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A SUMMARY OF INCIDENTS
INVOLVING
USAEC SHIPMENTS OF RADIOACTIVE MATERIAL

1963-64

UNITED STATES ATOMIC ENERGY COMMISSION
INDUSTRIAL SAFETY AND FIRE PROTECTION BRANCH
DIVISION OF OPERATIONAL SAFETY

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INTRODUCTION

This summary has been prepared to present information pertaining to incidents sustained by the AEC in the transportation of radioactive materials. The incidents presented herein cover the period from January 1, 1963, through December 31, 1964. Previous documents, AECU-3613, "A Summary of Transportation Incidents in Atomic Energy Activities, 1949--1956", TID-16764, "A Summary of Incidents Involving USAEC Shipments of Radioactive Material, 1957-1961", and TID-16764 (Suppl. 1), "A Summary of Incidents Involving USAEC Shipments of Radioactive Material, 1962", reviewed earlier experience.

In the period covered by this report, there were twenty-four incidents reported. Thirteen (54%) of the twenty-four incidents did not result in release of radioactive materials. Of the remaining eleven cases, which did involve radiation releases, six were limited to the carrier vehicle and only one involved costly cleanup. Tables 7 and 8 illustrate the shipment and vehicle damage experience for the period covered by this report. Of the twenty-four incidents reported, only one involved impact damage to the shipping container while the vehicles involved suffered damage ranging from none to total destruction.

In this summary, the incidents have been classified in accordance with the scheme used in TID-16764.

Table 1—INCIDENT EXPERIENCE BY MODE OR LOCATION

Mode	No. of Incidents			
	1963-1964	1962	1957-1961	1949-1956
Truck Incidents	17	8	21	9
Rail Incidents	5	5	11	2
Air Incidents	0	0	0	1
Terminal Incidents	2	1	15	1
Total	24	14	47	13

Table 2—INCIDENT EXPERIENCE BY CLASS OF RADIATION RELEASE

Class	No. of Incidents			
	1963-1964	1962	1957-1961	1949-1956
I	12	9	29	6
II	1	1	7	2
III	6	2	7	0
IV	5	2	3	3
V	0	0	1	1
VI	0	0	0	1
Total	24	14	47	13

Table 3—INCIDENT EXPERIENCE BY YEAR

Year	No. of Incidents
1949	1
1950	1
1951	1
1952	2
1953	0
1954	1
1955	2
1956	5
1957	6
1958	5
1959	15
1960	12
1961	9
1962	14
1963	9
1964	15
Total	98

Table 4—INCIDENT EXPERIENCE BY MONTHS

Month	No. of Incidents			
	1963-1964	1962	1957-1961	1949-1956
January	6	2	4	0
February	2	1	2	2
March	1	0	2	1
April	2	1	5	1
May	3	2	3	1
June	0	0	5	0
July	4	2	9	1
August	2	2	2	1
September	1	1	4	1
October	0	1	2	2
November	1	0	6	1
December	2	2	3	2
Total	24	14	47	13

Table 5—INCIDENT EXPERIENCE BY TYPE, IRRESPECTIVE OF MODE (UNLESS SPECIFIED)

Type	No. of Incidents			
	1963-1964	1962	1957-1961	1949-1956
Handling	2	1	15	0
Impact (Collision-Truck)	10	4	10	7
Impact (Collision-Air)	0	0	0	1
Impact (Collision-Rail)	0	1	2	0
Fire	0	2	5	3
Vehicle or Equipment Failure	1	0	5	0
Leakage of Containers	5	3	4	0
Derailment (Rail)	1	2	3	2
Tiedown or Bracing Failure	4	1	2	0
Aerial Dispersal	0	0	1	0
Packaging Failure	1	0	0	0
Total	24	14	47	13

Table 6—INCIDENT EXPERIENCE BY TYPE OF MATERIAL INVOLVED

Type of Material	No. of Incidents			
	1963-1964	1962	1957-1961	1949-1956
Source Material	13	8	14	10
Radioisotopes	3	1	10	0
Irradiated Fuel Elements	2	1	8	1
Special Nuclear Material	1	3	4	0
Radioactive Waste	1	1	3	0
Empty Containers	1	0	3	0
Contaminated Machinery	1	0	3	0
Unknown	2	0	2	2
Total	24	14	47	13

