 1.25-inch steel straps.

Material Limits

Plutonium-Contaminated Waste—Plutonium-contaminated waste, whether line-generated, process waste, or building scrap may be shipped in the drums previously described. Fissile material must be limited to 100 grams for drums of not less than 30-gallon capacity and to 200 grams for drums of 55-gallon and larger capacity. In addition, each drum must be limited to 200 pounds of graphite and to 10 watts internal energy. Line-generated waste and building scrap of such size and bulk that precludes the use of drums, may be packaged in crates. The fissile material content of each crate must be limited to 5 grams in any cubic foot.

Uranium-Contaminated Waste—Uranium-contaminated waste may be packaged in the same manner as plutonium waste except any crate used need not be given a fiber glass coating.

LOADING OPERATIONS

Loading Cargo Containers

Cargo containers provide an excellent means of rapidly loading and securing drums in the ATMX car. An 8- by 8- by 20-foot, fully enclosed container is the best standard size available. The container's allowable gross weight of 44,800 pounds closely matches the railcar capacity (when using two containers).

Drums are loaded into cargo containers in accordance with Association of American Railroads (AAR)

and National Cargo Bureau recommendations. The floor is first covered with a solid fiberboard liner, and four rows of 1.25-inch steel strapping are taped to the inside of the container. A total of 70 55-gallon drums may be placed in each container. With the drums in place, the four bands are pulled tight to form a "floating load." Three 6- by 6-inch timbers are placed between the main frame members and the drums to keep any load from the doors (Figure 12). Finally, the doors are closed by four double-action locks and secured with a tamper-proof seal. Heavy neoprene door gaskets provide a weather-tight closure.

Loading Containers into the Railcar

After removing the three hatch covers (Figure 4), the container may be lowered into the car. Guide rails at the ends and sides of each bay (Figure 13)

FIGURE 12. Details of Drum Banding and Blocking Inside a Cargo Container.

14902-7

FIGURE 13. Interior of car showing center supports, floor mounts and timber container guide rails. One container is mounted in far bay.

14706-1

provide rough positioning. The final 6 inches of vertical movement is guided by beveled edges on the cast steel, corner-securing fittings. Containers are loaded into the ATMX car with their door ends toward the center for security and as a further precaution against loss of contents during an accident. Securing the container to the car is quickly accomplished by engaging a locking pin (Figure 14) in each corner fitting.

The loaded cargo containers can be lifted only with a spreader frame (Figures 15 and 16), which applies a vertical lift through the corner castings.

Loading Directly into Railcar

Drums or crates may be loaded directly into an ATMX-600 car that has been properly

modified into the 3-bay configuration previously described.

One or two layers of drums are permitted. Layers are separated by solid fiberboard sheets or plywood. Each layer of drums must be individually blocked in place using timber (Figure 11) or inflatable dunnage bags (Figure 10).

Most crates are 4- by 4- by 7-foot size. These are loaded two-high with 8 crates in each bay. Two 48- by 96-inch dunnage bags are used in each bay to restrain the load. These may be placed between the car and the crates or between crates as shown in Figure 10. The load is faced with plywood or solid fiberboard, the bag inserted and then inflated. The length of each bay must be controlled to provide a 5- to 7-inch gap for the dunnage bag.

FIGURE 14. Engaging Locking Pin in Container Bottom Corner Casting.

13704-7

Closing and Sealing Railcar

The loaded car is closed by replacing the three hatch covers. These are secured by moving the locking slides to engage the lugs along each side of the covers. A deadbolt is inserted in both locking slides (Figure 5) and secured from inside the car. Finally, the personnel access door is closed and secured with a tamper-proof seal. All of these operations are described in Specification P12251, Operating Procedure for ATMX-600 Railcar.

ENGINEERING EVALUATION

Method

The ATMX-600 Series car with drums or crates for inner containers is a safe, reliable transportation system for shipping radioactive waste materials. The adequacy of the system can be demonstrated by relating it to the three principal factors upon which all regulations for transporting hazardous materials are based: (1) transportation environment,

(2) relative hazard potential, and (3) package performance. This evaluation is the only suitable type since a package of this size cannot be subjected to the hypothetical accident conditions (30-foot drop, half-hour fire, etc.) nor can strength, resistance to impact loads, or other calculations be related directly to package performance during these tests.

Transportation Environment

The chance of a serious accident (by definition, one which damages the car beyond economical repair) per 1000 miles of travel is approximately one in 82,000 for standard freight cars. This is based on data collected during a study of 3122 freight train accidents involving derailments for the period 1952 through 1954.² The report mentions that specially designed cars, such as the ATMX will "substantially" reduce the chance of a serious accident. Of the accidents reported in the study, fire or explosion followed a collision and/or derailment incident in only 1% of the cases. A later report³ cites this figure as being 1.5% for 1969.

