Abstract

Sandia National Laboratories was tasked by the Japan Nuclear Cycle Development Institute (JNC) to provide assistance in developing an emergency response plan for radioactive material transportation activities. Those tasks included compiling radioactive materials (RAM) transportation accident data from the open literature and databases, investigating emergency response plans for radioactive materials transport in the United States, and developing specific recommendations for the JNC’s nuclear material transport emergency response plan, based on information gathered during the first two tasks. These recommendations include developing a RAM database, a public transparency Internet website, an emergency response infrastructure designed specifically for transportation needs, and a clear set of directives to provide authority in the case of transportation accidents or incidents involving RAM.
Acknowledgment

First and foremost, the authors would like to thank the Japan Nuclear Cycle Development Institute (JNC) who provided funding for this project. The authors would also like to thank Sandia technical staff members, Chris Aas and J. D. Smith, who provided valuable review comments.
Contents

1. Introduction ..............................................................................................................................12

2. Task 1: Radioactive Materials (RAM) Transportation Accident Data ......................................14
   2.1 RAM Transportation Accident Databases ........................................................................14
   2.2 Other Databases .............................................................................................................14
   2.3 RAM Transportation Accident/Incident Reporting Requirements ....................................15
   2.4 RAM Transportation Accident/Incident Statistics ..........................................................15
   2.5 Case Histories (Accident Response and Site Remediation) ...........................................23
      2.5.1 Springfield, Colorado, September 27, 1977 ..............................................................23
      2.5.2 Oak Ridge National Laboratory, December 8, 1971 ...............................................24
      2.5.3 Southern Pacific, January 7, 1982 .........................................................................25
      2.5.4 Springfield, Massachusetts, December 16, 1991 ...................................................26
      2.5.5 Lessons Learned ....................................................................................................27
   2.6 Selected Resources ........................................................................................................28
      2.6.1 International Atomic Energy Agency (IAEA) ..........................................................28
      2.6.2 Nuclear Regulatory Commission (NRC) ................................................................28
      2.6.3 Environmental Protection Agency (EPA) ................................................................28
      2.6.4 DOE Transportation Emergency Preparedness Program (TEPP) ............................28
      2.6.5 North American Emergency Response Guidebook (NAERG) ..................................28
      2.6.6 Hazardous Materials Emergency Preparedness (HMEP) Program ..........................29

3. Task 2: RAM Transport Emergency Response Plans ..............................................................31
   3.1 Introduction ....................................................................................................................31
   3.2 The Incident Command System ....................................................................................32
      3.2.1 Relevant Definitions ................................................................................................32
      3.2.2 Emergency Response Procedures ..........................................................................33
   3.3 U.S. Federal Response to RAM Accidents ......................................................................38
   3.4 DOE Waste Isolation Pilot Plant (WIPP) Plan ...............................................................42
   3.5 Chalk River Laboratories (CRL) Plan ............................................................................43
   3.6 Lessons Learned .............................................................................................................46

4. Task 3: Recommendations ....................................................................................................47
   4.1 Introduction .....................................................................................................................47
   4.2 Emergency Response Procedures ..................................................................................47
   4.3 Elements of the Emergency Response Program .............................................................47
      4.3.1 Notification and Communication ............................................................................47
      4.3.2 Public Information ..................................................................................................48
      4.3.3 Fire and Rescue ....................................................................................................48
      4.3.4 Emergency Medical Services ..............................................................................49
      4.3.5 Law Enforcement ................................................................................................49
      4.3.6 Radiation Exposure Control ................................................................................49
      4.3.7 Medical Monitoring ..............................................................................................49
      4.3.8 Recovery and Reentry ..........................................................................................49
      4.3.9 Equipment ............................................................................................................49
      4.3.10 Training Program ................................................................................................50
      4.3.11 Contingencies .....................................................................................................50
Figures

Figure 1. Rockwell International transportation incident report from RMIR database................22
Figure 2. San Onofre Nuclear Power Station transportation incident report from RMIR database........................................................................................................................24
Figure 3. Oak Ridge National Laboratory accident report from RMIR database..................25
Figure 4. Southern Pacific train derailment accident report from RMIR database. .............26
Figure 5. Springfield, Massachusetts’s transportation accident report from RMIR database........................................................................................................................27
Figure 6. First responder flow chart for RAM transportation accidents (adapted from U. S. DOE, 2000b). .................................................................34
Figure 7. Response flow chart for RAM accidents involving injured or contaminated individuals (adapted from U. S. DOE, 2000b)....................................................35
Figure 8. Response flow chart for RAM accidents involving fires (adapted from U. S. DOE, 2000b)..........................................................................................36
Figure 9. Response flow chart for radiological events (adapted from U. S. DOE, 2000b) .................................................................................................37
Figure 10. Radioactive materials transportation accident notification process in the United States (adapted from FRERP, 1996). ......................................................39
Figure 11. DOE Carlsbad Area Office (CAO) emergency notification flowchart (U. S. DOE, 1995). .......................................................................................45
Figure 12. Emergency response flow chart for shipments from CRL to LANL (adapted from AECL, 1999). ...........................................................................45

Tables

Table 1. Characteristics for Hazardous Materials Shipments (all hazard classes) versus Radioactive Materials Shipments (Hazard Class 7) (adapted from U. S. Census Bureau, 1997). ..............................................................................................................16
Table 2. Characteristics for Radioactive Materials Shipments (Hazard Class 7) by Mode of Transport (adapted from U. S. Census Bureau, 1997). ..............................................16
Table 3. Statistics for U. S. RAM transportation events: 1971–April 2000................................17
Table 4. Classification of Reports (1971–April 2000). ..........................................................18
Table 5. Total Number of Packages Involved in Transportation Events Involving Nuclear Material (1971–April 2000). ..................................................18
Table 6. Number of Accidents Involving Each Nuclear Material Package Type (1971–April 2000). ......................................................................................18
Table 7. Summary of Accidents Involving Type B Packages (1971–April 2000) .....................20
Table 8. Incidents Involving the Release of Spent Nuclear Fuel Where Contamination Went Beyond the Vehicle. .................................................................21
Table 9. Incidents Involving the Release of Spent Nuclear Fuel Where Contamination was Confined to the Vehicle. ...............................................................23
Table 10. Identification of the Lead Federal Agency for Radioactive Materials Transportation Accidents. ..............................................................................38
Table 11. Response Functions. ..........................................................................................40
Nomenclature

AEC       Atomic Energy Commission
AECL      Atomic Energy of Canada Limited
CAO       Carlsbad Area Office
CFR       Code of Federal Regulations
CMR       Central Monitoring Room
CRL       Chalk River Laboratories
DFO       Disaster Field Office
DOD       Department of Defense
DOE       Department of Energy
DOJ       Department of Justice
DOS       Department of State
DOT       Department of Transportation
EM        Office of Environmental Management
EOC       Emergency Operations Center
EPA       Environmental Protection Agency
ETAS      Enterprise Transportation Analysis System
FBI       Federal Bureau of Investigation
FRA       Federal Railroad Association
FRERP     Federal Radiological Emergency Response Plan
FRMAC     Federal Radiological Monitoring and Assessment Center
FRP       Federal Response Plan
Hazmat    hazardous materials
HAZWOPER  Hazardous Waste Operations and Emergency Response
           (U. S. 29 CFR 1910.120)
HMIS      Hazardous Materials Information System
HLW       high-level waste
HMEP      Hazardous Materials Emergency Preparedness
IAEA      International Atomic Energy Agency
IART      Incident/Accident Response Team
IC        Incident Commander
ICS       Incident Command System
IAEA      International Atomic Energy Agency
JIC       Joint Information Center
JNC       Japan Nuclear Cycle Development Institute
JOC       Joint Operations Center
LC50      lethal concentration in 50% of the population
LFA       lead federal agency
NAERG     North American Emergency Response Guidebook
NASA      National Aeronautics and Space Administration
NCS       National Communications System
NDA       National Defense Area
NFPA      National Fire Protection Association
NIOSH     National Institute for Occupational Safety and Health
NRC       Nuclear Regulatory Commission
NSA  national security area
NTP  National Transportation Program
NTSB  National Transportation Safety Board
OSC  On-Scene Commander
OSHA  Occupational Safety and Health Administration
PPE  personal protective equipment
ppm  parts per million
PSM  prospective shipment module
RAM  radioactive materials
RAP  Radiological Assistance Program
RAT  Radiological Assessment Team (AECL) or Radiological Assistance Team (DOE)
RMIR  Radioactive Materials Incident Report
RSPA  Research and Special Programs Administration
SCBA  self-contained breathing apparatus
SCT  Transport and Communications of Mexico
SEO  Senior Emergency Officer
SFEN  Societe Francaise d'Energie Nucleaire
SMRO  Security Monitoring Room Operator
SNL  Sandia National Laboratories
TC  transport Canada
TEPP  Transportation Emergency Preparedness Program
TRANSCOM  Transportation Tracking and Communications System
TRU  transuranic waste
USCG  United States Coast Guard
WIPP  Waste Isolation Pilot Plant
1. Introduction

Sandia National Laboratories (SNL) was tasked by the Japan Nuclear Cycle Development Institute (JNC) to provide assistance in developing an emergency response plan for radioactive material transport. Specific tasks included:

**Task 1:** Accident data for radioactive material (RAM) transport accidents will be compiled from the open literature and databases and will include details of the cause, packaging, local accident response, and subsequent site remediation and restoration as available.

**Task 2:** Emergency response plans for radioactive materials transport in the United States will be investigated.

**Task 3:** Specific recommendations for the Japan Nuclear Cycle Development Institute’s (JNC’s) nuclear material transport emergency response plan will be developed based on a review of the above items.

The three tasks described above are contained within Sections 2, 3, and 4, respectively, of this report.
2. Task 1: Radioactive Materials (RAM) Transportation Accident Data

The first task involved gathering data and information from the open literature and from databases. The Radioactive Materials Incident Report (RMIR) database was the primary database consulted due to its direct relevance to the task. In addition, four RAM transportation accident case studies were examined and the lessons learned are discussed. Additional sources of information include the International Atomic Energy Agency (IAEA), U. S. Nuclear Regulatory Commission (NRC), Environmental Protection Agency (EPA), Department of Energy (DOE), Transportation Emergency Preparedness Program (TEPP), the North American Emergency Response Guidebook (NAERG), and the Hazardous Materials Emergency Preparedness (HMEP).

2.1 RAM Transportation Accident Databases

The RMIR is the only database in the United States that exclusively contains data related to radioactive materials transportation accidents and incidents. The RMIR database that was developed in 1981 at the Transportation Technology Center of SNL to support its research and development activities for the DOE. This database was developed to serve as a single-point resource that contains all pertinent information related RAM transportation incidents. The RMIR contains information about radioactive materials transportation incidents that have occurred in the United States since 1971 (the date when the U. S. Department of Transportation (DOT) instituted new reporting requirements for transportation incidents and accidents involving hazardous, including radioactive, materials). It includes information on the mode of transport and type of vehicle, type of RAM packaging, whether or not radioactivity was released, any subsequent injuries and deaths due to radioactivity released, and a narrative that contains details of the accident. Although the narratives that were provided to describe the incidents/accidents often include information on local accident response and subsequent site remediation and restoration, this is not a required field in the database.

The RMIR database draws most of its information from the DOT Hazardous Materials Information System (HMIS) database, a computerized information management system containing data related to the transportation of all hazardous materials by air, highway, rail, and water. However, RMIR also includes data obtained from the NRC, state radiation control offices, the DOE Unusual Occurrence Report database, and media coverage of radioactive materials transportation incidents.

2.2 Other Databases

The DOT maintains several other databases that contain statistics on all transportation accidents (i.e., not limited to the transportation of hazardous or radioactive materials). Statistics from these databases are often used in RAM transportation risk analyses because there are so few actual RAM transportation accidents from which to derive meaningful data. One such database is the Federal Railroad Association (FRA) database that contains railroad ac-
The National Response Center, operated by the U. S. Coast Guard (USCG), recently implemented an on-line query system that makes all dangerous goods and hazardous substances spill data available via the Internet (http://www.nrc.uscg.mil/foia.htm), last accessed in December 2000. The primary function of the National Response Center is to serve as the national point of contact for reporting all oil, chemical, radiological, biological, and etiological discharges into the environment anywhere in the United States.

2.3 RAM Transportation Accident/Incident Reporting Requirements

The two federal agencies with primary responsibility for developing and promulgating regulations for the transport of radioactive materials in the United States are the DOT and the NRC, and the RMIR database derives most of its information from these two agencies. Reporting requirements for these two agencies differ. DOT regulations for reporting a hazardous materials incident (of which radioactive material is a subset) 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 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) there is 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 (10 CFR 20.402 and 20.403) and require that the theft or loss of radioactive materials, exposure to radiation, or release of radioactive materials be reported.

2.4 RAM Transportation Accident/Incident Statistics

The RMIR database is the best single-point source for transportation accident/incident information in the United States and the statistics provided in this section were obtained from that source. The following definitions apply:

**Transportation Accident**: A vehicle transporting radioactive material is involved in an accident in which there is a fatality or injury, or in which the vehicle is damaged enough that it cannot move under its own power.

**Handling Accident**: Damage to a packaging during loading, handling, or unloading operations (e.g., a forklift puncturing a package at a warehouse).

**Other Incident**: An actual or suspected release, or surface contamination of radioactive materials from either the package or the transport vehicle that exceeds the regulatory requirements.
**Missing or Stolen**: Other incidents that involve the loss or theft of a radioactive cargo (e.g., the theft of a soil moisture-density gauge from a construction vehicle).

According to the U. S. Census Bureau (1997), RAM shipments represented less than 1% of the total number of hazardous material shipments (in terms of dollar amounts and miles traveled). The majority of the RAM shipments (again, in terms of dollar amounts and miles traveled) were made by truck, followed closely by rail (see precise values in Tables 1 and 2).

<table>
<thead>
<tr>
<th>Hazard Class</th>
<th>Value</th>
<th>Tons</th>
<th>Ton-miles</th>
<th>Ave. miles per shipment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number (million dollars)</td>
<td>Percent</td>
<td>Number (thousands)</td>
<td>Percent</td>
</tr>
<tr>
<td>Total of all classes</td>
<td>466,407</td>
<td>100</td>
<td>1,565,196</td>
<td>100</td>
</tr>
<tr>
<td>RAM Class 7</td>
<td>2,722</td>
<td>0.6</td>
<td>87</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

*Adapted from U. S. Census Bureau, 1997.