Table 7—SHIPMENT DAMAGE EXPERIENCE (1963-1964)

Description	No. of Incidents
No Damage	15
Impact Damage	1
Leakage	8
Total	<u>24</u>

Table 8—VEHICLE DAMAGE EXPERIENCE (1963-1964)

Description	No. of Incidents
No Damage	6
Minor Damage	6
Decontamination Necessary	8
Truck (50% Destroyed)	3
Rail-Major Accidents	
Derailment	1
Total	<u>24</u>

CLASS I RADIATION RELEASE

The vehicle has been involved in an accident or package damage is suspected. The shipment is delayed or stopped. No radioactive material is released and there is actually no loss of integrity to the package.

CASE 1

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Impact; collision with automobile

DATE

January 1, 1963

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Cask containing 5,000 curies of unspecified type

RADIATION CONSEQUENCES OF INCIDENT

None

DETAILS OF THE INCIDENT

A spare tire, normally carried under the trailer, came loose and the trailer ran over the tire, causing the trailer tailgate to come off. When the truck-driver stopped to retrieve the tire and the tailgate, an automobile ran into the rear of the truck.

NATURE OF INJURIES OR LOSS

There were no personnel injuries nor was there any damage to the cask, tie-downs or truck. The radiator of the automobile was damaged.

CASE 2

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Impact; collision with automobile

DATE

January 10, 1963

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Three 5-ton cylinders of uranium oxide

RADIATION CONSEQUENCES OF INCIDENT

None

DETAILS OF INCIDENT

An automobile leaving a gasoline station ran into the side of the tractor-trailer which was transporting the shipment.

NATURE OF INJURIES OR LOSS

There were no personnel injuries nor was there any damage to the cylinders. One of the truck's gasoline tanks was pierced; however, the truck switched to an auxiliary gas tank and proceeded.

CASE 3

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Impact; collision with truck (left roadway)

DATE

January 10, 1963

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Normal uranium fuel slugs

RADIATION CONSEQUENCES OF INCIDENT

None

DETAILS OF INCIDENT

A tractor-trailer carrying normal uranium fuel slugs left the roadway on a curve after it was sideswiped by a passing truck.

NATURE OF INJURIES OR LOSS

The tractor was damaged so that it could not complete the trip. The trailer, containing the fuel slugs remained upright and was essentially undamaged. A few hours' delay resulted while the tractor was replaced.

CASE 4

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Impact; collision with automobile

DATE

February 3, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Cylinder of uranium hexafluoride

CLASS I

RADIATION CONSEQUENCES OF INCIDENT

None

DETAILS OF INCIDENT

The tractor-trailer carrying the shipment was involved in a collision at an intersection. The driver of the tractor-trailer was cited for failure to yield the right-of-way. The tractor-trailer proceeded to destination.

NATURE OF INJURIES OR LOSS

The driver and the two passengers of the private automobile sustained minor injuries. The tractor sustained considerable damage; however, the trailer and cylinder were not damaged.

CASE 5

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Impact; collision with automobile

DATE

February 24, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Half-ton shipping cask containing less than 1 millicurie of tellurium 121 and less than 1 millicurie of promethium 149

RADIATION CONSEQUENCES OF INCIDENT

None

DETAILS OF INCIDENT

During a blizzard, the truck carrying the shipping cask collided with the rear of a Government sedan, knocking it into the rear of a truck ahead. All traffic was delayed by the blizzard for over nine hours, after which time the undamaged truck and shipment proceeded to destination.

NATURE OF INJURIES OR LOSS

There were no personnel injuries. The shipping cask was not disturbed nor was the truck carrying the shipment damaged. The Government sedan was damaged front and rear.

CASE 6

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Impact; collision with automobile

DATE

May 26, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Three 5-ton hoppers of normal uranium oxide

RADIATION CONSEQUENCES OF INCIDENT

None

DETAILS OF INCIDENT

The driver of an automobile lost control rounding a curve and slid on wet pavement into a truck transporting radioactive materials. The hoppers, tie-downs and trailer were undamaged and there was no loss of material. The tractor was capable of moving under its own power, but had a badly cut tire. The load was subsequently moved to destination by a new tractor.