By observing precautions required for the rail transportation of hazardous materials, as required

FIGURE 15. Rectangular Spreader Frame being Mated to Cargo Container.

13704-2

FIGURE 16. Close-Up of Container Corner Casting and Mating Quarter-Turn Fastener on Spreader.

13704-3

by the DOT, the chance of a serious accident would be further reduced. In summary, the environment that the ATMX car will see is favorable. With no special precautions, one could expect a freight car to experience a serious accident once in 82 million miles of travel. With a high strength car such as the ATMX-600 and using special precautions, the chance of a serious accident is remote.

Relative Hazard Potential

Contamination—The types of material shipped in an ATMX car have a minimal potential for release of radioactive contamination in the event of an accident. Even if the railcar and one or more inner containers (drums or crates) were breached, contamination is fixed to the extent that it would not be readily dispersible and could be expected to remain within the car.

In the case of line-generated waste such as machinery, the waste has been cleaned with solvents to remove as much plutonium as possible. Any remaining contamination is well fixed. For process waste, contamination is bound in hardened concrete or other solids in a manner that provides little hazard potential. Building scrap has the least potential for contamination since, in most cases, the level of radioactivity is on the order of low specific activity (LSA).*

In each case, contamination is in the less-hazardous insoluble form. In the event of a fire, the radioactive material, because of its density and non-volatility, would tend to remain at the burning site and therefore would constitute a hazard only in the immediate vicinity of the accident.

A recent report by the AEC's Directorate of Regulatory Standards⁴ discusses the potential for contamination release from the same types of waste containers that are transported by ATMX car. The report presents statistics that can be summarized by saying the likelihood of contamination release from a waste container involved in a railroad accident situation is extremely low.

*See Title 49 CFR Part 173.389 (c) for definition.

Penetrating Radiation—The radioactive waste shipped by ATMX car emits alpha particles and low-energy beta particles so it is primarily an internal hazard. Although some X and gamma rays are associated with radioactive decay of the material, radiation fields are not of a magnitude that constitutes a hazard when the material is contained or if it should be lost from its container.

Package Performance

Impact and Penetration—In any type of railroad accident, there is the possibility that the cars involved could roll down an embankment. The ATMX car was especially designed and reinforced to withstand this situation. The heavy, top, longitudinal members are supported at each end and by the two center braces to prevent the sides or top from collapsing.

A head-on crash is unlikely. The ATMX car could survive this type of crash, however, with little damage. Impact on the end of the cast frame would transmit a shock to the load but would leave the car intact. Impact higher up on the car would cause the impacting object to be deflected over the sloping end. Shock load transmitted to the contents would be less than in the first case, and the car, again, would be left intact.

A more likely type of impact would be a glancing blow on the side of the car caused by the car skidding into a solid structure or from another car skidding into the ATMX-600. In the event of a glancing blow, impact speed would be somewhat less than the original car (or missile) speed. Some bending and crushing of the car and a change in car (or missile) velocity would tend to dissipate much of the available energy. To be conservative, it must be assumed that a strong, pointed object such as a corner of a cast steel car frame, could penetrate the inner and outer skin of the ATMX car's side or roof. The penetrating object in this case could also penetrate one or more inner containers.

In any collision or impact, the shock transmitted to the inner containers is attenuated by the car itself. This shock is further reduced by the packaging

or blocking material. One could expect the inner containers, whether crates or drums, to remain reasonably intact, except for those few that may be punctured or crushed by an object penetrating the car.

Integrity of the inner packaging has been demonstrated by actual tests. DOT-17C drums containing semihardened process waste with gross weights up to 624 pounds have been subjected to the 30-foot drop and puncture tests.⁵ In only one test, where the contents were unusually plastic, was there any loss of contents. Fiber glass-coated plywood crates have been given modified free-drop and thermal-exposure tests. Crates loaded to 2500 pounds gross passed a flat-bottom drop and edge drop from heights of 4 and 6 feet without leakage.

Crates are loaded into the ATMX car with only 6 inches of fore-and-aft clearance, and then restrained with 46,000 pounds of force using two dunnage bags. The free travel and impact a crate might receive within the car would be negligible, certainly less than a 4-foot, free-drop equivalent.

In conclusion, the forces required to damage the ATMX-600 car are of a greater magnitude than those generated in the drop, impact, and penetration tests of an ordinary radioactive material container. While the car can, with the worst combination of conditions, be penetrated, overall damage to the car and contents will be minor.

Fire—Even though the statistical probability of the ATMX car being involved in a fire is negligible, the possibility must still be considered.

The thermal test conditions specified in the regulations can hardly apply to a container as large as the ATMX car. Sandia Corporation tests show that even for a medium-size container, the following conditions are necessary to assure proper test conditions: (1) a fire pit between 400 and 2000 square feet containing approximately 5000 gallons of fuel, (2) wind under 5 mph, (3) test item positioned a certain, optimum distance above the surface of the fuel, and (4) at least 3 feet of flame surrounding the container. It is difficult conceiving the existence of these conditions, either

by design or accident, when the package is 10 by 13 by 60 feet.