**Table 2. Characteristics for Radioactive Materials Shipments (Hazard Class 7) by Mode of Transport (adapted from U. S. Census Bureau, 1997).**

<table>
<thead>
<tr>
<th>Mode of Transport</th>
<th>Value</th>
<th>Tons</th>
<th>Ton-miles</th>
<th>Ave. miles per shipment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number (million dollars)</td>
<td>Percent</td>
<td>Number (thousands)</td>
<td>Percent</td>
</tr>
<tr>
<td>All Modes</td>
<td>2,722</td>
<td>100</td>
<td>87</td>
<td>100</td>
</tr>
<tr>
<td>Truck</td>
<td>1,456</td>
<td>53.5</td>
<td>56</td>
<td>64.4</td>
</tr>
<tr>
<td>Rail</td>
<td>914</td>
<td>33.6</td>
<td>20</td>
<td>23.0</td>
</tr>
<tr>
<td>Water</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Multiple Modes</td>
<td>352</td>
<td>12.9</td>
<td>11</td>
<td>12.6</td>
</tr>
</tbody>
</table>

*Adapted from U. S. Census Bureau, 1997.

Table 3 shows the transportation events reported in the RMIR database since 1971. These statistics do not include events reported to the NRC since December 1998; however, this does not affect the number of reported “accidents,” only the number of events categorized as
“missing or stolen.” Since most radioactive materials are transported on the highway, this mode of transport constitutes the largest number of reported events (73%). 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 sources used in medical devices.


<table>
<thead>
<tr>
<th>Mode</th>
<th>Transport Accidents</th>
<th>Handling Accidents</th>
<th>Missing or Stolen</th>
<th>Weeping Incidents</th>
<th>Other Incidents</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highway</td>
<td>349</td>
<td>111</td>
<td>208</td>
<td>6</td>
<td>752</td>
<td>1426</td>
<td>73</td>
</tr>
<tr>
<td>Rail</td>
<td>27</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>31</td>
<td>62</td>
<td>3</td>
</tr>
<tr>
<td>Water</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>9</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Air</td>
<td>25</td>
<td>162</td>
<td>40</td>
<td>0</td>
<td>149</td>
<td>376</td>
<td>19</td>
</tr>
<tr>
<td>Warehouse</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Courier</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>10</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Freight Forwarder</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>11</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
<td>4</td>
<td>12</td>
<td>0</td>
<td>25</td>
<td>41</td>
<td>2</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>405</td>
<td>293</td>
<td>268</td>
<td>7</td>
<td>982</td>
<td>1955</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>% total</strong></td>
<td>21%</td>
<td>15%</td>
<td>14%</td>
<td>&lt;1%</td>
<td>50%</td>
<td>N/A</td>
<td>NA</td>
</tr>
</tbody>
</table>

*Does not include NRC reports since December 1998. (This impacts the number of “missing or stolen” events but not number of reported “accidents”).

Table 4 shows the number of reported incidents categorized by type of radioactive material transported. Transportation events involving industrial materials such as nuclear moisture density gauges used in construction operations, represent the largest category of reported events.

Table 5 shows the total number of packages involved in transportation events. At least 75% of the reported events involve packages of the industrial type (strong and tight) and Type A, while Type B packages represent only 11% of the total packages involved in transportation events.

Table 6 may be more useful because it shows the number of accidents involving each package type. Recall from Table 3 that “accidents” represent only 21% of the reported events in the RMIR database. Type A packages were involved in the greatest number of accidents (56%) while Type B packages were involved in only 15% of all RAM transportation accidents.
Further, Table 7 breaks down each of the 61 accidents involving Type B packages and provides data regarding the mode of transport, type of RAM being shipped, and the number of packages shipped and damaged during transport. Shipments carrying spent fuel casks are noted in bold. A detailed description of each accident obtained from the RMIR database is contained in Appendix A.

<table>
<thead>
<tr>
<th>Classification of Nuclear Material</th>
<th>Number of Reports</th>
<th>Percentage of Reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical</td>
<td>532</td>
<td>27%</td>
</tr>
<tr>
<td>Industrial</td>
<td>609</td>
<td>31%</td>
</tr>
<tr>
<td>Nuclear Fuel Cycle</td>
<td>606</td>
<td>31%</td>
</tr>
<tr>
<td>Low Level Waste</td>
<td>56</td>
<td>3%</td>
</tr>
<tr>
<td>Unknown</td>
<td>152</td>
<td>8%</td>
</tr>
</tbody>
</table>

* Does not include NRC reports since December 1998.

<table>
<thead>
<tr>
<th>Package Type</th>
<th>Total Number of Packages</th>
<th>Percentage of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong-Tight</td>
<td>440</td>
<td>21%</td>
</tr>
<tr>
<td>Type A</td>
<td>1132</td>
<td>54%</td>
</tr>
<tr>
<td>Type B</td>
<td>240</td>
<td>11%</td>
</tr>
<tr>
<td>Unknown</td>
<td>272</td>
<td>13%</td>
</tr>
</tbody>
</table>

Total Number of Packages 2084**

* Does not include NRC reports since December 1998.
** Number of packages exceeds number of incidents because shipments can contain multiple packages.

<table>
<thead>
<tr>
<th>Package Type</th>
<th>Number of Accidents*</th>
<th>Percentage of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong-Tight</td>
<td>48</td>
<td>12</td>
</tr>
<tr>
<td>Type A</td>
<td>232</td>
<td>56</td>
</tr>
<tr>
<td>Type B</td>
<td>61</td>
<td>15</td>
</tr>
<tr>
<td>Unknown</td>
<td>69</td>
<td>17</td>
</tr>
</tbody>
</table>

Table 4. Classification of Reports (1971–April 2000).*

Table 5. Total Number of Packages Involved in Transportation Events Involving Nuclear Material (1971–April 2000).*

Table 6. Number of Accidents Involving Each Nuclear Material Package Type (1971–April 2000).
*Number of accidents totals 410 (exceeds the 405 provided in Table 3) because some shipments involve multiple package types.
<table>
<thead>
<tr>
<th>Date of Accident</th>
<th>Mode</th>
<th>Package Description</th>
<th>RAM Involved</th>
<th>Damaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>07/10/71</td>
<td>Highway</td>
<td>Lead container</td>
<td>Co-60</td>
<td>1/0</td>
</tr>
<tr>
<td>12/05/71</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>12/08/71</td>
<td>Highway</td>
<td>Cask, spent fuel</td>
<td>Spent Fuel</td>
<td>1/1</td>
</tr>
<tr>
<td>03/10/74</td>
<td>Highway</td>
<td>Container</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>03/29/74</td>
<td>Rail</td>
<td>Cask, spent fuel</td>
<td>Empty spent fuel cask</td>
<td>1/0</td>
</tr>
<tr>
<td>08/09/75</td>
<td>Highway</td>
<td>Cask</td>
<td>U-235, U-238, Pu 239</td>
<td>1/0</td>
</tr>
<tr>
<td>05/06/77</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>08/11/77</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>08/25/77</td>
<td>Rail</td>
<td>Cylinders</td>
<td>UF6</td>
<td>4/0</td>
</tr>
<tr>
<td>10/03/77</td>
<td>Highway</td>
<td>Radiography source</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>02/09/78</td>
<td>Highway</td>
<td>Cask, spent fuel</td>
<td>Spent fuel</td>
<td>1/0</td>
</tr>
<tr>
<td>04/10/78</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>07/07/78</td>
<td>Highway</td>
<td>Cask</td>
<td>Mixed fission</td>
<td>1/0</td>
</tr>
<tr>
<td>07/26/78</td>
<td>Highway</td>
<td>Steel cask, lead</td>
<td>Cs-137</td>
<td>2/0</td>
</tr>
<tr>
<td>08/13/78</td>
<td>Highway</td>
<td>Cask, spent fuel</td>
<td>Empty spent fuel cask</td>
<td>1/0</td>
</tr>
<tr>
<td>08/27/78</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>09/11/78</td>
<td>Highway</td>
<td>Radiograph, camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>09/15/78</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>11/28/78</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>01/10/79</td>
<td>Highway</td>
<td>Cylinder</td>
<td>Ir-192</td>
<td>5/0</td>
</tr>
<tr>
<td>08/12/79</td>
<td>Highway</td>
<td>Cask</td>
<td>Empty</td>
<td>2/0</td>
</tr>
<tr>
<td>12/11/79</td>
<td>Highway</td>
<td>Cylinder</td>
<td>UF6</td>
<td>5/0</td>
</tr>
<tr>
<td>01/14/80</td>
<td>Highway</td>
<td>Cask, teletherapy</td>
<td>Co-60</td>
<td>1/0</td>
</tr>
<tr>
<td>01/31/80</td>
<td>Highway</td>
<td>Cask</td>
<td>Low level Waste</td>
<td>2/0</td>
</tr>
<tr>
<td>07/21/80</td>
<td>Highway</td>
<td>Source</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>08/22/80</td>
<td>Highway</td>
<td>Cylinder, 30B</td>
<td>UF6</td>
<td>5/0</td>
</tr>
<tr>
<td>09/06/80</td>
<td>Rail</td>
<td>Cylinder, 30B</td>
<td>UF6</td>
<td>8/0</td>
</tr>
<tr>
<td>09/29/80</td>
<td>Rail</td>
<td>Radiography source</td>
<td>Sr-90, Y-90</td>
<td>3/0</td>
</tr>
<tr>
<td>06/09/81</td>
<td>Highway</td>
<td>Source, shielded</td>
<td>Am-241/be</td>
<td>1/0</td>
</tr>
<tr>
<td>09/02/81</td>
<td>Highway</td>
<td>Source</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>10/26/81</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>11/03/82</td>
<td>Highway</td>
<td>Cask</td>
<td>Empty LLW</td>
<td>2/0</td>
</tr>
<tr>
<td>03/11/83</td>
<td>Highway</td>
<td>Cask</td>
<td>LLW</td>
<td>1/0</td>
</tr>
<tr>
<td>05/10/83</td>
<td>Highway</td>
<td>Radiography source</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>07/14/83</td>
<td>Air</td>
<td>Cask</td>
<td>Y-90, Ir-192</td>
<td>2/0</td>
</tr>
<tr>
<td>12/09/83</td>
<td>Highway</td>
<td>Cask, spent fuel</td>
<td>Spent fuel</td>
<td>1/0</td>
</tr>
<tr>
<td>07/16/84</td>
<td>Air</td>
<td>Container</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>08/08/84</td>
<td>Highway</td>
<td>Container</td>
<td>Reactor waste</td>
<td>1/0</td>
</tr>
<tr>
<td>02/11/85</td>
<td>Highway</td>
<td>Steel drum</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>02/13/85</td>
<td>Highway</td>
<td>Steel drum</td>
<td>Ir-192</td>
<td>1/1</td>
</tr>
<tr>
<td>12/04/85</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>01/10/86</td>
<td>Highway</td>
<td>Source</td>
<td>Cs-137</td>
<td>1/0</td>
</tr>
<tr>
<td>08/15/86</td>
<td>Highway</td>
<td>Cylinder, 30B</td>
<td>UF6</td>
<td>3/0</td>
</tr>
<tr>
<td>03/24/87</td>
<td>Rail</td>
<td>Cask, spent fuel</td>
<td>Spent fuel</td>
<td>2/0</td>
</tr>
<tr>
<td>10/26/87</td>
<td>Highway</td>
<td>Radiography source</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>01/09/88</td>
<td>Rail</td>
<td>Cask, spent fuel</td>
<td>Empty Spent Fuel cask</td>
<td>1/0</td>
</tr>
<tr>
<td>01/23/88</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
</tbody>
</table>
Table 7. Summary of Accidents Involving Type B Packages (1971–April 2000) (continued).

<table>
<thead>
<tr>
<th>Date of Accident</th>
<th>Mode</th>
<th>Package Description</th>
<th>RAM Involved</th>
<th>Packages Shipped/ Damaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/23/88</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>03/27/89</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>05/19/89</td>
<td>Highway</td>
<td>Cask</td>
<td>LLW</td>
<td>1/0</td>
</tr>
<tr>
<td>06/08/91</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>09/15/91</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>11/03/91</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>02/07/92</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>03/04/93</td>
<td>Highway</td>
<td>LLW Cask</td>
<td>LLW</td>
<td>1/0</td>
</tr>
<tr>
<td>10/10/94</td>
<td>Highway</td>
<td>Sealed Source</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>12/23/94</td>
<td>Rail</td>
<td>Cylinder (14 ton)</td>
<td>UF6</td>
<td>1/0</td>
</tr>
<tr>
<td>12/14/95</td>
<td>Rail</td>
<td>Cask, Spent Fuel</td>
<td>Empty Spent Fuel Cask</td>
<td>1/0</td>
</tr>
<tr>
<td>09/09/96</td>
<td>Air</td>
<td>Packages (no details)</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
<tr>
<td>01/24/97</td>
<td>Highway</td>
<td>UF6 Cylinders</td>
<td>UF-6</td>
<td>4/0</td>
</tr>
<tr>
<td>03/5/98</td>
<td>Highway</td>
<td>Radiography camera</td>
<td>Ir-192</td>
<td>1/0</td>
</tr>
</tbody>
</table>

(Shipments involving spent fuel casks are noted in bold).

Of the 61 accidents involving Type B packages reported since 1971, eight accidents involved shipments of nine spent fuel casks. Only four casks were actually carrying spent fuel (three by highway and one by rail). The remaining four accidents (three by rail and one by highway) involved empty spent fuel casks (one of the rail shipments carried two empty casks).

There have been no releases of spent nuclear fuel under accident conditions; however, there have been eight reported incidents involving releases of spent fuel since 1960 (source: RMIR database and http://www.state.nv.us/nucwaste/trans/nucinc01.htm, last accessed December 2000). Four of the reported incidents involved releases of contamination beyond the vehicle (Table 8) and four involved releases confined to the vehicle (Table 9). Six of these eight incidents occurred prior to the date RMIR began recording data and were identified in a series of U. S. Atomic Energy Commission (AEC) reports (source: http://www.state.nv.us/nucwaste/trans/nucinc01.htm).

Table 8. Incidents Involving the Release of Spent Nuclear Fuel Where Contamination Went Beyond the Vehicle.

<table>
<thead>
<tr>
<th>Date</th>
<th>Mode</th>
<th>Description of Incident</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/2/60</td>
<td>Rail</td>
<td>Leak from cask, small areas at three rail yards contaminated, no runoff or aerial dispersion</td>
</tr>
<tr>
<td>8/21/62</td>
<td>Truck</td>
<td>Cask leakage, trailer and small portion of road contaminated.</td>
</tr>
<tr>
<td>11/11/64</td>
<td>Truck</td>
<td>Cask leakage, cask contaminated, contamination confined to trailer.</td>
</tr>
<tr>
<td>1/27/84</td>
<td>Truck</td>
<td>Slow drip from bottom front end of empty cask while stored in transportation terminal (See Figure 1)</td>
</tr>
</tbody>
</table>
Figure 1 shows the RMIR database report for the Rockwell International spent fuel cask incident. It should be noted that the cask was being stored at the transportation terminal and was not in transit when the release took place.