NATURE OF INJURIES OR LOSS

The driver of the automobile suffered a broken leg. The truckdriver was uninjured. The shipment was not damaged; however, the tractor sustained damages estimated at \$500. Damage to the private automobile was estimated at \$600.

CASE 7

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Impact; collision with automobile towing boat and trailer

DATE

July 1, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

168 grams of uranium 235; 56 grams of plutonium

RADIATION CONSEQUENCES OF INCIDENT

None

DETAILS OF INCIDENT

An automobile towing a boat passed the carrier, swerved and struck the trailer carrying the shipment.

NATURE OF INJURIES OR LOSS

None

CASE 8

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Impact; overturn

CLASS I

DATE

April 22, 1963

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Cylinders containing uranium hexafluoride

RADIATION CONSEQUENCES OF INCIDENT

None

DETAILS OF INCIDENT

The tractor-trailer transporting the cylinders was forced off the road by oncoming traffic and tipped over.

NATURE OF INJURIES OR LOSS

There were no personnel injuries, and there was no damage to the cylinders, seals or tiedowns. Damage was estimated at \$25. The shipment was delayed about five hours.

CASE 9

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Impact; jackknife

DATE

December 12, 1963

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Six boxes of fuel elements containing 21 kilograms of natural uranium; twelve boxes of fuel elements containing 31 kilograms of 93% enriched uranium; one box of fuel plates containing 210 grams of 93% enriched uranium; and one cask containing 0.067 curie of hafnium 181

RADIATION CONSEQUENCES OF INCIDENT

None

DETAILS OF INCIDENT

The tractor-trailer transporting the shipment jackknifed en route. The details were not reported.

NATURE OF INJURIES OR LOSS

There were no personnel injuries. The trailer was not damaged and the shipment packages were not disturbed. The tractor was damaged to an unknown degree.

CASE 10

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Impact; left roadway

DATE

March 15, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Two birdcages, approximately five feet tall, each containing five containers of U₃O₈ (powder), 4.9% enriched. There was a total of 18.48 kilograms of material in each birdcage.

RADIATION CONSEQUENCES OF INCIDENT

None

DETAILS OF INCIDENT

The carrier passed an automobile, went onto the shoulder of the road, lost control and went into a ditch. Despite severe bouncing, the trailer did not turn over. The birdcages and containers were undamaged and there was no spillage or contamination. A gamma reading of 1 mr/hr at contact and 0.25 mr/hr at one meter was obtained. This was consistent with the levels at origin. The cargo was transferred to another truck and proceeded to destination.

NATURE OF INJURIES OR LOSS

The truckdriver (broken leg) and his helper (face cuts) were hospitalized. There was no damage to the shipment. Truck damage was not reported.

CASE 11

DESCRIPTION OF OPERATION

Rail shipment

NATURE OF INCIDENT

Derailment

DATE

July 24, 1963

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Enriched uranium

RADIATION CONSEQUENCES OF INCIDENT

None

DETAILS OF INCIDENT

The train containing the shipment was derailed. Its speed at the time of derailment was five mph. The car containing the enriched uranium remained upright.

NATURE OF INJURIES OR LOSS

There were no injuries to personnel nor was there any damage to the shipment.

CLASS I

The rail car sustained only minor damage. The shipment was delayed about eight hours.

CASE 12

DESCRIPTION OF OPERATION

Trailer on flatcar (piggyback) shipment

NATURE OF INCIDENT

Loss of shipment

DATE

January 2, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

ICC Specification 55 lead and steel container holding a 7-curie iridium 192 encapsulated source

RADIATION CONSEQUENCES OF INCIDENT

None

DETAILS OF INCIDENT

On January 2, 1964, a railroad signalman discovered a container lying in a ditch along the railroad right-of-way. The seals and lid of the container were

intact. The container was in good condition and forwarded on to destination.

Subsequent investigation revealed that the container had left the origin on November 12, 1963, by truck and was forwarded subsequently by piggyback. During the rail portion of the movement, the container (178 lbs.) apparently had been jostled out of the trailer and into the ditch along the right-of-way. No estimate on the duration of the stay in the ditch was reported.