With the maximum conceivable fire, it can be assumed that only 50% of the car's outside surface will be enveloped in flame. This is based on the car being (1) partly submerged in a pool of fuel where the submerged portions are inaccessible to the flame, or (2) suspended above the flame by virtue of stacking on a pile of derailed cars in which case the supported areas and the upper surface would likely be inaccessible to the flame.

The car, even without contents, constitutes a massive heat sink (119,000 pounds of steel). A usable figure for net heat flux into a large cask is 1.3 calories per second per square centimetre (17,000 Btu/hr/ft²). The net heat flux during an International Atomic Energy Agency standard fire test was 3.15 W/cm² (10,000 Btu/hr/ft²).⁶ Assuming a net heat input of 17,000 Btu/hr/ft², and infinite conductivity, the average car temperature would not exceed 875 °F. Using a different type of analysis for an ATMX-500 (a railcar of similar construction, except for single-side wall), Union Carbide Corporation at Oak Ridge showed the car sides would be the hottest portion and the inside surface at this location could reach 950 °F.⁷ The Rocky Flats and Oak Ridge analyses show the average temperature of the contents would be approximately 200 °F. Crates or drums nearest the sides of the ATMX-600 could reach a temperature as high as 625 °F.

Since plywood will start to char and burn around 400 °F, some burning can be expected on those portions of the crates nearest the surface of the car. In the limited oxygen atmosphere within the car, burning crates should self-extinguish once the external heat source has been removed. Fiber glass-coated plywood has better fire-resistant properties than bare plywood; however, the exact ignition temperature is not known. Tests have demonstrated the excellent self-extinguishing properties of the type of fiber glass used to coat waste containers at Rocky Flats.

Work done at Rocky Flats by D. L. Ziegler⁸ shows that hardened process waste in steel drums will survive long exposure to 212 °F without damage.

Drums in hotter portions of the car would be expected to vent because of steam pressure. In this case and in the case of partially consumed crates, contamination would be slight because of the types of material involved.

Water Immersion—Crated waste, when flooded, would not constitute a criticality hazard since fissile material is limited to only 5 grams per cubic foot. The criticality evaluation for drums has considered flooding of one container, and of all containers in the array, since there is a possibility of some leakage after a severe impact or fire. The criticality evaluation shows that the flooded array is over-moderated and therefore less reactive than the case considered.

Water circulation through the car should be slight. Circulation through the inner containers would be nil. Contamination loss from the car during a 24-hour immersion would therefore be negligible.

Conclusions

Engineering evaluation has shown that the transportation environment of the ATMX-600 Series railcar is excellent, and that the chance of a serious accident is remote. Hazard potential of the contaminated waste is low since the radioactive materials are well fixed. Finally, the package performance is equivalent to that required for Type B packaging, and therefore suitable for "large quantities" of radioactive material.

In summary, the ATMX-600 Series car and its steel drum or plywood crate inner containers represent an ideal solution to the problem of safely transporting radioactive waste materials at a reasonable cost.

CRITICALITY EVALUATION

Introduction

The following criticality evaluation is for determining the nuclear safety of the ATMX-600 Series

Railcar for use in shipping drums of nonradioactive material contaminated with radioactive material.

The nuclear safety considerations for Class I shipments of fissile material is specified in the Appendix to AEC Chapter 0529.

Data

1. Outer structure is an ATMX-600 railcar.

Usable inner dimensions are:

Length — 50 feet 0 inches

Width — 9 feet 4 inches

Height — 9 feet 2 inches

2. Inside containers are:

- a. A specification ICC-17H 30-gallon container⁹ having the following dimensions:

Minimum inner diameter — 18.187 inches

Minimum inner height — 27.219 inches

Minimum thickness — 0.0428 inches

and/or

- b. A specification ICC-17H 55-gallon container¹⁰ having the following dimensions:

Minimum inner diameter — 22.437 inches

Minimum inner height — 32.719 inches

Minimum thickness — 0.0428 inches

3. Fissile material is:

- a. A maximum of 100 grams of ²³⁹Pu mixed with nonradioactive material (graphite, paper, plastic, etc.) in the ICC-17H 30-gallon drum.

and/or

- b. A maximum of 200 grams of ²³⁹Pu mixed with nonradioactive material (graphite, paper, plastic, etc.) in the ICC-17H 55-gallon drum.

Class I Shipments

1. Analysis for Normal Shipment

Assumptions:

- Optimum moderation
- Array is fully reflected
- Drums are undamaged
- In the calculations, the material is considered to be uniformly distributed through the drums.

The requirements for Class I shipments are specified in the Appendix to AEC Chapter 0529. In this analysis, these requirements will be applied to the inner ICC-17H 30-gallon and/or ICC-17H 55-gallon containers with the restriction that these containers are placed in the ATMX-600 Series Railcar.

