

AN HISTORICAL SUMMARY OF TRANSPORTATION ACCIDENTS AND INCIDENTS
INVOLVING RADIOACTIVE MATERIALS*

Cheryl Cashwell
Westinghouse Electric Corporation

Joint Integration Office
Albuquerque, New Mexico
P.O. Box 3150, Albuquerque, New Mexico 87190-3150

ABSTRACT

This paper describes the development of the Radioactive Materials Incident Report (RMIR) Database, which contains publicly available facts about radioactive materials transportation incidents and accidents. The RMIR data provides detailed reports from 1971 to the present; however, this paper will address those radioactive transportation events that have occurred for the time period 1971 through 1985. Additionally, an annual summary of the accidents/incidents that have occurred for calendar year 1985 is presented.

Introduction

The Radioactive Materials Incident Report (RMIR) Database was developed in 1981 at the Transportation Technology Center at Sandia National Laboratories (SNL) to support its research and development activities for the U.S. Department of Energy (DOE). The RMIR is now under the management and direction of Westinghouse Electric Corporation /Joint Integration Office (JIO) in Albuquerque, New Mexico, and continues to serve the overall research and development transportation programs of the DOE.

Currently, the RMIR is maintained on an IBM 4341 mainframe computer at the Idaho National Engineering Laboratory (INEL). The database is programmed using the fourth generation database management system called NOMAD2. Using NOMAD2, a user can search on any of the fields of information contained in the database. The RMIR database is monitored on a daily basis at the Joint Integration Office (JIO). In order to ensure that the database continues to serve as a credible information tool, the JIO receives an independent technical review of the data as they are entered into the database.

Reporting Requirements

In the United States (US), the two agencies that have primary responsibility for the transportation of radioactive materials are the U.S. Department of Transportation (DOT) and the U.S. Nuclear Regulatory Commission (NRC). Requirements for reporting accidents and incidents differ between the NRC and DOT. The NRC regulations, outlined in the Code of Federal Regulations (10 CFR 20.402 and 20.403), require that the theft or loss of radioactive materials, exposure to radiation, or release of radioactive materials be reported. The DOT regulations for reporting a hazardous material

incident (including radioactive materials) are specified in the Code of Federal Regulations (49 CFR 171.15). The DOT requires that a report be filed after each incident that occurs during the course of transportation (including loading, handling, unloading, and temporary storage) in which one of the following directly results from moving radioactive material: (1) a person dies; (2) a person is injured and requires hospitalization; (3) estimated carrier or other property damage exceeds \$50,000; (4) fire, breakage, spillage, or suspected contamination involving radioactive materials; or (5) a situation that the carrier believes should be reported.

In addition to the reports received from the DOT and NRC, the JIO requests information from all of the state radiation control offices. In January 1986, the JIO sent a letter to each state radiation control director requesting additional information or amendments to the RMIR information the database had tabulated for that state. Sixty-five percent (65%) of the states have responded to this first request. Since the data are still being evaluated and entered into the database, the tabulations presented in this paper do not include any new information from the state offices.

Analysis of U.S. Radioactive Materials Transportation Accident/Incident Data

First, a perspective on the shipment of all hazardous materials compared with the transport of radioactive materials. According to one study, it is estimated that during a given year approximately 500 billion packages of all commodities are transported by all modes in the United States. Of those shipments, approximately 100 million are classified as hazardous materials (flammables, explosives, poisons, and radioactive materials).⁽¹⁾ A 1982 survey of shippers of radioactive

materials indicates that there are about 2 million shipments totalling 2.79 million packages on an annual basis.(2) A quick evaluation of these statistics reveals that radioactive materials constitute a very small fraction of the total number of hazardous material shipments made annually.

When the database was developed in 1981, it was structured primarily to accommodate the information contained on the DOT reporting form (Form 5800). Entries into the database generally meet both the NRC and DOT regulatory requirements for notification of an event. A distinction is made between an accident and reported incident. Definitions of the three kinds of reported events classified in RMIR follow:

Incidents - Actual or suspected release of radioactive material, or surface contamination exceeding regulatory requirements on either the package or the transport vehicle.