NATURE OF LOSS OR INJURIES

Delay of shipment

REMARKS

Two lessons which can be learned from this accident:

1. When a shipment by piggyback is made, the tiedowns of containers should be sufficient to withstand the shocks and vibrations incident to rail transportation.

2. Shipper and receiver should maintain close contact regarding shipments so that an unusual delay in arrival can be immediately reported and the missing containers located.

CLASS II RADIATION RELEASE

The package integrity is breached. However, there is no release of radioactive materials.

Case 1

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Packaging failure

DATE

April 22, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Five 55-gallon drums each carrying five polyethylene bottles containing 2,000 grams of 93% enriched uranium oxide per bottle

RADIATION CONSEQUENCES OF THE INCIDENT

None

DETAILS OF INCIDENT

At origin, five 55-gallon drums, all containing highly enriched uranium in polyethylene bottles, were stacked on their sides, without bracing, on top of crates of machinery toward the front of a trailer. It appears that, as a result of vibration and shifting, several ringbolts were loosened and the lids on two drums were released. The movement was

sufficiently vigorous to eject four of the five plastic bottles from the inner pipe of one of the drums. While transferring the shipment to another truck at an intermediate terminal, the carrier's personnel replaced the covers on the two drums without noting the incompleteness of their contents or reporting the loss of integrity of the drums. After departure of the truck to which the drums were transferred, the four polyethylene bottles were found on the floor of the original truck at the intermediate terminal. The second truck was impounded at a succeeding terminal where the fifth bottle was found in the drum. The bottles were subsequently collected, repackaged and forwarded to destination.

There was no spillage or contamination but a potential hazard did exist for a period of 24 hours while the material was not subject to minimum controls against accidental criticality.

NATURE OF INJURIES OR LOSS

There were no personnel injuries and costs were not reported.

CLASS III RADIATION RELEASE

Radioactive material is released, but is confined to the package or the vehicle.

Case 1

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Impact; collision with automobile

DATE

August 22, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Five pallets of aluminum-clad thorium slugs in cardboard containers, weight 11,000 lbs; and eight aluminum boxes of aluminum-clad uranium fuel slugs, weight 20,000 lbs.

RADIATION CONSEQUENCES OF INCIDENT

None. There was no contamination inside or outside of the trailer. The highest radiation reading at the site was located on the surface of the trailer floor under the thorium pallets. The readings ranged from 20 to 30 mr/hr. At the side of the vehicle, the highest reading ranged from 2 to 3 mr/hr. At one foot from the side, it was less than 1 mr/hr.

DETAILS OF INCIDENT

An automobile, apparently skidding in the rain, struck the tractor-trailer carrying the shipment as it was crossing a bridge. The tractor smashed into the girders of the bridge, bending one. The tractor was completely demolished. The trailer jackknifed across the roadway, blocking three of the four lanes. The trailer remained sealed and seemed to be intact, except for one hole on the left side of the front through which an aluminum box protruded. All of the thorium and uranium remained in the truck.

The material had been placed in the trailer as follows: two aluminum boxes, then two pallets of thorium, then six aluminum boxes. Toward the rear of the trailer, there were three pallets of thorium. Upon breaking the seal, an

examination of the interior of the trailer revealed that the entire load had shifted to the front of the trailer. The cardboard boxes containing thorium that were between the aluminum boxes were squashed and the pallets were rendered to small splinters. All of the aluminum containers and the three rear pallets of thorium were in good condition.

The thorium was transferred from the broken boxes to a truck provided by the AEC. The uranium slugs and the rest of the thorium was transferred by fork-lift to a replacement trailer provided by the carrier. All material was returned to origin for inspection.

The bridge was closed to traffic from the time of the accident (6:40 a.m.) until 2:45 p.m. However, it should be pointed out that this was not due to the fact that radioactive material was involved, but to the nature of the accident and to a delay in obtaining a replacement vehicle.

NATURE OF INJURIES OR LOSS

Four persons were injured. The truck-driver suffered a broken kneecap and the driver of the automobile and his passenger were treated for cuts and bruises. The injury to the truckdriver's helper was reported as not serious. Damage to the truck was severe, amounting to virtual loss of the tractor and considerable mechanical damage to the trailer. Loss in terms of direct damage to the fuel elements amounted to \$2,300, which included reworking of slightly damaged slugs. Damage to the bridge was given an order-of-magnitude estimate of \$50,000 for straightening and/or replacement of steel work.