One of the requirements for Class I shipments is that any number of containers is subcritical, under normal conditions, in any arrangement with optimum moderation.

Interpreting the phrase "any arrangement" to mean "any arrangement under normal conditions," this requirement is met. The following evaluation shows that an infinite number of these ICC-17H 30-gallon and/or ICC-17H 55-gallon containers are subcritical when packaged in an infinite planar array of ATMX-600 Series Railcars.

From previous DTF-II calculations that were done for the Model 55/30 Container⁸ it was determined that the most reactive configuration with 200 g of ^{239}Pu in an ICC-17H 55-gallon container is when the material is mixed with graphite. A limit of 200 pounds of graphite per drum is assumed in this evaluation, even though 300 pounds of graphite gives a smaller critical mass, because 200 pounds of graphite is a practical amount of Rocky Flats wastes that could conceivably be put in a 30-gallon or 55-gallon container.

Using Pu and 200 pounds of graphite as the constituents of the material in the 30-gallon and 55-gallon containers, a series of DTF calculations^{*11} of infinite cylinder cells were

run to determine the critical, infinite slab height of these drums. Sixteen group cross sections¹² were used.

The configuration of the infinite cylinder cells, shown in Figure 17, was as follows:

ICC-17H 30-gallon container:*

Material: 100 grams ^{239}Pu and 200 pounds graphite
 I.D.: 18.18 inches
 Gap: 0.629 inches
 Wall thickness: 0.0378 inches

ICC-17H 55-gallon container:*

Material: 200 grams ^{239}Pu and 200 pounds graphite
 I.D.: 22.43 inches
 Gap: 0.629 inches
 Wall thickness: 0.0428 inches

*These dimensions differ by several thousandths of an inch from those in the specifications to allow a greater tolerance.

FIGURE 17. Infinite Cylinder Cells.

*Calculations done by D. C. Coonfield and L. E. Jackson, Rocky Flats Division, The Dow Chemical Company, 1968.

Results of the DTF-II calculations (after adjustment for reflection) indicate that the critical height for an infinite reflected* slab of 30-gallon containers in the configuration specified above is 121.2 inches and the critical height of an infinite reflected slab of 55-gallon containers in the configuration specified above is 166.8 inches.

Since the usable height of the ATMX-600 railcar is 110 inches, an infinite number of these railcars of ICC-17H 30-gallon drums containing a maximum 100 grams of ^{239}Pu and a maximum of 200 pounds of graphite, and/or ICC-17H 55-gallon drums containing a maximum of 200 grams of ^{239}Pu and a maximum of 200 pounds of graphite, are subcritical when fully reflected.

2. Analysis for Accident Conditions

Assumptions:

- Optimum moderation
- Array is fully reflected
- Undamaged inner containers
- In the calculations, the material is considered to be uniformly distributed through the drums.

Another requirement in the Appendix of AEC Chapter 0529, for Class I shipments, is that two hundred fifty (250) of these ICC-17H 30-gallon and/or ICC-17H 55-gallon containers must be subcritical in any arrangement with full water reflection on all sides and optimum moderation. The condition of each container is to be that which would result if each container was subjected to the hypothetical accident conditions specified in Annex 2 of the Appendix.

The following evaluation will illustrate that this requirement is met.

The 30-gallon and 55-gallon containers were assumed to be undamaged since the package-to-package spacing will not change to any large extent under accident conditions.¹³

*The reflection was considered as an additional safety factor although the regulations do not specifically state that it must be considered.

The contents of the ICC-17H 30-gallon container were considered to be 100 grams of ^{239}Pu and 200 pounds of graphite per container; the contents of the ICC-17H 55-gallon containers were considered to be 200 grams of ^{239}Pu and 200 pounds of graphite per container. These containers with their respective Pu contents were optimally moderated, as explained above, when the graphite was limited to 200 pounds per container.

The following calculations are used to convert the reflected critical infinite slab of 33-gallon containers, filled as specified above, to a reflected critical cubic array by equating the Buckling equations.

Infinite Slab:

$$B_s^2 = \left(\frac{\pi}{T + 2\delta} \right)^2$$

Cubic:

$$B_c^2 = 3 \left(\frac{\pi}{h + 2\delta} \right)^2$$

The extrapolation length (δ) used for the slab was 2.47 inches and for the cubic array was 2.23 inches.¹⁴

$$B_c^2 = B_s^2$$

$$3 \left(\frac{\pi}{h + 2\delta} \right)^2 = \left(\frac{\pi}{T + 2\delta} \right)^2$$

$$3 \left[\frac{\pi}{h + 2(2.23)} \right]^2 = \left[\frac{\pi}{121.2 + 2(2.47)} \right]^2$$

$$h = 213.76 \text{ inches}$$

The number of ICC-17H 30-gallon containers on an edge of the base of the cubic array is 11.32, which is the length of the base of the array divided by 18.88 inches [the inner diameter of the container plus two wall thicknesses plus the air gap (see Figure 17)].

