RADIOACTIVE MATERIAL TRANSPORTATION ACCIDENT AND INCIDENT EXPERIENCE IN THE U.S.A. (1971-1997)

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INTRODUCTION

The Radioactive Materials Incident Report (RMIR) database was developed in 1981 at the Transportation Technology Center of Sandia National Laboratories to support its research and development activities for the U.S. Department of Energy (DOE). This database contains information about radioactive materials transportation incidents that have occurred in the U.S. since 1971. These data were drawn from the U.S. Department of Transportation's (DOT) Hazardous Materials Incident Report system, from Nuclear Regulatory Commission (NRC) files, and from various agencies including state radiological control offices. Support for the RMIR data base is funded by the National Transportation Program (EM-70) of the U.S. Department of Energy.

Transportation events in RMIR are classified in one of the following ways: as a transportation accident, as a handling accident, or as a reported incident. This presentation will provide definitions for these classifications and give examples of each.

The primary objective of this presentation is to provide information on nuclear materials transportation accident/incident events in the U.S. for the period 1971-1997. Among the areas to be examined are: transportation accidents by mode, package response during accidents and an examination of accidents where release of contents has occurred.

Since its development in 1981, the RMIR database has evolved to become one of the most comprehensive compilations of information on transportation events involving radioactive materials. Over the years, RMIR has been used in the support of the following types of activities: transportation environmental analysis, safety analysis, public information materials, responses to inquiries, and mitigation of institutional concerns. The RMIR data base is located at Sandia National Laboratories in Albuquerque, NM.

REPORTING REQUIREMENTS FOR TRANSPORTATION INCIDENTS INVOLVING RADIOACTIVE MATERIALS

The two federal agencies with primary responsibility for developing and promulgating regulations for the transport of radioactive materials in the United States are the U.S. DOT and

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the U.S. NRC. The reporting requirements for these two agencies differ. The DOT regulations for reporting a hazardous materials incident (of which radioactive material is a subset) are specified in the Code of Federal Regulations. The DOT requires that a report be filed after each incident that occurs during the course of radioactive materials transportation (including loading, unloading, handling and temporary storage) in which one of the following directly results: (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. The NRC regulations are also outlined in the Code of Federal Regulations and require that the theft or loss of radioactive materials, exposure to radiation, or release of radioactive materials be reported.

In addition to the reports received from the DOT and NRC, the RMIR contains data obtained from state radiation control offices, the DOE Unusual Occurrence Report database, and media coverage of radioactive materials transportation incidents.

ANALYSIS OF U.S. RADIOACTIVE MATERIALS TRANSPORTATION ACCIDENT/INCIDENT DATA

To evaluate the history of transporting radioactive materials, it is helpful to obtain a perspective by viewing the hazardous materials shipment record. According to the Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes (1977), it is estimated that during a given year, approximately 500 billion packages of all commodities are transported by all modes throughout the United States. Of those 500 billion packages, approximately 100 million packages are classified as hazardous materials (flammables, explosives, poisons, corrosives and radioactive materials). The most recent study of the transport of radioactive materials (Javitz, et al., 1985) indicates that approximately 2 million shipments of radioactive materials are made each year which constitutes about 2.79 million packages. Thus, radioactive materials are only 2% of the total number of hazardous materials transported each year.

When the RMIR database was established in 1981, it was designed primarily to accommodate the information on the DOT Form 5800 (Hazardous Materials Incident Report) for the recording of transportation accidents and incidents. In order to better understand the type of reported transportation incidents, the RMIR database makes a definite distinction between an accident and other reported incidents. The three classifications of reported transportation incidents are defined as follows:

Transportation Accident: A transportation accident is any accident that involves the vehicle which is transporting radioactive material.

Handling Accident: Damage to a packaging during loading, handling, or unloading operations; e.g., a forklift puncturing a package at an air terminal.

Reported Incident: This broad term includes transportation occurrences where there is an actual or suspected release or surface contamination of radioactive materials which exceed the regulatory requirements from either the package or the transport vehicle. (In the database structure and query programs, a category, **Missing or Stolen**, has been added to accommodate the requests of other federal agencies using the RMIR data.) In this summary the categories of missing and stolen will be considered a sub-heading under Reported Incidents.

Table 1 tabulates the transportation accidents, handling accidents, and incidents that have occurred for the 25-year time frame of 1971 through 1996. Transportation accidents represent 21 percent of the 1828 reported incidents. Handling accidents represent 16 percent of the reported incidents. 1156 reported incidents do not involve transportation or handling accident conditions. Reported incidents comprise 62 percent of all reported incidents.