Case 2

DESCRIPTION OF OPERATION

Truck shipment

CLASS III

NATURE OF INCIDENT

Impact; empty cask dropped

DATE

January 10, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Not reported

RADIATION CONSEQUENCES OF INCIDENT

Portions of cask and pallet contaminated to 25 mr/hr

DETAILS OF INCIDENT

An empty cask was dropped on a truck while being transferred at an intermediate terminal. The force of the fall splintered the wooden collar on the pallet, requiring removal of the cask from the truck and holding it at the terminal until a new pallet could be fabricated. At the request of the carrier, the local fire department surveyed the cask and found no radioactive contamination. The truck was then forwarded to destination.

When surveyed at destination, contaminated wood splinters were found on the metal floor of the truck. The highest contamination level detected was 25 mr/hr at contact. Vacuum-cleaning techniques were successful in decontaminating the truck. The State Health Department of the state in which the intermediate terminal was located was notified. The cask, pallet, terminal and truck which delivered the cask to the terminal were surveyed by that agency. The drainplug near the bottom of the case was contaminated to a level of 20 mr/hr at two inches and exhibited evidence of having leaked en route. The plug was not damaged by the fall. The collar was contaminated to approximately the same level. No other contamination was found. The contaminated spot on the cask was covered with plastic and the contaminated pallet components were packaged in plastic prior to forwarding to destination.

NATURE OF INJURIES OR LOSS

There were no personnel injuries. The cost of monitoring and decontamination was not reported.

CASE 3

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Leakage en route

DATE

July 10, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Sixty fiberboard drums containing thorium nitrate tetrahydrate

RADIATION CONSEQUENCES OF INCIDENT

10,000 cpm over 5-10 sq. ft. of trailer bed.

DETAILS OF INCIDENT

Upon arrival at destination, the trailer carrying the shipment was found to be contaminated. One drum was contaminated and appeared to have lost a portion of its contents. Since the drums had been transferred from another trailer at a terminal, it was also surveyed. A very slight amount of contamination was found in the first trailer and no contamination was found at the terminal transfer point. The second trailer was decontaminated.

NATURE OF INJURIES OR LOSS

There were no personnel injuries. The cost of monitoring and decontamination was not reported.

CASE 4

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Contaminated cask

DATE

September 2, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Cask carrying irradiated shim motors

RADIATION CONSEQUENCES OF INCIDENT

Contamination of 5 to 10 mr/hr within vehicle

DETAILS OF INCIDENT

Upon arrival at destination, contamination, later identified as being caused by fission products, was detected on the outside of the cask and its supports, and on the floor of the trailer. Since the cask had been placed in the front of the trailer, cross-contamination as a result of other transfers and deliveries was unlikely and no further contamination was detected in

subsequent checks. The means by which the contamination occurred was not reported.

NATURE OF INJURIES OR LOSS

The trailer was delayed approximately one hour for decontamination.

CASE 5

DESCRIPTION OF OPERATION

Rail shipment

NATURE OF INCIDENT

Leakage en route

DATE

December 10, 1963

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Cask containing irradiated fuel samples

RADIATION CONSEQUENCES OF INCIDENT

Cask became contaminated to approximately 13 mr/hr

DETAILS OF THE INCIDENT

A cask containing irradiated fuel samples departed origin with external radiation reading 0.1 mr/hr. Upon arrival at destination, the external radiation reading was 13 mr/hr. Smear tests resulted in readings of 8,000 dpm/100 cm². State officials were asked to check the railroad car.

NATURE OF INJURIES OR LOSS

There were no personnel injuries. The cask was decontaminated. Necessity for

decontamination of the railroad car was not reported.

CASE 6

DESCRIPTION OF OPERATION

Trailer on flatcar (piggyback) shipment.

NATURE OF INCIDENT

Leakage - load shifted

DATE

May 2, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Drums containing contaminated waste

RADIATION CONSEQUENCES OF INCIDENT

Minor contamination of exterior of drums

DETAILS OF INCIDENT

During the shipment of contaminated waste to a burial site, the cargo shifted in a trailer riding piggyback on a flat car because of rough handling at an intermediate freight yard. The trailer and contents were monitored prior to reloading. Some minor decontamination of the drum exteriors was necessary. There was no rupturing of drums or spread of contamination.