<table>
<thead>
<tr>
<th>Incident Number: 84030208</th>
<th>Date: 01/27/1984</th>
<th>Time: 16:00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode: HIGHWAY</td>
<td>Vehicle: TRUCK, FLATBED</td>
<td>Transportaion Link Closed?: N</td>
</tr>
<tr>
<td>Radioactivity Released: 0.001 UCI</td>
<td>Search Code: NFC</td>
<td></td>
</tr>
<tr>
<td>Injuries and Deaths Due to Radioactivity Released: 0, 0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Carrier: TRI-STATE MOTOR TRANSIT CO  MISSOURI
Location: TRI-STATE TERMINAL, TRACY  CALIFORNIA
Shipper: ROCKWELL INTERNATIONAL  WASHINGTON
Consignee: ROCKWELL INTERNATIONAL  CALIFORNIA
Remarks:
SLOW DRIP FROM BOTTOM FRONT END OF SHIPPING CASK--STORED IN TRI-STATE TERMINAL. EMERGENCY RADIOLOGICAL ASSISTANCE TEAM AT LAWRENCE LIVERMORE SURVEYED THE TRACTOR, CASK AND TRAILER. ALL SURFACE READINGS ON THE CASK WERE LESS THAN 0.5 MR/HR WITH 2 EXCEPTIONS; ONE READING OF 5 MR/HR BETA-GAMMA ON THE REAR END CAP OF CASK AND 1 MR/HR ON THE FRONT END CAP OF CASK. MORE DATA AVAILABLE. TERMINAL. EMERGENCY RADIOLOGICAL ASSISTANCE TEAM AT LAWRENCE LIVERMORE SURVEYED THE TRACTOR, CASK AND TRAILER. ALL SURFACE READINGS ON THE CASK WERE LESS THAN 0.5 MR/HR WITH 2 EXCEPTIONS; ONE READING OF 5 MR/HR BETA-GAMMA ON THE REAR END CAP OF CASK AND 1 MR/HR ON THE FRONT END CAP OF CASK. MORE DATA AVAILABLE.

--- Materials Involved --- Category: EMPTY
EMPTY SPENT FUEL CASK

--- Packages Involved ---
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>CASK</td>
<td>HALLAM CASK</td>
<td>B</td>
</tr>
</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: N/A

--- Figure 1. Rockwell International transportation incident report from RMIR database.

Table 9 shows four incidents where spent nuclear fuel was released from a cask but the contamination was confined to the transporting vehicle. Only the fourth incident on July 4, 1976, is contained in the RMIR database (see Figure 2) because the other incidents occurred prior to DOT record keeping.

Figure 2 shows the RMIR database report for the San Onofre spent fuel cask incident on July 4, 1976.

In summary, there have been no releases of spent nuclear fuel under accident conditions. However, there have been at least eight incidents involving such a release, as described above. On the other hand, accidents involving other package types have resulted in releases of RAM. These accidents have usually involved packages of the industrial type (strong and tight) or Type A packages that were not designed to withstand accident conditions.
Table 9. Incidents Involving the Release of Spent Nuclear Fuel Where Contamination was Confined to the Vehicle.

<table>
<thead>
<tr>
<th>Date</th>
<th>Mode</th>
<th>Description of Incident</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/20/60</td>
<td>Truck</td>
<td>Small leak from cask onto trailer floor, result of shifting cask, contamination confined to vehicle</td>
</tr>
<tr>
<td>9/22/61</td>
<td>Truck</td>
<td>Leak from cask onto trailer floor, result of shifting, contamination confined to vehicle</td>
</tr>
<tr>
<td>12/10/63</td>
<td>Rail</td>
<td>Cask leakage, cask contaminated, contamination confined to trailer</td>
</tr>
<tr>
<td>7/4/76</td>
<td>Truck</td>
<td>Pinhole leak of, reported as, coolant/moderator on outside jacket of cask. Shipment continued without risk to public (See Figure 2)</td>
</tr>
</tbody>
</table>

2.5 Case Histories (Accident Response and Site Remediation)

Four case studies are described in this section and the lessons learned are discussed at the end. Accident response times are usually on the order of minutes. The first to arrive on the scene are usually the local law enforcement, followed by the local firefighters and paramedics, and/or local hazardous materials (hazmat) team. The state, tribal, or local government has the ultimate responsibility for taking emergency actions at the radiological emergency scene, although several federal agencies play significant supporting roles, as described in Section 3 of this report.

There has never been a release from a Type B package under accident conditions in the United States, and hence, there never was a release of spent fuel or high-level waste due to a transportation accident. All accidents with RAM releases have involved packages of the industrial type (strong and tight) or Type A packages. The regulatory limit on the activity that can be transported in a Type A package, the A1 or A2 magnitude, provides a high level of environmental safety when releases from Type A packages (or industrial packages) occur. Therefore, site remediation activities are often limited to simply picking up and repacking the spilled contents.

2.5.1 Springfield, Colorado, September 27, 1977

On September 27, 1977, a truck carrying 50 drums of uranium oxide, or “yellow cake,” for Exxon Minerals Company collided with three horses approximately 14 miles north of Springfield, Colorado. The truck overturned and 29 of the 50 drums lost their lids, releasing between 10,000 and 12,000 pounds of yellow cake. Five thousand (5,000) pounds were contained within the trailer; however, the remaining 7,000 pounds were spilled onto a 3,000 by 4,000 square-foot area. Police and fire department personnel initially covered the truck and contaminated areas with canvas and heavy plastic sheeting. Later, the loose yellow cake was repackaged and clean-up crews worked with hand tools, vacuums, and scrub brushes to decontaminate the area. The crews worked under a tent to minimize the potential for airborne dispersion of yellow cake powder. The State of Colorado insisted upon decontamination to background levels. Within two weeks the Health Department took its final readings and released the area for public use.
Incident Number: 6070402  Date: 07/04/1976  Time:
Mode: HIGHWAY  Vehicle: TRUCK, TRAILER
Accident Code: I  Transportation Link Closed?: N
Radioactivity Released: NONE  Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: TRI-STATE MOTOR TRANSIT CO  MISSOURI
Location: TRUCK STOP  WYOMING
Shipper: SAN ONOFRE NUCLEAR POWER STATION  CALIFORNIA
Consignee: GENERAL ELECTRIC  ILLINOIS
Remarks:
INTERNAL PRESSURE: WHILE STOPPED IN ROCK SPRINGS, WY, THE DRIVER NOTICED A
LEAK DURING ROUTINE INSPECTION. A LEAK DEVELOPED IN THE OUTSIDE JACKET OF
THE SHIPPING CASK. THE PINHOLE LEAK ALLOWED THE LOSS OF COOLANT/MODERATOR
(BORATED ETHYLENE GLYCOL). THE ESTIMATED ACTIVITY WAS 50,000 CI. RESPONSE
TEAM FROM ID FALLS, ID, RESPONDED & DETERMINED SHIPMENT COULD CONTINUE
WITHOUT RISK TO PUBLIC SAFETY.

--- Materials Involved ---
Category: SPENT FUEL
SPENT FUEL

--- Packages Involved ---
Description ID Code Category
CASK NAC-1 B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: N/A

--- Figure 2. San Onofre Nuclear Power Station transportation incident report from RMIR database. ---

This case is a good example of how the emergency response and subsequent site remediation activities matched the risk level associated with the released material. Often the risks associated with a RAM shipment are exaggerated but in this particular case the actions were appropriate. This example was retrieved from the RMIR database and is one of a series of similar such accidents.

2.5.2 Oak Ridge National Laboratory, December 8, 1971

Only one spent nuclear fuel accident has resulted in more than trivial damage to the cask. This was a highway accident on December 8, 1971, on U. S. 25 in Tennessee (see Figure 3). The cask was thrown into a ditch as the result of a rollover. However, radiation surveys taken at the accident scene indicated that the structural integrity of the cask was not compromised and there was no release of RAM. The driver of the truck transporting the cask was killed in the accident but these conditions were not related to the radioactive nature of the cargo.
Incident Number: 1120173        Date: 12/08/1971         Time:  13:50
Mode: HIGHWAY                   Vehicle: TRUCK, FLATBED
Accident Code: T                   Transportation Link Closed?: Y
Radioactivity Released: NONE                             Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier:   KILLION MOTOR EXPRESS, INC                    KENTUCKY
Location:  US 25-WEST, 2.3 NORTH OF CLINTON              TENNESSEE
Shipper:   GULF ENERGY & ENVIRONMENTAL SYSTEMS           PENNSYLVANIA
Consignee: OAK RIDGE NATIONAL LABORATORY                 TENNESSEE
Remarks:
TRUCK LEFT ROAD TO AVOID HEAD ON: THE TRUCK TRANSPORTING THE SPENT
REACTOR FUEL ELEMENT SWERVED TO AVOID A HEAD-ON COLLISION WITH
ANOTHER VEHICLE AND WAS FORCED OFF THE ROAD. THE DRIVER WAS KILLED BY
IMPACT AND THE SPENT FUEL CASK WAS THROWN INTO A DITCH. THE RAD
ASSISTANCE TEAM FROM OAK RIDGE ARRIVED. SURVEYS INDICATED THERE WAS
NO RELEASE. THE CASK WAS TAKEN TO OAK RIDGE FOR EXAMINATION-CASK
PAINT, TARPALIN & THERMAL INSULATION & CENTER RING DOWELS & BOLTS
WERE DAMAGED. NO RELEASE.

--- Materials Involved ---
Category: NFC
SPENT FUEL

---Packages Involved ---
Description  ID Code  Category
CASK          HNPF       B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 1

--- Packages Involved ---
Description  ID Code  Category
CASK          HNPF       B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 1

Figure 3. Oak Ridge National Laboratory accident report from RMIR database.

2.5.3 Southern Pacific, January 7, 1982

A Southern Pacific Transportation Company Train carrying radioactive material derailed 14
cars at Thermal, California, while traveling at 57 miles per hour. The RMIR accident report
is shown in Figure 4. Four individuals who illegally stowed away on the train were seri-
ously injured and a fifth such individual died. Radioactive material was discovered in a de-
ralled car about an hour after the accident; however, accurate information regarding the
RAM shipment was not available until about five hours after the accident. The emergency
response effort was hampered by erroneous information contained in the shipping docu-
ments. In addition, erroneous information had been provided to the crew, resulting in the
train not being operated in accordance with Southern Pacific’s rules for carrying hazardous
materials. This misinformation resulted in an overreaction to the situation.

The RAM was a special form radioactive material consisting of 16 curies of americium-241
and beryllium. (A special form RAM means that the material might present some direct ra-
diation hazard due to radiotoxicity but would have little possibility of contamination). The
RAM packaging consisted of a steel cylinder with polyethylene filling the interior void.
There was no obvious damage to the RAM packaging, and monitoring conducted after the
accident indicated no abnormal radiation levels outside the packaging (NTSB, 1983).
Incident Number: PNOV8202       Date: 01/07/1982         Time:  22:00
Mode: RAIL                      Vehicle: RAIL CAR
Accident Code: T                  Transportation Link Closed?: Y
Radioactivity Released: NONE                     Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier:   SOUTHERN PACIFIC RAILROAD
Location:  ALONGSIDE ROUTE 111                          CALIFORNIA
Shipper:   SCHLUMBERGER WELL SERVICES                    TEXAS
Consignee: SCHLUMBERGER WELL SERVICES                    CALIFORNIA
Remarks:
DERAILMENT, NO DAMAGE TO RAM: 14 CARS DERAILED. BILL OF LADING STATED:'RAM-NOS, URANIUM FISSLICE CLASS III.' ACTUALLY, THE RAM ON BOARD WAS A 16 CI AMERICIUM SOURCE. 65 PEOPLE WERE THOUGHT TO HAVE BEEN EXPOSED TO THE URANIUM FISSLICE MATERIAL AND WERE ISOLATED. ALSO, THE HOSPITAL WHERE INJURED PEOPLE WERE TAKEN WAS SEALED OFF. THE SOURCE WAS RECOVERED INTACT AND UNDAMAGED. MORE DATA AVAILABLE.

--- Materials Involved ---
Category: INDUSTRIAL
AMERICIUM/BERYLLIUM

--- Packages Involved ---
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRUM</td>
<td>UNKNOWN</td>
<td>A</td>
</tr>
</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0

Figure 4. Southern Pacific train derailment accident report from RMIR database.

2.5.4 Springfield, Massachusetts, December 16, 1991

One of the most notable transportation accidents in the United States involved the shipment of 12 Type A packages, each of which contained 2 unirradiated nuclear fuel assemblies destined for Vermont Yankee Nuclear Power Plant (U. S. NRC, 1992a and 1992b). The accident occurred early in the morning on December 16, 1991 on Interstate 91 in downtown Springfield, Massachusetts (see Figure 5). A car was traveling on the wrong side of the interstate, and although the truck driver swerved to avoid a collision, the car struck the tractor-trailer on the right side near the right fuel tank. The truck continued northbound and hit the center guardrail on the opposite side of the road. After striking the outside guardrail, the truck skidded across the highway and came to rest against the center guardrail.

A fire started in the engine compartment of the tractor and spread to the entire tractor and then the trailer. The NRC’s report on the accident (U. S. NRC, 1992a and 1992b) indicated that the fire burned for at least 45 minutes before the cargo was affected. At the time, the entire cargo was entirely intact. However, since the fire was not extinguished, the flatbed trailer and the radioactive cargo also burned. The entire fire lasted approximately three hours.

The tractor-trailer was completely destroyed by the fire and there was significant damage to several Type A packages and their contents. Eight containers fell off the trailer and sustained minor damage from the impact. The wooden outer containers burned and the inner
metal containers sustained damage ranging from minor to severe. However, no release of radioactive materials occurred.