TABLE 1

U.S. RADIOACTIVE MATERIALS TRANSPORTATION EVENTS (1971-1996)

Transportation Accidents	388
Handling Accidents	284
Transportation Incidents	1156
TOTAL	1828

Most radioactive materials are transported on the highway; these highway shipments generally include industrial gauges, radioactive material used in or as a result of the nuclear fuel cycle, low-level radioactive materials or waste, and teletherapy sources. Radioactive materials that are shipped by air are generally isotopes with short half-lives that are being shipped over 500 miles from the shipper's location. Upon arrival at an airport, these radioisotopes are generally delivered to their consignees by a courier service. Radioactive materials transported by modes other than aircraft are usually those that do not require immediate delivery.

Tables 2 through Table 4 provide a description of the characteristics of 393 total incidents (transportation accidents, handling accidents and reported incidents) that were reported to RMIR for the period of 1991 through 1996. During (1971-1996) a total of 388 transportation accidents occurred. In the set of 388 accidents, a total of 59 transportation accidents involved Type B accident resistant packages. The package response for these Type B packages will be reported in Tables 5 and 6.

TABLE 2

END-USE CLASSIFICATION FOR INCIDENT REPORTS (1991-1996)

END-USE CLASSIFICATION	Number	Percent of Reports
Medical	139	35%
Industrial	175	45%
Fire	4	1%
NFC-Nuclear Fuel Cycle	50	13%
LLW - Low Level Waste	7	1%
Unknown	18	5%

TABLE 3

TRANSPORT MODE CLASSIFICATION FOR INCIDENT REPORTS (1991-1996)

TRANSPORT MODE	Number	Percent of Reports
Highway	293	75%
Rail	14	3%
Air	62	17%
Water (Marine)	3	<1%
Freight Forwarder/Courier	5	<1%
Warehouse	0	0%
Unknown/Other	16	4$

TABLE 4

PACKAGE CLASSIFICATION FOR INCIDENT REPORTS (1991-1996)

PACKAGE TYPE IN REPORTED INCIDENTS	Number	Percent of Reports
Strong-Tight	23	6%
Type A	184	47%
Type B	35	9%
Unknown	129	33%
Other	22	<6%

TABLE 5

PACKAGE RESPONSE FOR REPORTED ACCIDENTS (1971-1996)

PACKAGE TYPE IN REPORTED ACCIDENTS	Number of Packages in Accidents	Estimated Number of Packages with Release of RAM Contents
Strong-Tight	155	236
Type A	2379	219
Type B	91	0

In the period of time from 1971 through 1990, approximately 180,000 hazardous material (hazmat) incident reports have been submitted to the U.S. Department of Transportation. This represents an average of approximately 9000 hazardous material reports sent to the DOT per year. For the period of 1971 through 1996, if the reporting level to the DOT remained at past levels there would have been approximately 234,000 hazmat reports made to the DOT for the period of 1971 through 1996. From Table 1, only 1828 of these reports involved radioactive materials for the period of 1971 through 1996. This means that the part of the hazardous materials population where incidents have been reported to DOT, radioactive materials occupy only (1828 / 234000) or approximately 0.8 percent of the reported incidents involved radioactive materials.

Table 6 provides a tabulation of the 59 accidents involving Type B packages that have occurred in the period from 1971 through 1996. These accidents involved 90 Type B packages, none of which released their radioactive contents due to accident conditions. Of these accidents, seven involved spent nuclear fuel (three of them occurred during rail transport and four occurred on the highway). There has been only one spent nuclear fuel

accident which resulted in more than trivial damage to the cask. This accident occurred on December 8, 1971, on U.S. 25 in Tennessee. The accident rollover conditions caused the cask to come off of the trailer. The radiation surveys taken at the accident scene indicated that the structural integrity of the cask was intact and there was no release of radioactive contents. The driver of the truck transporting the cask was killed by the forces of the accident but these conditions were not related to the radioactive nature of the cargo.

CONCLUDING REMARKS

The radioactive material accident/incident summary documented in this presentation is based on accident/incident occurrences that have taken place in the calendar years 1971 through 1996. Additional accident occurrences have been received for the calendar year 1997 and as of this date, October 1997, there have been 23 accident/incident occurrences for 1997 through March 27, 1997. Two of these occurrences were transportation accidents and the remainder were reported incidents. Updates on U.S. accident /incident experience can be obtained by gaining access to the TRANSNET system of codes and data bases. Access to TRANSNET can be accomplished by contacting the Transportation Systems Department 6341 at Sandia National Laboratories. In addition, updates for the RMIR data base can be viewed in the near future by addressing the Transportation Technology Development Home Page on the Internet at http://www.sandia.gov/ttp/.html.