NATURE OF INJURIES OR LOSS

There were no personnel injuries. The shipment was delayed approximately six hours.

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CLASS IV RADIATION RELEASE

Radioactive material is released to the ground or trafficway with no runoff or aerial dispersal.

Case 1

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Leakage of Liquid

DATE

January 14, 1963

TYPE OF RADIOACTIVE MATERIAL INVOLVED

A 13-gallon glass carboy containing a plutonium-contaminated gold chloride solution consisting of 8.4 gms plutonium and 498 gms gold chloride in 6 gallons of acidified solution.

RADIATION CONSEQUENCES OF THE INCIDENT

Widespread alpha contamination; no significant exposures to personnel.

DETAILS OF INCIDENT

During transit, plutonium-contaminated liquid leaked from a glass carboy (with a loosely-fitting ceramic stopper) and contaminated several trailers, truck terminals, a number of packages of other materials, and several persons handling the materials.

The leakage was detected during routine monitoring of the unloading platform after the shipment was unloaded at its destination.

The glass carboy was packed in a wooden box which was marked "this end up". The box also had pallets on its sides, however, and when placed on its side, the material slowly leaked out of the container. The carboy was not surrounded on all sides by an absorbent material sufficient to absorb the entire liquid contents.

NATURE OF INJURIES OR LOSS

There were no personnel injuries. The cost of decontamination was estimated to be \$27,500.

Case 2

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Leakage of liquid from container dropped at terminal

DATE

May 18, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

Not reported

RADIATION CONSEQUENCES OF INCIDENT

Cask emitting 6 r/hr gamma at the top at destination. Contamination was present on a ten-square-foot area of terminal dock with readings to 20 mr/hr and on several additional isolated spots reading 2 mr/hr.

DETAILS OF INCIDENT

Upon arrival at destination, the cask containing the shipment was found to be emitting 6 r/hr (gamma) from the top. Subsequent investigation revealed that the cask had been dropped on its side at an intermediate terminal prior to loading on the tractor-trailer which forwarded the shipment to destination. The terminal dock was surveyed, found to be contaminated as indicated above, and decontaminated to levels below 1 mr/hr. There was no contamination of the involved tractor and trailer.

NATURE OF INJURIES OR LOSS

There were no personnel injuries. The cost of decontamination was not reported.

Case 3

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Leakage of liquid from container dropped at terminal

DATE

August 3, 1963

CLASS IV

TYPE OF RADIOACTIVE MATERIAL INVOLVED

A 3,250-pound cask containing six fuel specimens. Primary isotope was 0.04 curie of zirconium/niobium 95.

RADIATION CONSEQUENCES OF THE INCIDENT

Contamination of about 1/2 square foot of wooden deck surface to levels of 1/2 to 1 mr/hr at contact.

DETAILS OF INCIDENT

The cask was dropped while being transferred at an intermediate terminal. Approximately two ounces of liquid leaked from the container causing the contaminated spot. Decontamination was effected by removing 1/8th inch of the wooden surface.

NATURE OF INJURIES OR LOSS

There were no personnel injuries nor was there any damage to the cask.

CASE 4

DESCRIPTION OF OPERATION

Truck shipment

NATURE OF INCIDENT

Leakage of liquid; container failure

DATE

November 11, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

An "autoclave", housed in a lead shipping cask and containing nine unclad fuel pins (490 grams of 20% enriched uranium) in 432 cc's of water with approximately 5 millicuries of fission products. An isotopic analysis of the contaminating material indicated:

Isotope	Approx. %
Ba ¹⁴⁰ -La ¹⁴⁰	40
I ¹³¹	40
Ce ¹⁴¹	10
Zr ⁹⁵ -Nb ⁹⁵	5
Other	5

RADIATION CONSEQUENCES OF INCIDENT

Beta and gamma contamination of portions of a trailer, certain cargo and a terminal. Levels indicated below.