Transportation Accidents - Accidents involving the vehicles transporting the radioactive materials.

Handling Accidents - Damage to a shipping container during loading, handling, or unloading operations; e.g., a forklift puncturing a package at an air terminal.

As Table I shows, only 18% of the events in US radioactive materials transportation experience can be classified as transportation accidents.

TABLE I

US Radioactive Materials Transportation
Accidents/Incidents
(1971 - 1985)

Transportation Accidents	203
Handling Accidents	216
Incidents	<u>722</u>
TOTAL	1,141

As in the shipment of many other commodities, highway transportation is the most common method of shipment of radioactive materials. As one would expect, highway events occur more often as shown by the tabulations in Table II.

TABLE II

Transportation Events by Mode
(1971 - 1985)

Mode	Accidents	Handling Accidents	Incidents
Highway	175	84	581
Air	14	121	124
Rail	13	2	9
Courier	1	1	1
Freight Forwarder	0	3	5
Warehouse	0	2	0
Water	0	2	2
Unknown	<u>0</u>	<u>1</u>	<u>0</u>
TOTAL	203	216	722

The release or suspected release of radioactivity from a packaging can result from many situations. However, the most common occurrences are when there is minor external damage to a package, a package has become wet or damp, and liquid leaking from a trailer. Generally, these incidents are innocuous upon investigation. Wet or damp packages are the result of loading or unloading operations. Occasionally, a trailer will be halted at a state port of entry because a motorist or a police officer has noticed liquid leaking from the trailer, such situations occur when a truck has been traveling through rain or snow in a previous state and water accumulated inside the rear trailer doors and then leaked out.

Before a package is shipped, there has to be a radiation survey of the package surface. During this survey, surface contamination (non-fixed) is sometimes discovered and an incident report is written. These situations do not involve a package failure nor release of radioactive materials from a package.

In Table II, the number of accidents, handling accidents and incidents were tabulated according to the transportation mode. Table III shows the number of packaging failures or damages that occurred with respect to transportation accidents by transport mode.

TABLE III

Package Failures and Damages By Transport Mode
(1971 - 1985)

Mode	No. of Accidents	No. of Package Failures or Damages	
		Type A	Strong & Tight
Highway	175	50	30
Air	14	7	3
Rail	13	4	2
Courier	<u>1</u>	<u>0</u>	<u>0</u>
TOTAL	203	61	35

The RMIR data indicate that Type B packages have performed very well, especially with respect to accident conditions. Table IV gives a list of the type of materials transported in Type B packages that were subjected to accident conditions. In the total 33 accidents, there were no failures of the packages.

TABLE IV

Type B Accidents
(1971 - 1985)

See Attached Table

The final table, Table V, provides an overview of the transportation experience for the calendar year 1985. A word of caution is required if one expects to make a direct correlation between the 1985 data and other reports which show chronological summaries of data by year. Although, the RMIR database contains data from 1971 DOT reports, the NRC did not institute a reporting

collection system until 1976. Therefore, one should be careful in determining accident occurrence rates using information with different origination dates and with varying degrees of completeness.

TABLE V

1985 Summary of Transportation Events

See Attached Table

Summary

The information contained in the RMIR database is the most complete compilation of radioactive materials transportation events known to exist in the United States. This information is shared with several government agencies, among them are: the DOT, DOE, NRC and the Federal Emergency Management Agency.

Analyses using the RMIR data have proven to be useful in risk assessment codes and also with regard to the environmental impacts of transportation events. Additionally, RMIR data are of value when assessing the regulatory requirements for the development of radioactive materials packaging.

References

1. J.D. MCCLURE, and A. TYRON-HOPKO, "Radioactive Materials (RAM) Transportation Accident/Incident Analysis", SAND85-1016, Sandia National Laboratories, March 1986.