REFERENCES

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10 CFR 20.402, 20.403 Code of Federal Regulations, Energy

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TABLE 6

SUMMARY OF ACCIDENTS INVOLVING TYPE B PACKAGES (1971-1996)

Date of Accident	Mode	Package Description	RAM Involved	Packages Shipped/ Damaged
07/10/71	Highway	Lead container	Co-60	1/0
12/05/71	Highway	Radiography camera	Ir-192	1/0
12/08/71	Highway	Cask, spent fuel	Spent Fuel	1/1
03/10/74	Highway	Container	Ir-192	1/0
03/29/74	Rail	Cask, spent fuel	Spent fuel	1/0
08/09/75	Highway	Cask	U-235, U-238 Pu-239	1/0
05/06/77	Highway	Radiography camera	Ir-192	1/0
08/11/77	Highway	Radiography camera	Ir-192	1/0
08/25/77	Rail	Cylinders	UF6	4/0
10/03/77	Highway	Radiography source	Ir-192	1/0
02/09/78	Highway	Cask, spent fuel	Spent fuel	1/0
04/10/78	Highway	Radiography camera	Ir-192	1/0
07/07/78	Highway	Cask	Mixed fission	1/0
07/26/78	Highway	Steel cask, lead	Cs-137	2/0
08/13/78	Highway	Cask, spent fuel	Spent fuel	1/0
08/27/78	Highway	Radiography camera	Ir-192	1/0
09/11/78	Highway	Radiography camera	Ir-192	1/0
09/15/78	Highway	Radiography camera	Ir-192	1/0
11/28/78	Highway	Radiography camera	Ir-192	1/0
01/10/79	Highway	Cylinder	Ir-192	5/0
08/12/79	Highway	Cask	Empty	2/0
12/11/79	Highway	Cylinder	UF6	5/0
01/14/80	Highway	Cask, teletherapy	Co-60	1/0
01/31/80	Highway	Cask	Low level Waste	2/0
07/21/80	Highway	Source	Ir-192	1/0
08/22/80	Highway	Cylinder, 30B	UF6	5/0
09/06/80	Rail	Cylinder, 30B	UF6	8/0
09/29/80	Rail	Radiography source	Sr-90, Y-90	3/0
06/09/81	Highway	Source, shielded	Am-241/be	1/0
09/02/81	Highway	Source	Ir-192	1/0
10/26/81	Highway	Radiography camera	Ir-192	1/0
11/03/82	Highway	Cask	Empty LLW	2/0
03/11/83	Highway	Cask	LLW	1/0

Table 6 (con't)

Date of Accident	Mode	Package Description	RAM Involved	Shipped/ Damaged
05/10/83	Highway	Radiography source	Ir-192	1/0
07/14/83	Air	Cask	Y-90, Ir-192	2/0
12/09/83	Highway	Cask, spent fuel	Spent fuel	1/0
07/16/84	Air	Container	Ir-192	1/0
08/08/84	Highway	Container	Reactor waste	1/0
02/11/85	Highway	Steel drum	Ir-192	1/0
02/13/85	Highway	Steel drum	Ir-192	1/1
12/04/85	Highway	Radiography camera	Ir-192	1/0
01/10/86	Highway	Source	Cs-137	1/0
08/15/86	Highway	Cylinder, 30B	UF6	3/0
03/24/87	Rail	Cask, spent fuel	Spent fuel	2/0
10/26/87	Highway	Radiography source	Ir-192	1/0
01/09/88	Rail	Cask, spent fuel	Spent fuel	1/0
01/23/88	Highway	Radiography camera	Ir-192	1/0
09/23/89	Highway	Radiography camera	Ir-192	1/0
03/27/89	Highway	Radiography camera	Ir-192	1/0
05/19/89	Highway	Cask	LLW	1/0
06/08/91	Highway	Radiography camera	Ir-192	1/0
09/15/91	Highway	Radiography camera	Ir-192	1/0
11/03/91	Highway	Radiography camera	Ir-192	1/0
02/07/92	Highway	Radiography camera	Ir-192	1/0
3/04/93	Highway	LLW Cask	LLW	1/0
10/10/94	Highway	Industrial rad. source	Ir-192	1/0
12/23/94	Rail	Cylinder (14 ton)	UF6	1/0
09/06/96	Air	Packages (no details)	Ir-192	1/0
12/06/96	Air	Packages (no details)	Ir-192	0

SESSION 5.1

On-Site Transfers