DETAILS OF INCIDENT

Upon arrival at destination it was discovered that the shipment had leaked

resulting in possible contamination. The leakage occurred as a result of a break in a piece of tubing supporting a valve closing the autoclave. It is believed that metal fatigue resulting from constant vibration en route caused the valve to shear the tubing at the surface of the autoclave. The lead shipping cask had not been sealed. Less than a pint of fission product contaminated water had leaked from the cask.

The cask was transported on three different trailers between origin and destination. Thus, it was necessary to locate, monitor, and possibly decontaminate each trailer, as well as that cargo suspected of possibly having been contaminated.

The first trailer, which transported the cask about 250 miles from the origin, was located and found uncontaminated.

The intermediate terminal was surveyed and no contamination found.

The second trailer, which had traveled about 1,500 miles, was found to be en route, nonstop, to another destination. The cargo which had been aboard this trailer at the time it was carrying the cask was located. No contamination was found, except for one carton which showed evidence of having been wet over a spot in one corner measuring about three inches by six inches. This area read about 7.5 mr/hr. The carton was disposed of. The trailer was monitored when it arrived at its new destination and it was determined that the bed of the trailer had an approximately three feet by six feet contaminated area. Radiation levels at the surface of the contamination ranged from 25-600 mrad/hr. (beta). Some of the containers of the cargo were contaminated. All but two of the containers were easily decontaminated and released. The remaining two packages required repackaging. There was no evidence of contamination of the material contained in the cartons. The contaminated flooring on the trailer was replaced.

A survey of the terminal, where the second transfer had been made, revealed one spot of approximately twelve square inches with a level of about 10 mr/hr at one inch, beta and gamma. The cask had

CLASS IV

stood in this location for approximately two days. The contamination was successfully removed. The third trailer, which carried the shipment a short distance for delivery to the receiver, was found not to be contaminated.

NATURE OF INJURIES OR LOSS

There were no personnel injuries. The total cost of monitoring, decontamination, and replacement of flooring was not reported.

CASE 5

DESCRIPTION OF OPERATION

Rail shipment

NATURE OF INCIDENT

Spillage and loss

DATE

July 23, 1964

TYPE OF RADIOACTIVE MATERIAL INVOLVED

251 drums (10-, 30- and 55-gallon) containing 0.947 enriched uranium residues

RADIATION CONSEQUENCES OF INCIDENT

None of significance

DETAILS OF INCIDENT

On July 23, the boxcar carrying the shipment was found in a rail yard near destination with the doors open and two 10-gallon drums of material outside, one having spilled its contents onto the ground. A radiological assistance team dispatched from the receiver's plant cleaned up the area, replaced the material in the drum and sealed it. The receiver arranged for the temporary repair of the car door and had the car switched to destination so that unloading could proceed. The car was badly contami-

nated from spilled drums and had to be vacuumed as unloading progressed to prevent further contamination. Unloading was completed July 29, at which time it was determined that two additional drums of material were still missing. On July 30, the missing drums were located at the same yards where the original spill took place. These drums were intact and no loss of material was indicated.

The car in question was loaded during the evening hours of July 16 and completed during the early morning of July 17. Upon completion of loading, it was determined that one of the car doors (opposite from the loading dock) was bent and did not close entirely and that the taper locking pin would not completely seat. Since (1) the car had to be shipped prior to a vacation shutdown, (2) there were no other rail cars in the loading yard and, (3) the last rail switch was imminent, it was decided by the loading crew to let the car go, with the addition of a chain and padlock through the door handles for added security in the event that the taper locking pin bounced out of its slot. The receiver reported that the door handles were broken, the doors on both sides bulged and that the lading was completely stirred inside the car, all of which suggested rough handling by the carrier and poor loading procedures by the shipper. One spill of UF_4 from a 30-gallon drum penetrated the void between the inner and outer wall of the car. Removal of part of the inner wall was required to decontaminate the car.

NATURE OF INJURIES OR LOSS

There were no personnel injuries. The cost was not reported.

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CLASS V RADIATION RELEASE

Radioactive material is released, resulting in aerial dispersal.

No incidents occurred that fall within this Class.

CLASS VI RADIATION RELEASE

Radioactive material is released and enters a watercourse, either directly or after *spilling* to the ground or trafficway.

No incidents occurred that fall within this Class.