<table>
<thead>
<tr>
<th>Incident Number: TTC0292</th>
<th>Date: 12/16/1991</th>
<th>Time: 3:00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode: HIGHWAY</td>
<td>Vehicle: TRUCK, TRAILER</td>
<td></td>
</tr>
<tr>
<td>Accident Code: T</td>
<td>Transportation Link Closed?: Y</td>
<td></td>
</tr>
<tr>
<td>Radioactivity Released: NONE</td>
<td>Search Code: FIRE</td>
<td></td>
</tr>
<tr>
<td>Injuries and Deaths Due to Radioactivity Released: 0, 0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Carrier: MCGIL TRUCKING
Location: I-91, EXIT 7, SPRINGFIELD
Shipper: GENERAL ELECTRIC
Consignee: VERMONT YANKEE NUCLEAR POWER PLANT

--- Materials Involved ---
Category: NFC
FRESH FUEL

--- Packages Involved ---
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>CASING, METAL</td>
<td>USA/4986</td>
<td>A</td>
</tr>
</tbody>
</table>

Figure 5. Springfield, Massachusetts’s transportation accident report from RMIR database.

The firefighters did not extinguish the blaze immediately due to lack of knowledge and training in responding to RAM accidents. Had the fire been extinguished immediately, the damage to surrounding structures would have been minimal and the media attention would have been less. This was a very high profile accident because, even though no RAM was released, the accident was significant from a public relations standpoint.

2.5.5 Lessons Learned

Important lessons were learned as a result of the four RAM transportation accidents described above. First, emergency response and site remediation activities must be consistent with the actual risk level associated with the RAM involved. Second, actions must be taken to ensure that shippers of radioactive materials know and understand the nature of the radioactive cargo they are shipping, and shipping documents must be complete and accurate. Third, emergency response personnel, including firefighters and emergency medical personnel, must be trained and drilled in responding to transportation emergencies involving RAM. Lack of knowledge seriously hampers both the response to a RAM incident and any subsequent activities, including site remediation. The philosophy of the trained response force should include an assumption that a spill will actually occur some time in the future, and that the responders can mitigate up to and including the worst-case accident. And fi-
nally, it is very important to have a good public relations team to handle public and media interactions.

2.6 Selected Resources

This section includes a sampling of the various resources available online for issues related to RAM transportation emergency response.

2.6.1 International Atomic Energy Agency (IAEA)

The IAEA provides guidelines for RAM transportation emergency response programs in Safety Series No. 37 (Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material Safety). The IAEA safety guidelines are located at http://www.iaea.or.at/ns/.

2.6.2 Nuclear Regulatory Commission (NRC)

The NRC maintains a website (http://www.nrc.gov/) containing a wealth of information, including a copy of the Federal Radiological Emergency Response Plan (located at http://www.nrc.gov/ NRC/AEOD/ER/FRERP/frerp.html). The FRERP is discussed in detail in Section 3 of this report.

2.6.3 Environmental Protection Agency (EPA)

The EPA Radiological Emergency Response Plan (RERP) outlines EPA’s approach to managing radiological releases. A copy of the RERP can be downloaded at http://www.epa.gov/radiation/rert/.

2.6.4 DOE Transportation Emergency Preparedness Program (TEPP)

The DOE TEPP addresses the emergency response concerns of state, tribal, and local officials affected by DOE RAM shipments. TEPP training and guidance documents for initial responders are located at http://www.em.doe.gov/otem/.

2.6.5 North American Emergency Response Guidebook (NAERG)

A downloadable copy of the North American Emergency Response Guidebook (NAERG) is located at http://hazmat.dot.gov/gydebook.htm. The NAERG was developed jointly by Transport Canada (TC), the U. S. DOT, and the Secretariat of Transport and Communications of Mexico (SCT) for use by initial responders to transportation incidents involving dangerous goods (U. S. DOT, 2000). It is primarily used to identify the hazards of the materials involved in the incident and to protect responders and the general public during the ini-
tial response phase. In the United States, first responders are required by law (under OSHA, 29 CFR 1910.120 and EPA, 40 CFR Part 311) to be trained in the use of the NAERG.

2.6.6 Hazardous Materials Emergency Preparedness (HMEP) Program

The HMEP Program is a joint effort between the U. S. DOT Research and Special Programs Administration (RSPA) and the Federal Emergency Management Agency (FEMA). The HMEP maintains links to various HAZMAT websites at http://www.fema.gov/emi/hmep/hmlinks.htm.
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3. Task 2: RAM Transport Emergency Response Plans

The second task for the JNC project involved reviewing RAM transportation emergency response plans in the United States. In this section, the main components of a response plan are outlined and the federal response to a radiological emergency is described in detail. Two examples are provided: one for the shipment of RAM to the DOE Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico and the second for the shipment of RAM from a location in Canada (Chalk River Laboratories) to a site in the United States (Los Alamos National Laboratories [LANL]).

3.1 Introduction

Often the transportation emergency response plan is part of a broader emergency management program plan that outlines the emergency procedures for a particular facility (for example, the Hanford Site in southeastern Washington state) or for a particular organization (for example, the U. S. DOE). Five elements exist in any effective emergency management program.

- *emergency planning*, which includes identification of hazards and threats, hazard mitigation, development and preparation of emergency plans and procedures, and identification of personnel and resources needed for an effective response;
- *emergency preparedness*, which includes acquisition and maintenance of resources, training, drills, and exercises;
- *emergency response*, which includes the application of resources to mitigate consequences to workers, the public, the environment, and the national security, and the initiation of recovery from an emergency;
- *recovery*, which includes planning for and taking actions following termination of the emergency to return the site to normal;
- *readiness assurance*, which includes assessments and documentation to ensure that stated emergency capabilities are sufficient to implement emergency plans.

In general, transportation emergency response plans follow the guidelines outlined by the IAEA (IAEA, 1985, as amended 1990), which are based on the U. S. guidelines (U. S. DOT 1979, 1980) that were later encoded in the United States in 49 CFR. France (Vallette-Fontaine and Frantz, 1998) and Canada (Karmali, 1987; AECL, 1999) adopted similar guidelines in preparing their plans.

The main goals of a transportation emergency response plan are to minimize radiation exposure to workers, emergency response individuals, and the public; to contain any release; and to clean up the accident scene. In the United States, the response to RAM transportation accidents are managed in a manner similar to responses to non-RAM hazardous material accidents with additional actions and precautions implemented as necessary due to the radiological concerns.
3.2 The Incident Command System

RAM transportation emergencies are handled using the Incident Command System (ICS), which is an organized approach to controlling and managing operations at any emergency site involving a hazardous or radioactive material. Use of the ICS is actually mandated in the United States under 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response and implemented and standardized through the NFPA 472 requirement. Use of the ICS involves having an Incident Commander (IC) who directs activity at the scene, sets up a command post, and establishes control zones, each with its own rules for entry (e.g., personal protective equipment (PPE) and monitoring requirements). Generic procedures for first responders to a RAM transportation accident are shown in Figures 6 through 9.

3.2.1 Relevant Definitions

The following terms are relevant to the ICS and were adapted from the NAERG (U. S. DOT, 2000):

**Control zones** are designated areas at dangerous goods incidents, based on safety and the degree of hazard. Many terms are used to describe control zones. The NAERG defines these zones as the hot/exclusion/restricted zone, warm/contamination reduction/limited access zone, and cold/support/clean zone. (EPA Standard Operating Safety Guidelines, OSHA 29 CFR 1910.120, NFPA 472).

**Hazard zones** (inhalation hazard zones) include:

- HAZARD ZONE A: lethal concentration in 50% of the population (LC50) of less than or equal to 200 parts per million (ppm);
- HAZARD ZONE B: LC50 greater than 200ppm and less than or equal to 1000ppm;
- HAZARD ZONE C: LC50 greater than 1000ppm and less than or equal to 3000ppm;
- HAZARD ZONE D: LC50 greater than 3000ppm and less than or equal to 5000ppm.

The **hot zone** (also referred to as exclusion zone, red zone or restricted zone) is the area immediately surrounding a dangerous goods incident that extends far enough to prevent adverse effects from released dangerous goods to personnel outside the zone (EPA Standard Operating Safety Guidelines, OSHA 29 CFR 1910.120, NFPA 472).

**Personal protective equipment** (also referred to as personal protective clothing) includes both respiratory and physical protection. One cannot assign a level of protection to clothing or respiratory devices separately. These levels were accepted and defined by response organizations such as the U. S. Coast Guard (USCG), National Institute for Occupational Safety and Health (NIOSH), and U. S. EPA:

- Level A: self-contained breathing apparatus (SCBA) plus totally encapsulating chemical resistant clothing (permeation resistant);
- Level B: SCBA plus hooded chemical resistant clothing (splash suit);
• Level C: Full or half-face respirator plus hooded chemical resistant clothing (splash suit);
• Level D: Coverall and splash guard apparel and gloves (as appropriate), eye protection, but no respiratory protection.

The **Radiation Authority** is either a federal, state/provincial agency, or state/province designated official. The responsibilities of this authority include evaluating radiological hazard conditions during normal operations and during emergencies. If the identity and telephone number of the authority are not known by emergency responders, or included in the local response plan, the information can be obtained from the agencies listed on the inside back cover. They maintain a periodically updated list of radiation authorities.

The **warm zone** (also referred to as the contamination reduction corridor, contamination reduction zone, yellow zone or limited access zone) is the area between the hot and cold zones where personnel and equipment decontamination and hot zone support take place. It includes control points for the access corridor and thus assists in reducing the spread of contamination (EPA Standard Operating Safety Guidelines, OSHA 29 CFR 1910.120, NFPA 472).

### 3.2.2 Emergency Response Procedures

The emergency response team should:

1. Assist in the emergency rescue and first aid procedures, as necessary;
2. Provide technical information to assist in medical treatment, and assist hospital in contamination control and decontamination;
3. Evaluate the radiological hazards, including whether there is a release from the package and whether a radiation hazard exists;
4. Minimize personnel exposure to radiation and spread of contamination;
   - Assist police to clear the area,
   - Locate and monitor exposed persons and assist in decontamination,
   - Demarcate an exclusion area,
   - Set up a control point, upwind of the accident, and
   - Provide PPE as necessary.
5. Contain the released radioactive material;
6. Carry out decontamination of equipment, vehicles, and the environment and restore to pre-accident conditions.

In addition, personnel involved in handling potentially contaminated patients and/or human remains need to take additional precautions as described in the DOE Transportation Emergency Preparedness Program (TEPP) “Model Procedure for Properly Handling and Packag-
Approach cautiously from upwind and stay clear of all spills, vapors, fumes, and smoke.

Visually assess the accident site for:
- spills, leaks, or fire
- hazardous properties of the cargo
- victims
- type of vehicle and containers
- placards and markings
- container damage
- witnesses
- shipping papers
- hazards and exposure problems
- entry point

Notify Emergency Communications Center and assume position of IC* until relieved by higher authority.

Establish a Command Post at least 150 meters upwind from Entry Point. Establish lines of communication. Priorities include:
- safety of response personnel
- rescue injured personnel
- secure the scene
- isolate the area and deny entry
- assure safety of people and environment
- monitor radiation levels
- restrict entry until radiological emergency response team arrives

Evaluate information and consult NAERG** to identify hazards and cargo.

Establish Zones.

Don protective clothing and SCBA***

Are there victims?
- Yes
  - Go to Figure 7
- No
  - Monitor the station and standby

Is there a fire?
- Yes
  - Go to Figure 8
- No
  - Monitor the station and standby

Radiological Event

- Yes
  - Follow guidelines in the NAERG**
  - Go To Figure 9
- No

*IC = Incident Commander
**NAERG = North American Emergency Response Guidebook
***SCBA = Self-Contained Breathing Apparatus

Figure 6. First responder flow chart for RAM transportation accidents (adapted from U. S. DOE, 2000b).
Figure 7. Response flow chart for RAM accidents involving injured or contaminated individuals (adapted from U. S. DOE, 2000b).

*SCBA = Self-Contained Breathing Apparatus
Figure 8. Response flow chart for RAM accidents involving fires (adapted from U. S. DOE, 2000b).

- **FIRE**
  - **SMALL FIRES**
    - **USE**
      - dry chemical
      - CO₂
      - water spray or regular foam
  - **LARGE FIRES**
    - **USE**
      - water spray, fog, or regular foam
      - dike fire control water for later disposal
      - if tanks or metal containers are present, cool containers with flooding amounts of water until well after the fire is out (or withdraw from area and let the fire burn)
      - always stay away from the ends of the tank.
  - Reassess situation and take appropriate action to protect response personnel, victims, equipment, the public, and property
Figure 9. Response flow chart for radiological events (adapted from U. S. DOE, 2000b).

Radiological Event

- Call emergency response telephone number(s)
- Notify Radiation Authority
- Priorities for rescue, life saving, first aid, and control of fire and other hazards are higher than the priority for measuring radiation levels
- Isolate spill or leak area to at least 50 meters in all directions
- Detain and/or isolate uninjured persons or equipment suspected to be contaminated
- Delay decontamination and clean-up until instructions are received from Radiation Authority
- Follow specific instructions in the NAERG* for evacuation, fire or explosion, spill or leak information, first aid information, and health information

Use NAERG* as the guideline for first response actions and information

Reassess situation and take appropriate action to protect response personnel, victims, equipment, the public, and property

* NAERG = North American Emergency Response Guidebook
Potentially Radiologically Contaminated Patients” and the TEPP “Model Procedure for Medical Examiner/Coroner on the Handling of a Body/Human Remains that are Potentially Radiologically Contaminated” (U. S. DOE, 2000b).

### 3.3 U.S. Federal Response to RAM Accidents

U. S. roles and responsibilities and lines of authority concerning emergency response for RAM transportation accidents in the United States vary from state to state and even from region to region, in accordance with the procedures outlined in each state’s and/or tribal region’s emergency response plan. The federal response to a RAM transportation accident is outlined in the U. S. “Federal Radiological Emergency Response Plan” (FRERP) was approved in 1985 and revised in 1996. According to the FRERP, one agency is designated as the Lead Federal Agency (LFA) and interagency response centers are then established. The LFA coordinates all federal onscene actions and assists state and local governments in determining measures to protect life, property, and the environment (FRERP, 1996). However, the state or local government has the ultimate responsibility for taking emergency actions (with support from the federal agencies, upon request).

In the event of a transportation accident involving a nuclear weapon, special nuclear material, classified components, or all three, the owner (i.e., Department of Defense (DOD), DOE, or National Aeronautics and Space Administration (NASA)) will declare a National Defense Area (NDA) or National Security Area (NSA). NDAs and NSAs are established to safeguard classified information and/or restricted data, or equipment and material. Establishment of these areas places non-federal lands under federal control and results only from an emergency event (FRERP, 1996).

As summarized in Table 10, the NRC, DOD, DOE, and EPA are the LFAs for the emergency response to radioactive materials transportation accidents. The NRC is the LFA for an emergency that involves RAM licensed by the NRC or an Agreement State. For materials shipped by or for DOD or DOE, the LFA is either DOD or DOE depending on which of these agencies has custody of the material at the time of the accident. The EPA is the LFA for a transportation emergency that involves RAM not licensed or owned by a federal agency or an Agreement State.