The number of ICC-17H 30-gallon containers on the edge of the height of the cubic array is 7.85, which is the height of the array divided by 27.22 inches (the inner height of the container).

The critical number of 30-gallon containers in the cubic array is as follows:

$$N_c = (\text{number on edge})^2 (\text{number high}) = 1005$$

Two hundred fifty ICC-17H 30-gallon containers are subcritical in a cubic array with full reflection and optimum moderation.

An analysis similar to that done for the 30-gallon containers indicates that 1430 55-gallon containers, filled as specified above, are subcritical in a cubic array with full reflection and optimum moderation.

The ICC-17H 30-gallon drums, each containing a maximum of 100 grams of ^{239}Pu and nonfissile material (provided the nonfissile material does not exceed 200 lbs. of graphite per drum), and/or ICC-17H 55-gallon drums containing a maximum of 200 grams of ^{239}Pu and nonfissile material each (provided the nonfissile material does not exceed 200 pounds of graphite per drum), meet the requirements of Section II.H for Class I shipments, when these drums are packaged in the ATMX-600 series railcar.

Since the crates are limited to 5 grams of ^{239}Pu per cubic foot, these crates may be intermixed in the ATMX-600 Series railcar with the specified drums. The substitution of these crates for the drums would lead to a less reactive arrangement.

Summary

The ATMX-600 Series railcars meet the specifications of Class I shipments provided the capacity of each railcar is limited to:

1. 30-gallon drums containing a maximum of 100 grams of ^{239}Pu and nonfissile material each (provided the nonfissile material does not exceed 200 pounds of graphite per drum).

and/or

2. 55-gallon drums, each containing a maximum of 200 grams of ^{239}Pu and nonfissile material (provided the nonfissile material does not exceed 200 pounds of graphite per drum).

and/or

3. Crates containing a maximum of 5 grams of ^{239}Pu per cubic foot.

QUALITY ASSURANCE

Background

AEC Manual Chapter 0529 requires that each AEC contractor establish a quality assurance program for the fabrication, assembly, and testing of off-site shipping containers. The intent of this program is to assure that high quality standards are met during the fabrication, assembly, and inspection of each package and to assure that packages in use continue to meet these same standards.

Requirements

Listed below are the AEC's requirements for a packaging quality assurance program, followed by the method used at Rocky Flats to comply with those requirements.

Responsibilities—Assign specific responsibilities to the user, vendors, and fabricators to assure specified quality at all stages of construction.

At Rocky Flats, responsibilities for assuring specified quality of interior packaging materials are assigned by Document Q2000, a quality control procedure entitled, "Radioactive Packaging Quality Assurance." Primary responsibility is assigned to Quality Control Engineering, which supervises the preliminary determination (Receiving inspection). All packaging material is purchased from commercial suppliers or fabricators. Certain key fabricators, such as drum manufacturers, are subject to a vendor audit conducted by a team of

Purchasing, Quality Control, and Product Engineering personnel. This team ensures that the fabricators maintain good manufacturing and quality control methods. Primary reliance for quality assurance is placed in the receiving inspection conducted at Rocky Flats since all features of the purchased material are readily accessible for inspection and/or testing at this stage. Defective material is returned to the vendor for rework or replacement; acceptable parts are stocked in the warehouse. All ATMX-600 railcars were built in 1957. There are no plans to fabricate additional cars.

Specifications—Designate codes, standards, material specifications, fabrication methods, testing and performance requirements.

Drawings listed in the sections on railcar and interior packaging definition give all necessary dimensions, standards, and material specifications to produce acceptable components. All special fabrication methods or nondestructive tests required are given on the applicable engineering drawings. A formal system of drawing preparation, control, and distribution is defined by the Rocky Flats Product Engineering Manual. Drawings controlled by Rocky Flats are prepared, issued, and maintained in accordance with this manual.

Acceptance Requirements—Establish acceptance criteria in terms of measurable characteristics and tests to assure that all package design requirements, including performance tests (such as drop, fire, and immersion), would be met by the assembled container.

Inspection and test requirements for the “preliminary determination before first use” of the ATMX car are given in P12251, Operating Procedure for ATMX-600 Railcar. For all internal packaging components, the requirements for the “preliminary determination” are itemized on a Product Engineering controlled form, which is a part of the component definition.

Routine Maintenance Inspection—Provide for the routine inspection prior to the reuse of any

container to ensure that all applicable design standards have been met.

Loading of the ATMX cars and “routine determination before each use” is accomplished by using Procedure P12251, which lists the necessary inspection requirements. Since all interior packaging is used only once, routine maintenance inspection is not necessary.

Records—Provide that quality assurance records are maintained in an auditable file during the service life of the container.