2. H.S. JAVITZ, et al, "Transport of Radioactive Materials in the United States: Results of a Survey to Determine the Magnitude and Characteristics of Domestic, Unclassified Shipments of Radioactive Materials", SAND84-7174, Sandia National Laboratories, April 1985.

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TABLE IV

Type B Accidents
(1971-1985)

Date of Acc/Inc	Operation Involved	Radioactive Material Involved	Description of Package Involved	No. Pkgs Shipped	Conditions
07/10/71	Highway	CO 60	Lead Container	1	Collision
12/08/71	Highway	RAM Fissile	Cask, Spent Fuel	1	Truck went off road
03/10/74	Highway	RA 192	Container	1	
03/29/74	Rail	RAM LSA	Cask, Spent Fuel	1	Car derailed
08/09/75	Highway	U235,U238,PU239,C058, etc.	Cask	1	Trailer ran off road
05/06/77	Highway	IR 192, 86 Ci	Camera, Radiography	1	Truck accident
08/11/77	Highway	IR 192, 100 Ci	Camera, Radiography	1	Collision with gas truck
10/03/77	Highway	IR 192, 120 Ci	Radiography Source	1	Collision
02/09/78	Highway	Spent Fuel	Cask, Spent Fuel	1	Trailer buckled
04/10/78	Highway	IR 192, 60 Ci Source	Camera, Radiography	1	One vehicle accident
07/26/78	Highway	CS 137	Steel Cask, Lead Lined	2	
08/13/78	Highway	Empty Spent Fuel Cask	Cask, Spent Fuel	1	Trailer bed failure
08/27/78	Highway	IR 192, 45 Ci	Camera, Radiography	1	Pickup truck accident
09/11/78	Highway	IR 192, 20 Ci	Camera, Radiography	1	Vehicle overturned
09/15/78	Highway	RA, 100 Ci	Cask	1	Vehicle overturned
11/28/78	Highway	IR 192, 120 Ci		1	Vehicle overturned
01/10/78	Highway	Uranium Hexafluoride	Cylinder	5	Truck was rear-ended
08/12/79	Highway	Empty	Cask	2	None
01/14/80	Highway	Teletherapy Source, 2066 Ci	Cask, Teletherapy Source	1	Semi-trailer hit truck
01/31/80	Highway	RAM LSA	Cask	2	Trailer jack-knifed
07/21/80	Highway	IR 192, 67 Ci	Exposure Device, Magnaflux	1	Truck-car collision
08/22/80	Highway	Uranium Hexafluoride Fissile	Cylinder, 30B	5	Truck edged off road
09/06/80	Rail	Uranium Hexafluoride Fissile	Cylinder, 30B	8	Train accident
09/29/80	Rail	SR 90, Y 90 100 mCi	Radiography Source	3	Train accident
06/09/81	Highway	AM 241/BE 2.9 Ci, CS 125 mCi	Source, Shielded	1	Pickup truck
09/02/81	Highway	IR 192 Source	Source		Vehicle collision
11/03/82	Highway	Empty Cask	Cask	2	Truck overturned
03/11/83	Highway	RAM LSA	Cask	1	Truck sideswiped
05/10/83	Highway	IR-192, 75 Ci	Camera, Radiography	1	Head-on collision
07/14/83	Air	RAM NOS	Cask	2	Plane overshot runway
02/11/85	Highway	IR-192	Steel Drum	1	Trailer jack-knifed
02/13/85	Highway	IR-192	Steel Drum	1	Truck overturned
10/05/85	Highway	MO-99/TC-99M RAM NOS	Type B	5	Collision