<table>
<thead>
<tr>
<th>Radioactive Materials Transportation Accident Involving:</th>
<th>Lead Federal Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipment of materials licensed by NRC or an NRC Agreement State</td>
<td>NRC</td>
</tr>
<tr>
<td>Materials shipped by or for DOD</td>
<td>DOD</td>
</tr>
<tr>
<td>Materials shipped by or for DOE</td>
<td>DOE</td>
</tr>
<tr>
<td>Shipment of materials not licensed or owned by a federal agency or an Agreement State</td>
<td>EPA</td>
</tr>
</tbody>
</table>
The RAM transportation accident notification process in the United States is outlined in Figure 10. Each federal agency has a specific response function, as outlined in Table 11.

The LFA assists state and local governments in determining measures to protect life, property, and the environment, and ensures that other federal agencies assist the state and local government agencies in implementing protective actions, if requested. The LFA coordinates all federal onscene actions from an onscene location known as the Joint Operations Center (JOC). The LFA is the principal federal source of information about onsite conditions.

The DOE coordinates the initial radiological monitoring and assessment at the accident scene. Long-term monitoring is handled by the EPA. The Department of Justice (DOJ) and the Federal Bureau of Investigation (FBI) coordinate the law enforcement aspects of a criminal act (e.g., sabotage) involving radioactive material. The Department of the Interior (DOI) acts as a liaison between Indian tribal governments and the LFA, state, and local agencies for accidents that occur on tribal lands.
Table 11. Response Functions.

<table>
<thead>
<tr>
<th>Response Action</th>
<th>Responsible Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintain cognizance of the federal response conduct and manage federal onsite actions</td>
<td>LFA</td>
</tr>
<tr>
<td>Coordinate initial federal offsite radiological monitoring and assessment</td>
<td>DOE</td>
</tr>
<tr>
<td>Coordinate intermediate and long-term federal offsite radiological monitoring and assessment</td>
<td>EPA</td>
</tr>
<tr>
<td>Develop and evaluate recommendations for offsite protective actions for the public</td>
<td>LFA, in coordination with other agencies</td>
</tr>
<tr>
<td>Present recommendations for protective actions to the appropriate state and/or local officials</td>
<td>LFA, in coordination with other agencies</td>
</tr>
<tr>
<td>Coordinate release of federal information to LFA</td>
<td>Congress</td>
</tr>
<tr>
<td>Provide reports to the President and keep the White House informed on all aspects of the emergency</td>
<td>LFA</td>
</tr>
<tr>
<td>Coordinate the law enforcement aspects of a criminal act involving radioactive material</td>
<td>Department of Justice (DOJ) and Federal Bureau of Investigation (FBI)</td>
</tr>
</tbody>
</table>


The five stages of the federal response include:

A. Notification
B. Activation and Deployment
C. Response Operations
D. Response Deactivation
E. Recovery.

A. Notification

The owner of the RAM shipment performs the initial notification to the state and local authorities and the LFA. The notification includes:

- Location and nature of the accident;
- Assessment of the severity of the problem;
- Potential and actual consequences;
- Initial response actions.

If any federal agency receives notification from any source other than the LFA, the agency notifies the LFA. The LFA is then responsible for:

- Verifying the accuracy of the notification;
- Notifying the advisory team agencies and providing them with information;
- Verifying that other federal agencies have been notified;
- Verifying that the state has been notified.
B. Activation and Deployment

Responsibilities of the LFA include:

- Deploying response personnel to the scene and providing liaison to the state and local authorities as appropriate;
- Designating a federal Onscene Commander (OSC) at the scene of the emergency to manage onsite activities and coordinate the overall federal response to the emergency;
- Establishing bases of federal operation, such as the JOC and the Joint Information Center (JIC);
- Coordinating the federal response with the owner of the RAM shipment; and
- Providing advice on the radiological hazard to the federal responders.

C. Response Operations

The LFA and other federal agencies exchange liaison personnel and maintain staffs at their Emergency Operating Centers (EOCs) to support their respective onscene operations. Federal agencies may also activate a regional or field office EOC in support of the emergency. The following response centers are established at onscene locations in coordination with state and local authorities and other federal agencies:

- The JOC is established by the LFA under the operational control of the federal OSC as the focal point for management and direction of onsite activities, establishment of state requirements and priorities, and coordination of the overall federal response;
- The Federal Radiological Monitoring and Assessment Center (FRMAC) is established by DOE (with subsequent transfer to EPA for intermediate and long-term actions) for the coordination of federal radiological monitoring and assessment activities with that of state and local agencies;
- The JIC is established by the LFA, under the operational control of the LFA-designated Public Information Officer, as a focal point for the coordination and provision of information to the public and media concerning the federal response to the emergency.

D. Response Deactivation

Each agency discontinues its emergency response operations when its assistance is no longer required or when its statutory responsibilities have been fulfilled. The LFA consults with participating federal agencies and the state and local government to determine when the JIC and the JOC operations should be terminated. The agency managing the FRMAC consults with the LFA and other participating federal agencies, and state and local officials to determine when a formal FRMAC structure and organization is no longer required. Normally, this will occur when operations move into the recovery phase and extensive federal multi-agency resources are no longer required to augment state and local radiological monitoring and assessment activities.

E. Recovery

The state or local governments have the primary responsibility for planning the recovery of the affected area. (The term recovery as used here encompasses any action dedicated to the
continued protection of the public and resumption of normal activities in the affected area). Recovery planning is initiated at the request of the states, but doesn’t take place until after the initiating conditions of the emergency have stabilized and immediate actions to protect public health and safety and property have been accomplished. The LFA coordinates the overall activity of federal agencies involved in the recovery process.

The radiological monitoring and assessment activities are terminated when the EPA, after consultation with the LFA and other participating federal agencies, and state and local officials, determines that:

- There is no longer a threat to the public health and safety or to the environment;
- State and local resources are adequate for the situation; and
- There is mutual agreement of the agencies involved to terminate the response.

### 3.4 DOE Waste Isolation Pilot Plant (WIPP) Plan

The initial response to a WIPP transportation emergency will be from state, tribal, or local emergency response agencies followed by the appropriate DOE Radiological Assistance Team (RAT). The DOE divides the U. S. into eight regions and WIPP is located in DOE RAP Region 4. The procedures that the RATs follow are outlined in the DOE “Radiological Assistance Team (RAT) Procedures for TRU Waste Transportation Incidents” (U. S. DOE, 199X).

DOE’s response to a WIPP RAM transportation emergency is based on a tiered approach that ranges from “0” for a minor incident to “3” for an incident involving a release of RAM. If it is necessary to repack the RAM, the procedures contained in DOE’s “Recovery Guide for Packaging” (U. S. DOE, 1995) are followed. Depending on the severity of the transportation incident, the DOE may dispatch the Incident/Accident Response Team (IART). The IART follows supplementary procedures outlined in the “Incident/Accident Response Team Guide” (U. S. DOE, 1998).

Response actions considered in the WIPP plan include:

- Determine if a RAM release has occurred;
- Determine the status of the package(s);
- Determine if DOT requirements and regulations can be met, or if an exemption is required;
- Determine if a recovery team is necessary to perform the mechanical and logistical activities associated with returning the shipment to a roadworthy condition;
- Keep the state, tribal and local officials informed on evaluation and assessment progress.

The notification procedures for a transportation incident or accident involving RAM shipments to the WIPP site in Carlsbad, New Mexico, are shown in Figure 11 (U. S. DOE, 1995).
3.5 Chalk River Laboratories (CRL) Plan

Figure 12 is a site-specific flow chart that outlines the emergency response procedures for shipments from the Chalk River Laboratories (CRL) in Canada to Los Alamos, New Mexico (AECL, 1999). The emergency response process under the CRL plan includes:

- Initial Response Phase
- Accident Control Phase
- Post-Emergency Phase.

If an accident occurs, either the Radiation Protection Escort or the Physical Security Escort notifies:

- Local police (through the Ontario Provincial Police)
- CRL Security Monitoring Room Operator (SMRO)

If neither of the escort personnel is available, the notification may be made by the carrier driver, emergency personnel such as police or firefighters, or a private citizen. The SMRO contacts the Senior Emergency Officer (SEO) immediately upon receiving notification of an accident. The SEO determines whether activation of the response plan is required, including the need to establish the Emergency Operations Center (EOC) and the extent of the initial response required. This process is outlined in Figure 12.

The SEO may activate the Initial Response Team, which consists of a RAT and a Public Affairs Representative, to respond to the accident scene and assist the OSC. Activities of the Initial Response Team include:

- Locate and, if required, reestablish control and containment of the material;
- Provide a thorough assessment of the situation;
- Assist the OSC in establishing response zones;
- Assist response groups with radiological control, monitoring, and decontamination activities.

Activities conducted by the Initial Response Team during the accident control phase will depend on the nature of the accident. In the event of a minor accident, the response team will confirm that the RAM package sustained no damage. In the event of a serious accident, the Initial Response Team Leader will act as a liaison between the OSC and the Initial Response Team. The Radiation Protection Escort is usually the Initial Response Team Leader. He or she coordinates briefings with the Response Team, as well as responders from all agencies. The RAT Leader and the Public Affairs Representative both report to the Initial Response Team Leader.

Activities conducted during the post-emergency phase also depend on the severity of the accident. In the case of a minor accident, activities focus on getting the shipment underway again. In a major collision, the initial assessments conducted by the Initial Response Team are used to determine the amount of decontamination and the degree of site remediation re-
required. Additional assessments are conducted to confirm the effectiveness of the restoration activities.

**Carrier Corporate Office**
- Orders recovery equipment and monitoring personnel
- Notifies DOT

**Incident Occurs**
Carrier Driver Notifies*:
- State Law Enforcement Agency
- Central Monitoring Room
- DOE/AL EOC
- Carrier Corporate Office

* If condition of drivers and/or equipment allows

**Central Monitoring Room (CMR) Notifies**
- AL/EOC
- State Law Enforcement
- Shipper
- Carrier Corporate Office
- Incident/Accident Response Team (IART)*

* IART alerted by CMR with notification of deployment following if authorized by AL/EOC

**DOE/AL/EOC**
Categorized incident/accident/IART Deployment
Notifies:
- Regional Coordinating Office
- Headquarters
- CMR – if IART deployment required

**Regional Coordinating Office**
- Notifies State
- Coordinates IART response
- Notifies and coordinates Radiological Assistance Team (RAT) response

**State**

**Radiological Assistance Team (RAT)**
Security Monitoring Room notified of RAM transportation accident

Notify SEO*

SEO* authorizes Notification of Response Groups?

No Activation

Yes

Activate Requested Group(s)

Response Team
- Initial Response Team Leader
- Radiological Assessment Team
- Public Affairs Representative

EOC** Team
- Senior Emergency Officer
- Health and Environment Authority
- Logistics Authority
- Communications Authority
- EOC Operations Officer

Off-Site Response Team

Notify (as requested by SEO*)
{Includes list of relevant telephone numbers, including Ontario Hydro, Ontario Power Generation, Hydro Quebec, and New Brunswick Power}

1. Respond to Page
2. Proceed to Accident Scene.

1. Respond to Page
2. Proceed EOC**

*SEO = Senior Emergency Officer
**EOC = Emergency Operations Center

Figure 11. DOE Carlsbad Area Office (CAO) emergency notification flowchart (U. S. DOE, 1995).

Figure 12. Emergency response flow chart for shipments from CRL to LANL (adapted from AECL, 1999).
3.6 Lessons Learned

This section describes some of the important lessons learned from both actual RAM transportation emergency response events and from independent audits of emergency management programs. Lack of training and drills accounted for most of the problems encountered in responding to a transportation emergency. Other problems were related to poor coordinating, inadequate communications systems, and lack of dedicated radio and phone equipment. Lessons learned include:

A. Training and Drills

- Programs need to be sufficiently rigorous and comprehensive to adequately prepare personnel for their roles and responsibilities in emergency response situations and establish definite links of communication as well as command and control.
- Routinely evaluate the proficiency and level of knowledge of emergency responders in using site emergency plans and procedures.
- Develop and implement strategies to improve performance for those individuals who are identified as lacking proficiency and understanding.
- Local fire and medical personnel along the transportation route also need to be trained in responding to transportation accidents involving radioactive materials and they should be proficient in interpreting and employing shipping manifests and the procedures in the NAERG (U. S. DOT, 2000).

B. Communication Systems and Equipment

- Emergency response personnel should carry appropriate identification so they have immediate access to the accident scene.
- Radiation monitoring equipment needs to be readily available along the shipping route.
- Emergency response personnel should have dedicated communication equipment and lists of telephone numbers available.

C. Contingencies

- Response personnel need to be prepared for adverse meteorological conditions and for response to remote locations (may require a helicopter in some cases).

D. Corrective Actions

- Implement a comprehensive corrective action process to address any deficiencies.
- Hold emergency response council meetings to address issues and concerns and develop minutes for each meeting.
4. Task 3: Recommendations

The third task was to provide JNC with specific recommendations for their RAM transportation emergency response plan.

4.1 Introduction

A transportation emergency response plan needs to fit into the context of a broader emergency management program that contains the elements of planning, preparedness, response, recovery, and readiness assurance. An integrated and comprehensive emergency management program must be developed that ensures:

- effective and efficient response to transportation emergencies, including measures to protect workers, the public, the environment, and the national security;
- prompt recognition and classification of emergency conditions;
- prompt reporting and notification of transportation emergencies;
- safe and proper reentry activities (e.g., recovery and post-emergency activities).

4.2 Emergency Response Procedures

Emergency response procedures must clearly delineate:

- the operation of the Incident Command System (ICS) and responsibilities of the ICS organization;
- the responsibilities of an emergency operations center, which includes a policy team, a management team, and an information or communication center;
- recognition, categorization/classification (severity), and notification of transportation emergencies;
- protective action recommendations, including actions to protect human health and the environment.

4.3 Elements of the Emergency Response Program

The JNC RAM transportation emergency response program should address the following elements.

Unified Command

1. Drill all responsible organizations
2. Establish ICS structure
3. Memoranda of understanding between state, towns/cities, agencies, etc.
4.3.1 Notification and Communication

A notification system and communications network should be established and responding sites should be selected to provide good coverage of the transportation routes. In addition, emergency response personnel should have dedicated communication equipment and lists of telephone numbers readily available.

As an example, the U. S. DOE uses the Transportation Tracking and Communications System (TRANSCOM) system which combines satellite communications, computerized database management, user networks, and ground communications to follow the progress of shipments of radioactive materials. The primary objective of TRANSCOM is to provide a central monitoring and communications center for DOE shipments of spent fuel, high-level waste, and other high visibility shipping campaigns.