Quality Control maintains the record of preliminary determinations for all interior packaging components (such as drums and crates) for a period of at least two years after shipment. Results of the preliminary and routine determinations on the ATMX car and all other required data are maintained by the Traffic Department for a period of at least two years after shipment. In the case of the preliminary determination of the ATMX car, the certification is retained as long as the car is in service. Any major modifications to the car requires a new certification.

Audits—Perform an audit of each AEC contractor at least annually as required by Manual Chapter 0504.

Rocky Flats is audited annually by the Operational Safety Division of the Albuquerque Operations Office to ensure satisfactory performance in the areas of radiation safety, criticality, and packaging. In addition, internal audits are conducted at least semiannually by Dow's Quality Control Department.

Special Processes—Provide for training, testing, and certification of manufacturing and inspection personnel involved in special processes, such as welding and non-destructive testing, and for the certification of equipment and procedures used in the performance of special processes.

Welding of the ATMX-600 railcars should be considered a “special process.” The welding process and welders must be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code.

Use of Package by Other Contractors—*Provide data to other AEC contractors or licensees who may use the ATMX car to assure that all requirements of Manual Chapter 0529 and 5201 are met.*

This document has been furnished expressly to provide all information needed to convey package design intent, provide data on accident test performance, and to define the requirements for fabrication, inspection, and use of the ATMX-600 railcar and the specified interior packaging components. Before any user ships radioactive material in the ATMX-600, he should have a copy of this document, the engineering drawings and procedures listed herein, and the DOT Special Permit.

MAINTENANCE

Inspection and maintenance are important for any railroad car, but more so for cars that are to carry hazardous materials. A properly maintained car is an important factor in reducing railroad accidents.

Before being returned to Rocky Flats for loading, each ATMX car is inspected by the Denver and Rio Grande Western Railroad Company in their Denver shops. Any necessary adjustments or repairs are made at that time. Inspection includes all mechanical equipment and safety appliances such as brake shoe thickness, air system, hand brakes, wheels, and couplers.

Every three years, each car is returned to the Atchison, Topeka, and Santa Fe Railroad shops for general maintenance and inspection. As a minimum, the following service is performed:

- Disassemble and inspect trucks.
- Magnaflux inspection of tension-truck components.
- Magnaflux wheels, axles, and couplers.
- Service air system.
- Lubricate roller bearings.

- Inspect car lids for fit and for cracks and defects. Perform sheet metal work, welding, and other work as necessary to correct alignment and to seal cracks.
- Sandblast and repaint car. Restencil all marking.

The maintenance described above meets or exceeds all AAR requirements. Although not required by the AAR or by the DOT, a certificate is furnished by the Denver and Rio Grande Western Railroad for each ATMX car inbound to Rocky Flats to indicate that the mechanical inspection was performed.

REFERENCES

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 11. B. G. Carlson, W. Guber, M. Shapiro, and W. J. Worlton. *DTF Users Manual*. UNC Phys/Math-3321. United Nuclear Corporation, Grasslands Road, Elmsford, New York.
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See

DEPARTMENT OF TRANSPORTATION
HAZARDOUS MATERIALS REGULATIONS BOARD
WASHINGTON, D.C. 20590

THIRD REVISED SPECIAL PERMIT NO. 5948
(COMPLETE REVISION)

This special permit is reissued pursuant to 49 CFR 170.15 of the Department of Transportation (DOT) Hazardous Materials Regulations, as amended, and on the basis of the June 5, 1970, petition by the Monsanto Research Corporation (Mound Laboratory), Miamisburg, Ohio and the previous petitions on file with the Department.

1. Shipments of fissile and large quantities of radioactive materials, n.o.s., are hereby authorized in the packaging as described in this special permit. This packaging, when constructed and assembled as prescribed herein, with the contents as authorized herein, meets the standards prescribed in the DOT regulations, Sections 173.395(c)(2) and 173.396(c)(3). Shipments must be in accordance with the provisions of the U. S. Atomic Energy Commission (USAEC), Albuquerque Operations Office certificates of approval dated December 20, 1968, as amended March 11, 1969, June 18, 1969, August 13, 1969, and May 18, 1970. This permit is issued only to authorize shipments by the shippers named below, in certain, specially modified rail cars, of large quantities of normal form radioactive/fissile waste materials, in packaging which may not completely conform to the requirements of §173.398(c).

2. Shipments under the terms of this permit are authorized only by the Dow Chemical Company, Golden, Colorado, Monsanto Research Corporation (Mound Laboratory), Miamisburg, Ohio, or the U. S. Atomic Energy Commission, Albuquerque, N. M. Each USAEC Operations Office which acts as a shipper shall register its identity with this Board prior to its first shipment, and shall have a copy of this permit in its possession before making any shipment.