TABLE V
1985 Events-Accidents

Date of Acc/Inc	Radioactivity Released	Operation Involved	Radioactive Material Involved	Categorization Cause
01/08/85	None	Highway	SE-75 A TC	None
01/17/85	Contamination	Highway	Medical Isotopes	Collision
02/10/85	None	Highway	Radopharmaceuticals	None
02/11/85	None	Highway	IR-192	None
02/13/85	None	Highway	IR-192	None
03/06/85	Contamination	Highway	Medical Isotopes	Collision
04/02/85	None	Highway	LLW	Failure of Inner Receptacles
04/17/85	None	Highway	LLW	Collision
05/02/85	None	Highway	None	None
06/10/85	None	Highway	UFG	Collision
06/25/85	None	Highway	Uranium, Enriched	Collision
08/27/85	Contamination	Highway	Uranium Oxide	Collision
10/05/85	None	Highway	MO-99/TC-99M RAM NOS	Collision
10/06/85	None	Highway	Medical Isotopes	Collision
11/15/85	None	Highway	Radioactive Device	None
<u>Handling Accidents</u>				
01/04/85	None	Warehouse	RAM LSA, Fire Suppressant	Punctured by forklift
01/14/85	None	Highway	TC-99, Thallium	Fell in transit
02/23/85	None	Air		Dropped - surface moisture
05/01/85	Contamination	Unknown	RAM	Spillage
10/12/85	None	Air	XE 133, GA67	Fell in transit
<u>Incidents</u>				
01/11/85	Contamination	Highway	RAM NOS	Unknown
01/15/85	None	Highway		Improper label, misrouted
02/03/85	Contamination	Highway	Fissile NOS	Cask leaching
02/13/85	None	Highway	Cesium-137	Stolen
02/20/85	None	Highway	I 125, 5mCi	Abandoned on roadside
02/27/85	Unknown	Highway	MO-TC Generators	Lost in transit

TABLE V
(con'd)
1985 Events-Accidents

Date of Acc/Inc	Radioactivity Released	Operation Involved	Radioactive Material Involved	Categorization Cause
03/11/85	Unknown	Highway		Excessive T.I.
	None	Highway	LLW	None
03/14/85	None	Highway	IR-192	Dropped - seal failure
04/02/85	Contamination	Highway	Iodine-125, 10 mCi	Excessive T.I.
04/03/85	None	Rail	Cesium-137	Misrouted
04/03/85	None	Air	Americium-241	Lost in transit
04/05/86	None	Highway	LLW	Abandoned in field
04/10/85	None	Highway	TC-99	Stolen from vehicle
04/11/85	None	Air	Thallium Solution	Dropped - run over
04/12/85	None	Air	I-131	Dropped - run over
05/01/85	None	Highway	Cesium-137	Misrouted
05/02/85	Unknown	Highway	LLW	Liquid Leak
05/04/85	Contamination	Highway	Cesium-137	
05/22/85	6 mR/hr	Highway	LLW	External puncture
05/30/85	None	Highway	RAM	None
06/24/85	Contamination	Highway	RAM	None
06/25/85	None	Highway	Cesium-137, AM-241	Stolen from vehicle
06/37/85	None	Highway		External puncture
07/08/85	Contamination	Highway	Empty Spent Fuel Cask	Unknown
07/09/85	2 mCi	Highway	Thallium Chloride	Dropped - crushed
07/10/85	Contamination	Air		Unknown
07/16/85	None	Highway	Cesium-137	Stolen from vehicle
07/22/85	None	Highway	Tritium	Stolen
07/29/85	None	Highway	Dewatered Resins	
08/06/85	None	Highway	SR 90	Package and label did not meet CFR
08/20/85	Contamination	Highway	Resins	
08/26/85	None	Air	Uranium, U-235	Lost in transit
09/10/85	None	Highway	Cs-137, AM-241	Stolen from vehicle
09/20/85	None	Highway	SR 90	Improper packaging
10/31/86	None	Highway	Safpak, empty	Stolen
11/01/85	Contamination	Highway	Empty Cask	Unknown
12/11/85	None	Highway	Uranium Nitrate	Truck damage by strikers
12/12/85	Contamination	Highway	Fresh Fuel	Unknown
12/13/85	None	Highway	LLW	Violation of DOT regs
12/16/85	None	Air	Tritium-192	Unauthorized foreign shipment falsification of shipping papers