In addition, the DOE Enterprise Transportation Analysis System (ETAS) database provides centralized collection, validation, analysis, and reporting of transportation data for shipments made by and on behalf of DOE. The automated system allows current information to be retrieved and provides an assortment of querying capabilities. ETAS also serves as a program management tool for DOE, facilitating coordination across several contractors and sites. Transportation managers can use the database for transportation cost analyses, rate evaluation, carrier evaluation, packaging utilization, and for preparing traffic activity reports required under DOE Order 460.2. ETAS also has a Prospective Shipment Module (PSM) that forecasts shipments for a year.

4.3.2 Public Information

Due to the high visibility of an accident involving radioactive materials, plans should be established for dissemination of public information. A lead public information officer should be designated. A database similar to the RMIR database should be initiated in Japan for accident and incident occurrence data. A transparency office should be established to provide accurate and readily available public information. An Internet web site would be an efficient and responsive method to accomplish public information exchange. This web site should be in at least two languages: Japanese for the Japanese National information exchange, and English for foreign dissemination of interested public and officials.

4.3.3 Fire and Rescue

Special consideration should be made regarding procedures for fire and rescue at a transportation accident involving radioactive materials. Personnel should be trained to recognize radiological hazards. Specific response procedures should be developed for radioactive hazards by fire and rescue organizations.
4.3.4 Emergency Medical Services

Planning considerations should be made by emergency medical services for radiologically contaminated victims. Plans and coordination should be developed between the paramedics and hospitals to prepare for the management and care of contaminated victims. Personnel should receive training for radiological hazards and procedures for decontamination of victims, equipment and response personnel, and the roles and responsibilities of all medical services organizations should be clearly delineated.

4.3.5 Law Enforcement

Law enforcement personnel should receive training to recognize radiological hazards, and procedures for notification to appropriate agencies in the event of an accident involving radioactive materials. Law enforcement officials should be responsible for traffic control and area security. Coordination agreements and roles and responsibilities for government and law enforcement agencies should be clearly delineated.

4.3.6 Radiation Exposure Control

Plans should be provided for evacuation of the incident area. Recommended evacuation distances are contained in the NAERG (U. S. DOT, 2000). Response personnel should cordon off the area and ensure as few personnel as necessary enter into this zone.

4.3.7 Medical Monitoring

Plans should be provided for long term medical monitoring of contaminated response personnel and victims.

4.3.8 Recovery and Reentry

The agencies tasked with determining when the site is safe for reentry must be determined. Typically the radiological monitoring team will advise the IC of reentry safety. The criteria for recovery should also be delineated.

4.3.9 Equipment

Consideration of equipment needed for response to a radiological incident should be made and dedicated radiation monitoring equipment should be readily available along the shipping route. Planning should be conducted to determine which agency (or agencies) will conduct monitoring. Communication equipment should be planned with the appropriate usage and supplied to all cognizant agencies and personnel.
4.3.10 Training Program

A training program, including emergency response exercises and drills, should be established. In addition to vehicle drivers and other workers, local fire and medical personnel along the transportation route also need to be trained in responding to transportation accidents involving radioactive materials.

4.3.11 Contingencies

Contingencies should be in place in the event of an accident in a remote region or under adverse weather conditions. For example, a helicopter may be required in some cases.

4.4 Conclusions

Sandia National Laboratories (SNL) was tasked by the Japan Nuclear Cycle Development Institute (JNC) to provide assistance in developing an emergency response plan for radioactive material transport. Those tasks included compiling radioactive materials (RAM) transportation accident data from the open literature and databases, investigating emergency response plans for radioactive materials transport in the United States (U.S.), and developing specific recommendations for the JNC’s nuclear material transport emergency response plan, based on information gathered during the first two tasks.

Several sources of data and information were consulted, including national and international organizations, and the results are documented in this report. RAM transportation accident data were compiled from the Radioactive Material Incident Report (RMIR) database developed at SNL. In addition, four RAM transportation accident case studies were examined. These case studies illustrate the importance of accurately assessing RAM risks, the importance of good communication and training, including educating the public, and the importance of a good public relations team.

There have been no releases from Type B packages under accident conditions in the U.S. and hence, no releases of spent fuel or high-level waste. However, accidents involving other packages, such as the strong and tight and Type A packages, have resulted in releases of RAM. Accident response times are usually on the order of minutes and the first responders are usually the local law enforcement, followed by the local firefighters and paramedics, and/or local hazardous materials (hazmat) team. In the U.S., the response to RAM transportation accidents is managed in a manner similar to responses to non-RAM hazardous material accidents using the Incident Command System (ICS). The state, tribal, or local government has the ultimate responsibility for taking emergency actions at the radiological emergency scene, although several federal agencies play significant supporting roles. The DOE emergency response directives are provided to show an example of governmental rules. The U.S. roles and responsibilities for emergency response are shown, together with examples of lessons learned concerning the U.S. programs.
A transportation emergency response plan needs to fit into the context of a broader emergency management program that contains the elements of planning, preparedness, response, recovery, and readiness assurance. The main goals are to minimize radiation exposure to workers, emergency response individuals, and the public, to contain any release, and to cleanup the accident scene. Special consideration should be given in the plan to issues related to training, notification and communication, public information, fire and rescue, emergency medical services, law enforcement, medical monitoring, equipment, and of course, contingencies.

A set of recommendations for JNC includes establishing a database for Japan similar to the RMIR database, a public transparency Internet site to include this database, the development of an emergency response infrastructure specifically designed for transportation needs, and the development of a set of clear directives to provide authority in the case of accidents or incidents involving nuclear material transport. This infrastructure would include the necessary equipment, training, procedures, and clearly understood roles and responsibilities agreed to in advance by all potentially involved governmental authorities.

The report identifies specific elements that the JNC RAM transportation emergency response program should address.

- Notification and Communication
- Public Information
- Fire and Rescue
- Emergency Medical Services
- Law Enforcement
- Radiation Exposure Control
- Medical Monitoring
- Recovery and Reentry
- Equipment
- Training Program
- Contingencies.

A full description of these elements is outside the scope of this tasking. A recommendation for further study is to evaluate each of these areas in terms of the U. S. program and determine which components would be applicable to JNC’s program on emergency response.

A second recommendation concerning these elements is to establish a cooperative JNC/SNL program that coordinates the U. S. emergency response program for JNC needs. This program would be an ongoing effort to provide continuity and the latest updates to JNC.
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5. References


Appendix A
RMIR Database Retrieval for Type B Accidents
(1971 - April 2000)

<table>
<thead>
<tr>
<th>Incident Number: 1080013</th>
<th>Date: 07/10/1971</th>
<th>Time: 12:05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode: HIGHWAY</td>
<td>Vehicle: TRUCK, TRAILER</td>
<td></td>
</tr>
<tr>
<td>Accident Code: T</td>
<td>Transportation Link Closed?: U</td>
<td></td>
</tr>
<tr>
<td>Radioactivity Released: NONE</td>
<td>Search Code: IND</td>
<td></td>
</tr>
<tr>
<td>Injuries and Deaths Due to Radioactivity Released: 0, 0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Carrier: TIME-DC INC | State: TENNESSEE |
| Location: US 63, CITY LIMITS | State: MISSOURI |
| Shipper: AUTOMATION INDUSTRIES INC | State: PENNSYLVANIA |
| Consignee: ATLAS FOUNDRY & MACHINE CO | State: WASHINGTON |

Remarks:
COLLISION: DRIVER WAS ENROUTE TO SPRINGFIELD, MO WITH EQUIPMENT. HE STARTED TO PASS A CAMPER TRAILER ON A TWO LANE BRIDGE - HE STRUCK THE CAMPER AND LOST CONTROL OF HIS VEHICLE AND IT OVERTURNED, DEMOLISHING THE TRACTOR TRAILER. MOST OF THE CARGO BURNED. IT WAS RAINING AND THE PAVEMENT WAS WET WHEN THE ACCIDENT OCCURRED.

--- Materials Involved ---
Category: SOURCE
COBALT-60

--- Packages Involved ---
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<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
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# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0

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<th>Description</th>
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# Packages: Shipped: 44; Damaged w/ Release: 1; Damaged, No Release: 0
Incident Number: TTC0048          Date: 12/05/1971          Time: 22:30
Mode: HIGHWAY                    Vehicle: VEHICLE, SMALL
Accident Code: T                  Transportation Link Closed?: Y
Radioactivity Released: NONE       Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: CONAM INSPECTION COMPANY   NEW JERSEY
Location: ROBERTA MILL ROAD NEAR HARRISBURG  NORTH CAROLINA
Shipper: CONAM INSPECTION COMPANY   NEW JERSEY
Consignee: CONAM INSPECTION COMPANY NEW JERSEY
Remarks:
TRUCK OVERTURNED; NO DAMAGE TO RAM: (N.C. REPORT# 25) A PICKUP TRUCK CARRYING TWO RADIOGRAPHY SOURCES LEFT THE HIGHWAY, WENT DOWN A DITCH AND OVERTURNED. THE AREA WAS SURVEYED; NO CONTAMINATION WAS FOUND. ONE CAMERA CONTAINED AN IRIDIUM 192 SOURCE (92 CI) IN AN IRIDITRON 100A CONTAINER AND THE COBALT 60 SOURCE (9 CI) WAS IN A GAMMA INDUSTRIES PACKAGE.

--- Materials Involved ---
Category: INDUSTRIAL
COBALT-60                        IRIDIUM-192

--- Packages Involved ---
DOT Description ID Code Category
CAMERA, SOURCE UNKNOWN U
# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
CAMERA, SOURCE UNKNOWN B
# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: 1120173        Date: 12/08/1971         Time: 13:50
Mode: HIGHWAY                   Vehicle: TRUCK, FLATBED
Accident Code: T Transportaion Link Closed?: Y
Radioactivity Released: NONE Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0

Carrier:  KILLION MOTOR EXPRESS, INC KENTUCKY
Location: US 25-WEST, 2.3 NORTH OF CLINTON TENNESSEE
Shipper:  GULF ENERGY & ENVIRONMENTAL SYSTEMS PENNSYLVANIA
Consignee: OAK RIDGE NATIONAL LABORATORY TENNESSEE

Remarks:
TRUCK LEFT ROAD TO AVOID HEAD ON: THE TRUCK TRANSPORTING THE SPENT
REACTOR FUEL ELEMENT SWERVED TO AVOID A HEAD-ON COLLISION WITH
ANOTHER VEHICLE AND WAS FORCED OFF THE ROAD. THE DRIVER WAS KILLED BY
IMPACT AND THE SPENT FUEL CASK WAS THROWN INTO A DITCH. THE RAD
ASSISTANCE TEAM FROM OAK RIDGE ARRIVED. SURVEYS INDICATED THERE WAS
NO RELEASE. THE CASK WAS TAKEN TO OAK RIDGE FOR EXAMINATION-CASK
PAINT, TARPAULIN & THERMAL INSULATION & CENTER RING DOWELS & BOLTS
WERE DAMAGED. NO RELEASE.

--- Materials Involved ---
Category: NFC
SPENT FUEL

--- Packages Involved ---
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<th>Description</th>
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<tr>
<td>CASK</td>
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# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 1
Incident Number: 4030399        Date: 03/10/1974         Time: 20:15
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                 Transportation Link Closed?: U
Radioactivity Released: NONE     Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier:   ALLEGHANY CORP, JONES MOTOR DIV        PENNSYLVANIA
Location: RTE 422 AND 645, MYERSTOWN        PENNSYLVANIA
Shipper:   GENERAL MOTORS (TEREX DIV)        OHIO
Consignee: RADIATION PRODUCTS        MASSACHUSETTS
Remarks:
COLLISION, NO DAMAGE TO RAM: JONES MOTOR WAS INVOLVED IN AN ACCIDENT
BUT THERE WAS NO RELEASE NOR DAMAGE TO THE RADIOACTIVE MATERIALS (AN
IRIDIUM SOURCE). THE PA STATE POLICE RESPONDED & CONTACTED THE
HAZARDOUS MATERIAL BOARD. A HAZ MAT REPRESENTATIVE RESPONDED &
SURVEYED THE TRUCK AND AREA AND FOUND NO RELEASE OR CONTAMINATION.
THE SOURCE WAS INTACT.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

---Packages Involved ---
DOT
Description                              ID Code                Category
CONTAINER                                 UNKNOWN                    B
# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
**Incident Number:** 4040129  **Date:** 03/29/1974  **Time:** 21:05  
**Mode:** RAIL  **Vehicle:** RAIL CAR  
**Accident Code:** T  **Transportation Link Closed?:** N  
**Radioactivity Released:** NONE  **Search Code:** NFC  
**Injuries and Deaths Due to Radioactivity Released:** 0, 0  
**Carrier:** SEABOARD COAST LINE RAILROAD  **NORTH CAROLINA**  
**Location:** RAILYARD IN HAMLET  **NORTH CAROLINA**  
**Shipper:** U. S. DEPARTMENT OF ENERGY  **PENNSYLVANIA**  
**Consignee:** CHARLESTON NAVAL SHipyARD  **SOUTH CAROLINA**  

**Remarks:**  
DERAILLED CAR, NO DAMAGE TO RAM: DERAILED TANK CAR HIT FLAT CAR. THERE WAS MINOR DAMAGE TO A WOOD BOX CONTAINING PLASTIC WRAPPED TOOLS. THE BOX WAS LOCATED NEAR ONE CORNER OF THE CAR. THE SPENT FUEL CASK WAS EMPTY AND WAS NOT DAMAGED. THERE WAS NO CONTAMINATION. (NC REPORT #37).  

--- Materials Involved ---  
Category: NFC  
RAM LSA  

---Packages Involved---  
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<td>BOX, WOOD</td>
<td>UNKNOWN</td>
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# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0  
# Packages: Shipped: 2; Damaged w/ Release: 0; Damaged, No Release: 1
**Incident Number:** 5080654        **Date:** 08/09/1975         **Time:** 18:00
**Mode:** HIGHWAY                   **Vehicle:** TRUCK, TRAILER
**Accident Code:** T              **Transportation Link Closed?:** Y
**Radioactivity Released:** NONE             **Search Code:** NFC
**Injuries and Deaths Due to Radioactivity Released:** 0, 0
**Carrier:** TRI-STATE MOTOR TRANSIT CO          **Location:** US 20-18MI WEST OF IDAHO FALLS         **Shipper:** ARGONNE NATIONAL LABORATORY
**Consignee:** ARGONNE NATIONAL LABORATORY         **Remarks:** TRUCK OVERTURNED, NO RELEASE: TRACTOR/TRAILER RAN OFF ROAD AND ROLLED OVER ON U. S. HIGHWAY 20. THE TRUCK WAS LOADED WITH 9 PACKAGES OF RADIOACTIVE MATERIAL FROM EBR-II. ABOUT 10 EMPTY WOODEN BOXES SPILLED ON THE SHOULDER OF THE ROAD. ALL RADIOACTIVE PACKAGES REMAINED INSIDE THE TRAILER-NONE WERE DAMAGED. THERE WAS NO RELEASE. THE DRIVER RECEIVED MINOR INJURIES. MORE DATA AVAILABLE.