3. The packaging authorized by this permit consists of either DOT Specification 17C or 17H, or equivalent, steel drums or wooden crates (DOT Specification 19A or 19B, or equivalent) or wooden crates which meet the requirements for Specification 7A general packaging. Each drum or crate must be lined internally with 5-mil or 8-mil polyethylene respectively. These packages, with the contents authorized herein are authorized for shipment only in specially modified ATMX Series 500 or Series 600 Rail Cars. The methods of loading, shoring, positioning of packages, and rail car modifications must be as prescribed in either Monsanto Research Corporation's Report entitled "ATMX-500 Rail Car Modification Report", dated April 10, 1970, or Dow Chemical Company's Report No. 2257-68-PE, entitled "ATMX-600 Series Rail Car", dated October 2, 1968, as revised December 11, 1968, January 28, 1969, and March 7, 1969.

4. The contents of each package authorized by this permit consist of radioactive and/or fissile radioactive material n.o.s., in the form of waste materials (containing Americium and/or Plutonium) up to and including large quantities. Contents, which must be in a form that are not readily dispersible, are further described as follows:

a. Drums - Not more than 100 grams (for drums of less than 55-gallon capacity) or 200 grams (for drums of 55-gallon capacity or greater) of fissile material per drum, with a maximum thermal decay energy of 10 watts per drum, in the form of process wastes (greases or sludges hardened to a solid or semi-solid state with "oil-dry" cement or equal) or line-generated waste (graphite, molds, filter-sludge, insulation, combustibles, metals, misc. residues, etc.). Each drum shall be limited to a maximum of 200 pounds of graphite.

b. Crates - Contents are similar to the line-generated wastes, except that the size or bulkiness of the items precludes use of drums (pipe, lumber, equipment, machinery, etc.). The fissile material content of each crate shall not exceed 5 grams per cubic foot.

5. The packaging authorized by this permit meets the requirements for shipment as Fissile Class I. The transport index must be assigned based on external radiation levels. Crates, 30-gallon, and 55-gallon drums, with the contents as set forth above, may be intermixed in any manner within the rail car.

Continuation of 3rd Rev SP 5948

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6. Prior to each shipment authorized by this permit, the shipper shall notify the consignee of the dates of shipment and expected arrival. The shipper shall notify each consignee of any special loading/unloading instructions prior to his first shipment.

7. The outside of each rail car must be plainly and durably marked "DOT SP 5948", in connection with and in addition to the other markings and labels prescribed by the DOT regulations. Each shipping paper issued in connection with shipments made under this permit must bear the notation "DOT SPECIAL PERMIT NO. 5948", in connection with the commodity description thereon.

8. Shipments are authorized only by rail, in modified ATMX Series 500 or Series 600 Rail Cars which have been assigned for the sole use of the consignor, with instructions to that effect issued with the shipping papers.

9. The shipper is required to furnish an experience report to this Board before expiration of the permit and when any amendment is requested. This report must include the approximate number of packages shipped, and the number of packages involved in any loss of contents.

10. Any incident involving loss of contents of the package must be promptly reported to this Board at the earliest feasible moment following the incident.

11. This permit does not relieve the shipper or carrier from compliance with any requirement of the DOT regulations, except as specifically provided for herein.

12. This permit expires on July 31, 1972, and may be revoked for cause at any time.

Issued at Washington, D.C.

Mac E. Rogers
For the Administrator
Federal Railroad Administration

JUL 7 1970

(Date)

Continuation of 3rd Rev SP 5948

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Address all inquiries to: Secretary, Hazardous Materials
Regulations Board, U.S. Department of Transportation,
Washington, D.C. 20590. Attention: Special Permits.

Dist: a, e, h, i

The Dow Chemical Co., Golden, Colorado

U. S. Atomic Energy Commission, Albuquerque, N.M.

DEPARTMENT OF TRANSPORTATION
HAZARDOUS MATERIALS REGULATIONS BOARD
WASHINGTON, D.C. 20590

SPECIAL PERMIT NO. 5948
FOURTH REVISION

Pursuant to 49 CFR 170.15 of the Department of Transportation (DOT) Hazardous Materials Regulations, as amended, and on the basis of the August 4, 1970, petition by the Dow Chemical Co., Golden, Colorado:

Special Permit No. 5948 is hereby amended as follows:

1. The reference to the Dow Chemical Company's Report Number in paragraph (3) for ATMX-600 Car Shipments is changed to Report RFP-1411, "ATMX-600 Rail Cars for Radioactive Waste Shipments" dated January 7, 1970.

2. Paragraph (4)(a) is revised to read as follows:

"4. * * *

a. "Drums - Not more than 100 grams (for drums of not less than 30-gallon capacity) or 200 grams (for drums of 55-gallon capacity or greater) of fissile material per drum, with a maximum thermal decay energy of 10 watts per drum, in the form of process wastes (greases or sludges hardened to a solid or semi-solid state with 'oil dry' cement or equal) or line-generated waste (graphite, molds, filter-sludge, insulation, miscellaneous residues, etc.). Each drum shall be limited to a maximum of 200 pounds of graphite."