--- Materials Involved ---
**Category:** NFC
COBALT-58                               PLUTONIUM-239
URANIUM-235                             URANIUM-238

--- Packages Involved ---
**Description** | **ID Code** | **Category**
--- | --- | ---
BOX | UNKNOWN | S
# Packages: Shipped: 2; Damaged w/ Release: 0; Damaged, No Release: 0
CASK | 5607/B | B
# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
DRUM | UNKNOWN | S
# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0

MISSOURI                   **IDAHO**
**ILLINOIS**
Incident Number: NRC0003        Date: 05/06/1977         Time:
Mode: HIGHWAY                   Vehicle: VEHICLE, SMALL
Accident Code: T                 Transportation Link Closed?: U
Radioactivity Released: NONE     Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: NUCLEAR ENERGY SERVICES, INC   ILLINOIS
Location: ADAIR                    ILLINOIS
Shipper: NUCLEAR ENERGY SERVICES, INC ILLINOIS
Consignee: NONE; ACCIDENT IN TRANSIT
Remarks:
COLLISION; NO DAMAGE TO RAM: LICENSEE'S PICKUP TRUCK WAS INVOLVED IN AN ACCIDENT. THERE WAS NO DAMAGE TO THE SOURCE (IRIDIUM 192, 86 CI). A LEAK TEST WAS PERFORMED AT THE LICENSEE'S OFFICE IN ROSEMOUNT, IL AND THE DEVICE WAS FOUND TO BE INTACT. THE SOURCE WAS RETURNED TO SERVICE ON 5/9/77.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

--- Packages Involved ---
DOT
Description              ID Code       Category
CAMERA, SOURCE           UNKNOWN       B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
**Incident Number:** NRC0007  **Date:** 08/11/1977  **Time:**

- **Mode:** HIGHWAY
- **Vehicle:** TRUCK, TRAILER
- **Accident Code:** T
- **Transportation Link Closed?:** U
- **Radioactivity Released:** NONE
- **Search Code:** IND
- **Injuries and Deaths Due to Radioactivity Released:** 0, 0

**Carrier:** DAVIS X-RAY CO  **Location:** SPRINGSBORO  **Carrier:** DAVIS X-RAY CO  **Location:** SPRINGSBORO

**Shipper:** DAVIS X-RAY CO  **Consignee:** NONE; ACCIDENT IN TRANSIT

**Remarks:**
COLLISION: TRUCK IN ACCIDENT WITH GASOLINE TANK TRUCK. THE SOURCE AND ITS CAMERA REMAINED INTACT. THE DRIVER WAS TREATED AT A LOCAL HOSPITAL AND RELEASED.

--- Materials Involved ---
**Category:** INDUSTRIAL
IRIDIUM-192

--- Packages Involved ---

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<th>ID Code</th>
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# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: TTC0185        Date: 08/25/1977         Time: 20:00
Mode: RAIL                      Vehicle: RAIL CAR
Accident Code: T                      Transportation Link Closed?: Y
Radioactivity Released: NONE                             Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: ILLINOIS CENTRAL & GULF RAILROAD
Location: 4TH AND RIVER RD, LOUISVILLE                  KENTUCKY
Shipper: UNION CARBIDE CORP                             KENTUCKY
Consignee: NONE; ACCIDENT IN TRANSIT
Remarks:
TRAIN DERAILED; NO DAMAGE TO RAM: AN ILLINOIS CENTRAL TRAIN DERAILED
6 CARS; 1 FLAT CAR CONTAINED URANIUM HEXAFLUORIDE (UF6) THAT
PARTIALLY DERAILED. THERE WAS NO DAMAGE TO THE UF6 CAR OR THE
CYLINDERS. A CAR OF HYDROCYANIC ACID WAS BEHIND THE UF6 CAR. SURVEYS
REVEALED THERE WAS NO CONTAMINATION. SHIPMENT WAS ON ITS WAY 8/26 AT
1330. (KY REPORT; MORE DATA AVAILABLE).

--- Materials Involved ---
Category: NFC
URANIUM HEXAFLUORIDE

--- Packages Involved ---                                    DOT
Description                          ID Code      Category
OVERPACK                             TIGER       B

# Packages: Shipped: 4; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: NRC0008        Date: 10/03/1977         Time:
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                Transportation Link Closed?: U
Radioactivity Released: NONE     Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: TESTMASTER INC
Location: NEAR BLOOMFIELD       INDIANA
Shipper: TESTMASTER INC
Consignee: NONE; ACCIDENT IN TRANSIT
Remarks:
ONE VEHICLE ACCIDENT: THE RADIOGRAPHER'S TRUCK WAS INVOLVED IN A ONE
VEHICLE ACCIDENT. THE SOURCE CONTAINER REMAINED INTACT. THERE WAS NO
CONTAMINATION OR RADIATION PROBLEM.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

---Packages Involved ---
DOT Description                ID Code                Category
SOURCE, SEALED                UNKNOWN                B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNO7827        Date: 02/09/1978         Time: 20:20
Mode: HIGHWAY                  Vehicle: TRUCK, TRAILER
Accident Code: T                Transportation Link Closed?: Y
Radioactivity Released: NONE    Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: TRI-STATE MOTOR TRANSIT CO       MISSOURI
Location: US 54, NEAR GIBSON CITY     ILLINOIS
Shipper: COMMONWEALTH EDISON CO       ILLINOIS
Consignee: BABCOCK & WILCOX CO       VIRGINIA
Remarks:
TRAILER BED BUCKLED: TRAILER BUCKLED FROM WEIGHT OF CASK. CASK
CONTAINED 6 MIXED OXIDE SPENT FUEL RODS. CASK REMAINED ON TRAILER. NO
LEAKAGE. RESPONDERS INCLUDED EMERGENCY SERVICES & DISASTER AGENCY,
STATE RAD ASSISTANCE, STATE POLICE, & DEPTS OF HEALTH &
TRANSPORTATION. CASK WAS TRANSFERRED TO A NEW VEHICLE AND THE ROAD
WAS OPENED AT 10 A.M. ON 2/10/78. THERE WAS NO RELEASE OR
CONTAMINATION.

--- Materials Involved ---
Category: SPENT FUEL
SPENT FUEL

--- Packages Involved ---
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# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNO7876        Date: 04/10/1978         Time:
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                Transportation Link Closed?: U
Radioactivity Released: NONE     Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier:   UNIVERSAL TECHNICAL TESTING LABS              PENNSYLVANIA
Location:  RTE 623, GLEN COVE RD, CASTLETON              MARYLAND
Shipper:   UNIVERSAL TECHNICAL TESTING LABS              PENNSYLVANIA
Consignee: PHILADELPHIA ELECTRIC CO                      PENNSYLVANIA
Remarks:
TRUCK OVERTURNED; NO DAMAGE TO RAM: A RADIOGRAPHER'S TRUCK OVERTURNED
ON THE HIGHWAY. THE TRUCK WAS UPRIGHTED AND PROCEEDED TO ITS JOB SITE
AT PEACH BOTTOM NUCLEAR POWER PLANT. THE SOURCE WAS IN THE CAMERA AND
SECURED INSIDE ITS STORAGE BOX WHICH WAS BOLTED TO THE TRUCK. THERE
WAS NO RELEASE OF RADIOACTIVITY.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

---Packages Involved ---
Description                  ID Code                Category
CAMERA, SOURCE               UNKNOWN                    B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: TTC0220        Date: 07/07/1978         Time:
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T              Transportation Link Closed?: U
Radioactivity Released: NONE          Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: TRI-STATE MOTOR TRANSIT CO               MISSOURI
Location: U. S. 301, SOUTH OF ORANGEBURG             SOUTH CAROLINA
Shipper: MILLSTONE NUCLEAR POWER PLANT               CONNECTICUT
Consignee: CHEM-NUCLEAR SYSTEMS                  SOUTH CAROLINA

Remarks:
TRUCK HIT UTILITY POLE, NO DAMAGE TO RAM: A TRI-STATE TRUCK HAULING A PEACH BOTTOM CASK LOADED WITH NON FUEL BEARING REACTOR COMPONENTS WAS TRAVELING DOWNGRADE AND APPROACHED AN INTERSECTION. CAR IN FRONT OF TRUCK STOPPED & TO AVOID COLLISION, TRUCK SWERVED AND HIT A UTILITY POLE. NO DAMAGE TO TRAILER OR CASK. CHEM-NUCLEAR EMERGENCY TEAM RESPONDED & TOOK SMEARS OF CASK & SUPPORTS - NOTHING UNUSUAL IN READINGS. MORE DATA AVAILABLE. (SC REPORT)

--- Materials Involved ---
Category: LLW
COBALT-58                COBALT-60
IRON-59                   NICKEL-63

---Packages Involved ---
DOT
Description                ID Code     Category
CASK                CNSI              B
# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0

69
Incident Number: NRC0019        Date: 07/26/1978         Time:
Mode: HIGHWAY                   Vehicle: VEHICLE, SMALL
Accident Code: T                Transportation Link Closed?: U
Radioactivity Released: NONE     Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier:  BASIN SURVEY INC       WEST VIRGINIA
Location:  WASHINGTON           PENNSYLVANIA
Shipper:   UNKNOWN
Consignee:  NONE; ACCIDENT IN TRANSIT
Remarks:
TRUCK OVERTURNED; NO DAMAGE TO CASKS: A HEAVY DUTY JEEP WAS HAULING A
FLATBED TRAILER WHICH CONTAINED TWO CASKS OF CESIUM 137 (104 AND 2 CI). THE CONTAINERS WERE LEAD LINED STEEL CASED SHIPPING CASKS. THE TRUCK OVERTURNED IN AN ACCIDENT IN PA. THE CASKS WERE NOT DAMAGED. THEY WERE RETURNED TO THE COMPANY.

--- Materials Involved ---
Category: INDUSTRIAL
CESIUM-137

--- Packages Involved ---
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# Packages: Shipped: 2; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: NRC0020        Date: 08/13/1978         Time:  21:00
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                Transportation Link Closed?: U
Radioactivity Released: NONE                             Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0

Carrier:       CHEM-NUCLEAR SYSTEMS                          SOUTH CAROLINA
Location:      NEW JERSEY TURNPIKE                           NEW JERSEY
Shipper:       CHEM-NUCLEAR SYSTEMS INC                      SOUTH CAROLINA
Consignee:     BOSTON EDISON CO                              MASSACHUSETTS

Remarks:
TRAILER BED FAILURE: AN EMPTY CASK (MODEL-1600) BROKE THROUGH THE
TRAILER BED OF A CHEM-NUCLEAR TRUCK WHILE ENROUTE TO BOSTON EDISON.
THERE WAS NO PERSONNEL INJURY NOR WAS THERE ANY RELEASE OF
RADIOACTIVITY. THE CASK OVERPACK AND BASE PLATE WERE DAMAGED. THE
CASK IS BEING RETURNED TO BARNWELL FOR EXAMINATION. THE NEW JERSEY
STATE PATROL RESPONDED.

--- Materials Involved ---
Category: EMPTY
EMPTY SPENT FUEL CASK

---Packages Involved ---
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>CASK</td>
<td>GE-1600</td>
<td>B</td>
</tr>
</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNO78154       Date: 08/27/1978         Time:
Mode: HIGHWAY                   Vehicle: VEHICLE, SMALL
Accident Code: T               Transportation Link Closed?: Y
Radioactivity Released: NONE               Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: AMERICAN X-RAY AND INSPECTION INC       MICHIGAN
Location: I-75 NEAR SAGINAW       MICHIGAN
Shipper: AMERICAN X-RAY AND INSPECTION       MICHIGAN
Consignee: NONE; ACCIDENT IN TRANSIT
Remarks:
COLLISION, NO DAMAGE TO SOURCE: A PICKUP TRUCK CARRYING AN IRIDIUM 192 SOURCE WAS INVOLVED IN AN ACCIDENT. THE DRIVER WAS INJURED IN THE CRASH AND THE TRUCK WAS DAMAGED BY FIRE. THERE WAS NO DAMAGE TO THE RADIOACTIVE SOURCE. INTERSTATE 75 WAS CLOSED FOR 4.5 HOURS.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

--- Packages Involved ---
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAMERA, SOURCE</td>
<td>UNKNOWN</td>
<td>B</td>
</tr>
</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: NRC0023        Date: 09/11/1978         Time:
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                 Transportation Link Closed?: U
Radioactivity Released: NONE     Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: PEABODY PIPELINE TESTING PENNSYLVANIA
Location: NEAR WOODWARD          OKLAHOMA
Shipper: PEABODY PIPELINE TESTING PENNSYLVANIA
Consignee: NONE; ACCIDENT IN TRANSIT

Remarks:
TRUCK OVERTURNED, NO DAMAGE TO SOURCE: A PEABODY PIPELINE TRUCK
OVERTURNED; THE DRIVER WAS KILLED. THE RADIOGRAPHIC CAMERA (IRIDIUM
192 SEALED SOURCE) THAT THE TRUCK WAS TRANSPORTING WAS UNDAMAGED.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

---Packages Involved ---
Description            ID Code    Category
CAMERA, SOURCE          UNKNOWN    B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: NRC0025        Date: 09/15/1978         Time:
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                Transportation Link Closed?: U
Radioactivity Released: NONE    Search Code: N/A
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: UNKNOWN
Location: NEAR DOUBLE SPRINGS   ALABAMA
Shipper: UNKNOWN
Consignee: NONE; ACCIDENT IN TRANSIT
Remarks:
TRUCK OVERTURNED; NO DAMAGE TO SOURCE: A TRUCK WITH APPROXIMATELY 100 CURIES OF RADIUM OVERTURNED NEAR DOUBLE SPRINGS, AL. THE DRIVER WAS INJURED BUT THERE WAS NO RELEASE OF MATERIAL. THE STATE OF ALABAMA INVESTIGATED THE ACCIDENT.