* * * * *

All other terms of this permit as revised remain unchanged. The complete permit currently in effect consists of the Third and Fourth Revisions.

Issued at Washington, D.C.:

Mac E. Rogers
For the Administrator
Federal Railroad Administration

AUG 25 1970

(DATE)

Continuation of 4th Rev SP 5948

Page 2

Address all inquiries to: Secretary, Hazardous Materials
Regulations Board, U.S. Department of Transportation,
Washington, D.C. 20590. Attention: Special Permits.

Dist: a, e, h, i

Monsanto Research Corporation, Miamisburg, Ohio

U. S. Atomic Energy Commission, Albuquerque, N.M.

DEPARTMENT OF TRANSPORTATION
HAZARDOUS MATERIALS REGULATIONS BOARD
WASHINGTON, D.C. 20590

SPECIAL PERMIT NO. 5948
FIFTH REVISION

Pursuant to 49 CFR 170.15 of the Department of Transportation (DOT) Hazardous Materials Regulations, as amended;

Special Permit No. 5948 is hereby amended by revising paragraph (2) to read as follows:

"2. Shipments under the terms of this permit are authorized only by the U.S. Atomic Energy Commission and its contractors. Each shipper shall register his identity with this Board prior to his first shipment, and shall have a copy of this permit in his possession before making any shipment."

All other terms of this permit, as revised, remain unchanged. The complete permit currently in effect consists of the Third, Fourth and Fifth Revisions.

Issued at Washington, D.C.:

Mac E. Rogers
Mac E. Rogers
For the Administrator
Federal Railroad Administration

MAY 18 1971

(DATE)

Address all inquiries to: Secretary, Hazardous Materials Regulations Board, U.S. Department of Transportation, Washington, D.C. 20590.
Attention: Special Permits.

Dist: a, e, h, i

Monsanto Research Corporation, Miamisburg, Ohio
U.S. Atomic Energy Commission, Albuquerque, New Mexico
Los Alamos Scientific Laboratory, Los Alamos, New Mexico
Dow Chemical Company, Golden, Colorado
Idaho Nuclear Corporation, Idaho Falls, Idaho

DEPARTMENT OF TRANSPORTATION
HAZARDOUS MATERIALS REGULATIONS BOARD
WASHINGTON, D.C. 20590

SPECIAL PERMIT NO. 5948
SIXTH REVISION

Pursuant to 49 CFR 170.15 of the Department of Transportation (DOT) Hazardous Materials Regulations, as amended, and on the basis of the May 19, 1972 petition by the Dow Chemical Company, Golden, Colorado:

Special Permit No. 5948 is hereby amended by revising paragraph (12) to read as follows:

"12. This permit expires on July 31, 1974."

All other terms of this permit, as revised, remain unchanged. The complete permit currently in effect consists of the Third, Fourth, Fifth, and Sixth Revisions.

Issued at Washington, D.C.:

Mac E. Rogers
For the Administrator
Federal Railroad Administration

(DATE)

Address all inquiries to: Secretary, Hazardous Materials Regulations Board, U.S. Department of Transportation, Washington, D.C. 20590. Attention: Special Permits.

Dist: a, e, h, i

Idaho Nuclear Corporation, Idaho Falls, Idaho
Monsanto Research Corporation, Miamisburg, Ohio
U. S. Atomic Energy Commission, Albuquerque, N.M.
Los Alamos Scientific Laboratory, Los Alamos, N.M.

DEPARTMENT OF TRANSPORTATION
HAZARDOUS MATERIALS REGULATIONS BOARD
WASHINGTON, D.C. 20590

SPECIAL PERMIT NO. 5948
SEVENTH REVISION

Pursuant to 49 CFR 170.15 of the Department of Transportation (DOT) Hazardous Materials Regulations, as amended, and on the basis of the June 17, 1974 petition by The Dow Chemical Company, Golden, Colorado and supplementary correspondence from the U.S. Atomic Energy Commission dated July 11, 1974.

Special Permit No. 5948 is hereby amended by revising paragraph (12) to read as follows:

12. This permit expires on July 31, 1976.

All other terms of this permit, as revised, remain unchanged. The complete permit currently in effect consists of the Third, Fourth, Fifth and Seventh Revisions.

Issued at Washington, D.C.:

Mac E. Rogers
For the Administrator
Federal Railroad Administration

(DATE)

Address all inquiries to: Secretary, Hazardous Materials Regulations Board, U.S. Department of Transportation, Washington, D.C. 20590. Attention: Special Permits.

Dist: a, e, h, i, j
Monsanto Research Corporation, Miamisburg, Ohio
U.S. Atomic Energy Commission, Albuquerque, New Mexico
Los Alamos Scientific Laboratory, Los Alamos, New Mexico
Idaho Nuclear Corporation, Idaho Falls, Idaho
United Power Association, Elk River, Minn