--- Materials Involved ---
Category: INDUSTRIAL
RADIUM

--- Packages Involved ---
Description   ID Code   Category
CASK           UNKNOWN  B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: NRC0026        Date: 11/28/1978        Time:  23:45
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                Transportation Link Closed?: N
Radioactivity Released: NONE                             Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0

Carrier:   EXAM CO
Location:  U. S. 12, 5 MI SOUTH OF SAUK CITY              WISCONSIN
Shipper:   EXAM CO
Consignee: NONE; ACCIDENT IN TRANSIT
Remarks:
TRUCK OVERTURNED, NO DAMAGE TO SOURCE: THE TRUCK CARRYING THE
RADIOGRAPHIC CAMERA (120 CI IRIIDIUM 192 SOURCE) WENT OFF THE ROAD AND
OVERTURNED. THE DRIVER WAS NOT INJURED. THE SOURCE AND THE CAMERA
WERE INTACT; THERE WAS NO RELEASE OF RADIOACTIVITY.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

---Packages Involved ---
DOT
Description                  ID Code               Category
CAMERA, SOURCE  UNKNOWN           B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
**Incident Number:** 9020490  **Date:** 01/10/1979  **Time:**

- **Mode:** HIGHWAY  
- **Vehicle:** TRUCK, TRAILER  
- **Accident Code:** T  
- **Transportation Link Closed?:** U  
- **Radioactivity Released:** NONE  
- **Search Code:** NFC  
- **Injuries and Deaths Due to Radioactivity Released:** 0, 0  
- **Carrier:** HOME TRANSPORTATION CO  
- **Location:** I-81 NEAR MORRISTOWN  
- **Shipper:** OAK RIDGE NATIONAL LABORATORY  
- **Consignee:** TRANSNUCLEAR INC  
- **Remarks:**

TRUCK REAR-ENDED ANOTHER VEHICLE: A TRUCK CARRYING A SHIPMENT OF SLIGHTLY ENRICHED URANIUM-235 (UF6) REAR-ENDED ANOTHER TRUCK. THE TRUCK WITH THE UF6 CAME TO REST IN THE MEDIAN. THERE WAS NO DAMAGE TO THE TYPE B OVERPACKS OF UF6. RESPONDERS INCLUDED THE HAMBLEN COUNTY DEPT OF CIVIL DEFENSE & THE OAK RIDGE RADIOLOGICAL TEAM. THE DRIVER WAS TAKEN TO THE HOSPITAL FOR TREATMENT AND RELEASED.

--- Materials Involved ---
- **Category:** UF6 URANIUM HEXAFLUORIDE

--- Packages Involved ---

<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
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</thead>
<tbody>
<tr>
<td>CYLINDER</td>
<td>21PF-1</td>
<td>B</td>
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</tbody>
</table>

- # Packages: Shipped: 5; Damaged w/ Release: 0; Damaged, No Release: 0
**Incident Number:** TTC0045        **Date:** 08/12/1979         **Time:** 12:05

**Mode:** HIGHWAY           **Vehicle:** TRUCK, TRAILER
**Accident Code:** T        **Transportation Link Closed?:** Y
**Radioactivity Released:** NONE        **Search Code:** NFC
**Injuries and Deaths Due to Radioactivity Released:** 0, 0

**Carrier:** TRI-STATE MOTOR TRANSIT CO        **NEBRASKA**
**Location:** I-95 AT FOUR OAKS EXIT        **NORTH CAROLINA**
**Shipper:** CHEM-NUCLEAR SYSTEMS INC        **SOUTH CAROLINA**
**Consignee:** UNION CARBIDE CORP        **NEW YORK**

**Remarks:**
COLLISION, NO DAMAGE TO CASKS: (N.C. REPORT# 85) TRI-STATE TRUCK IN LEFT NORTH BOUND LANE WHEN TRUCK ON THE RIGHT HAD A BLOWOUT AND COLLIDED WITH LEFTSIDE OF THE TRI-STATE TRUCK. THERE WAS NO DAMAGE TO THE CASKS. RESPONSERS: NC STATE HIGHWAY PATROL, RADIATION SERVICES, AND WENDELL RESCUE SQUAD. MORE DETAILS ARE AVAILABLE.

--- Materials Involved ---
**Category:** EMPTY
EMPTY CASK

--- Packages Involved ---
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>DOT Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>CASK</td>
<td>USA/6058/B</td>
<td>B</td>
</tr>
</tbody>
</table>

# Packages: Shipped: 2; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: TTC0193        Date: 12/11/1979         Time: 12:00
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                Transportation Link Closed?: U
Radioactivity Released: NONE     Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: TRI-STATE MOTOR TRANSIT CO       MISSOURI
Location: I-80, JUST EAST OF ALTOONA EXIT       IOWA
Shipper: GOODYEAR ATOMIC CORP            OHIO
Consignee: EXXON NUCLEAR INC           WASHINGTON
Remarks:
COLLISION: A TRUCK CARRYING URANIUM HEXAFLUORIDE JACKKNIFED ON AN ICY ROAD AND CAME TO REST UPRIGHT IN THE CENTER MEDIAN. SURVEYS WERE TAKEN AND SHOWED NO RADIOACTIVE RELEASE NOR DAMAGE TO THE CYLINDERS. RESPONDERS INCLUDED HIGHWAY PATROL, DEPT OF ENVIRONMENTAL QUALITY, ETC. (IA REPORT; MORE DATA AVAILABLE).

--- Materials Involved ---
Category: NFC
URANIUM HEXAFLUORIDE

---Packages Involved ---
DOT Description    ID Code    Category
CYLINDER 4909/B  B

# Packages: Shipped: 5; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOI8006       Date: 01/14/1980         Time: 
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER 
Accident Code: T                   Transportation Link Closed?: Y
Radioactivity Released: NONE                   Search Code: MED
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier:   GATEWAY TRANSPORTATION CO INC
Location:  I-80, 8 MI. WEST OF DU BOIS                   PENNSYLVANIA
Shipper:   ADVANCED MEDICAL SYSTEMS INC                  OHIO
Consignee: HOSPITAL                   NEW YORK
Remarks:
COLLISION, NO DAMAGE TO RAM: A SNOW/ICE STORM CAUSED A TRUCK
TRANSPORTING A TELETHERAPY SOURCE TO HIT A TRUCK CARRYING TURKEYS.
THE CASK WAS UNDAMAGED AND THE TRUCK CONTINUED TO NEW YORK. PA STATE
POLICE RESPONDED TO EVENT.

--- Materials Involved ---
Category: INDUSTRIAL
COBALT-60

---Packages Involved ---
DOT
Description           ID Code   Category
CASK                          UNKNOWN    B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOII8018      Date: 01/31/1980         Time:
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                 Transportation Link Closed?: U
Radioactivity Released: NONE      Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: TRI-STATE MOTOR TRANSIT CO      MISSOURI
Location: I 95 NEAR ROANOKE RAPIDS      NORTH CAROLINA
Shipper: UNION CARBIDE CORP       NEW YORK
Consignee: CHEM-NUCLEAR SYSTEMS     SOUTH CAROLINA

Remarks:
TRAILER JACKKNIFED, NO DAMAGE TO RAM: SEMI JACKKNIFED ON ICY I-95,
CAME TO REST ON MEDIAN. NO CASK DAMAGE. ONE CASK HAD 230 GRAMS OF
URANIUM AND 700 CI OF MIXED FISSION PRODUCTS. THE OTHER CASK
CONTAINED 238 GRAMS OF URANIUM AND 933 CI OF MIXED FISSION PRODUCTS.
TWO OTHER VEHICLES WERE INVOLVED BUT THERE WERE NO INJURIES.
RESPONDERS: NC RADIATION PROTECTION. NO ABNORMAL RADIATION LEVELS
REPORTED. (SEE NC REPORT #91)

--- Materials Involved ---
Category: LLW
MIXED FISSION PRODUCTS URANIUM

--- Packages Involved ---
Description   ID Code        Category
CASK          USA/6058/B     B

# Packages: Shipped: 2; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOI80106      Date: 07/21/1980         Time:  17:00
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                Transportation Link Closed?: Y
Radioactivity Released: NONE                             Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0

Carrier:   PEABODY PIPELINE TESTING                      PENNSYLVANIA
Location:  US 22, 40 MI EAST OF PITTSBURG                PENNSYLVANIA
Shipper:   PEABODY PIPELINE TESTING                      PENNSYLVANIA
Consignee: NONE; ACCIDENT IN TRANSIT

Remarks:
COLLISION, NO DAMAGE TO RAM: A TRUCK TRANSPORTING A MAGNAFLUX
EXPOSURE DEVICE CROSSED TRAFFIC LANES AND COLLIDED WITH A CAR. THE
SOURCE WAS THROWN FROM THE TRUCK. THE RADIATION SAFETY OFFICER
RECOVERED THE SOURCE AND MEASURED THE RADIATION LEVELS WHICH WERE
DETERMINED TO BE NORMAL. THERE WAS NO RELEASE.

--- Materials Involved ---
Category: SOURCE
IRIDIUM-192

--- Packages Involved ---
DOT
Description                              ID Code                Category
SOURCE, SEALED                            UNKNOWN                    B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOII80142     Date: 08/22/1980         Time: 13:30
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                   Transportation Link Closed?: U
Radioactivity Released: NONE                Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0

Carrier: TRI-STATE MOTOR TRANSIT CO                     MISSOURI
Location: US 421 WEST NEAR NC HIGHWAY 68                   NORTH CAROLINA
Shipper: GOODYEAR ATOMIC CORP                             OHIO
Consignee: GENERAL ELECTRIC                                NORTH CAROLINA

Remarks:
TRUCK FORCED OFF HIGHWAY, NO DAMAGE TO RAM: TRUCK TRANSPORTING FIVE
FULL OR-30B UF6 CYLINDERS IN OVERPACKS WAS FORCED OFF I-85 NEAR
GREENSBORO, NC. THE TRUCK WENT INTO A DITCH BUT DID NOT OVERTURN.
THERE WAS NO DAMAGE TO THE CYLINDERS AND NO INJURIES. NC HIGHWAY
PATROL RESPONDED & SURVEYED AREA - NO RELEASE. (NC REPORT #106)

--- Materials Involved ---
Category: UF6
URANIUM HEXAFLUORIDE

--- Packages Involved ---
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>CYLINDER</td>
<td>OR-30B</td>
<td>B</td>
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</tbody>
</table>

# Packages: Shipped: 5; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: TTC0005        Date: 09/06/1980         Time:
Mode: RAIL                      Vehicle: RAIL CAR
Accident Code: T                Transportation Link Closed?: Y
Radioactivity Released: NONE                Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0

Carrier: NORFOLK & WESTERN RR
Location: TUG RIVER TRESTLE, HEMPHILL                   WEST VIRGINIA
Shipper: GOODYEAR ATOMIC CORP                          OHIO
Consignee: TRANSNUCLEAR INC                              VIRGINIA

Remarks:
HEAD ON COLLISION, NO DAMAGE TO RAM: FREIGHT TRAIN COLLIDED HEAD-ON
WITH AN EMPTY COAL TRAIN. 2 CREW DIED & A THIRD MISSING; DIESEL FUEL
FIRE. FREIGHT HAD A FLAT CAR WITH 2 PIGBACK TRAILERS, EACH WITH 4 30B
CYLINDERS WITH DOT 21PF1 OVERPACKS. THERE WAS NO DAMAGE TO THE
CYLINDERS. CYLINDERS DESTINED FOR NORFOLK 9/8/80 FOR EURATOM. MORE
DETAILS AVAILABLE. (URANIUM HEXAFLUORIDE, FISSION).

--- Materials Involved ---
Category: UF6
URANIUM HEXAFLUORIDE

--- Packages Involved ---
DOT Description ID Code Category
CYLINDER 30B B

# Packages: Shipped: 8; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOIV8033      Date: 09/29/1980      Time:
Mode: RAIL                      Vehicle: RAIL CAR
Accident Code: T                Transportation Link Closed?: U
Radioactivity Released: NONE     Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0

Carrier: BURLINGTON NORTHERN

Location: BAINVILLE             MONTANA
Shipper: U. S. ARMY             NEW JERSEY

Consignee: NONE; ACCIDENT IN TRANSIT

Remarks:
TRAIN ACCIDENT, NO DAMAGE TO RAM: A RAIL ACCIDENT OCCURRED NEAR
BAINVILLE, MT. THREE 100 MCI SOURCES OF STRONTIUM-90/YTTRIUM-90
SOURCES WERE BEING TRANSPORTED IN A TRUCK TRAILER ON A FLAT CAR. THE
TRAILER WAS REPORTED TO BE HEAVILY DAMAGED BUT THE SOURCES REMAINED
INTACT AND THERE WAS NO RELEASE OR DAMAGE TO THE CONTAINERS.

--- Materials Involved ---
Category: INDUSTRIAL
STRONTIUM-90                     YTTRIUM-90

--- Packages Involved ---
DOT                          Description          ID Code        Category
SOURCE, SEALED               UNKNOWN          Category

# Packages: Shipped: 3; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: TTC0012        Date: 06/09/1981         Time:  23:30
Mode: HIGHWAY                   Vehicle: VEHICLE, SMALL
Accident Code: T                   Transportation Link Closed?: Y
Radioactivity Released: NONE        Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: SHELWELL SERVICES INC                         OHIO
Location: US 30 BRIDGE, MASSILLON                       OHIO
Shipper: SHELWELL SERVICES INC                         OHIO
Consignee: NONE; ACCIDENT IN TRANSIT
Remarks:
COLLISION; NO DAMAGE TO RAM: A PICKUP/CAMPER TRUCK STRUCK THE
GUARDRAIL IN THE MEDIAN STRIP AND THEN HIT A BRIDGE ABUTMENT WHICH
CAUSED THE TRUCK TO FLIP END OVER END ONTO THE RAILROAD TRACKS. THERE
WERE 2 CYLINDERS: 1 WITH AMERICIUM & THE OTHER A CESIUM SOURCE
(LOGGING TOOL). BOTH CYLINDERS STAYED IN THE TRUCK BUT THE CESIUM
CYLINDER SLIPPED OUT OF ITS LEAD SHIELD; MEASURED 2 MR/HR AT 10 FT.
RESPONDERS: OHIO HIGHWAY PARTOL, OH DEPT OF TRANSPORTATION, FIRE,
DISASTER SERVICE, ETC. ROAD CLOSED FOR

--- Materials Involved ---
Category: INDUSTRIAL
AMERICIUM-241                          CESIUM

---Packages Involved ---
DOT
Description    ID Code    Category  CYLINDER    UNKNOWN    B  # Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
CYLINDER      UNKNOWN    A  # Packages: Shipped: 1; Damaged w/ Release: 1; Damaged, No Release: 0
Incident Number: PNOIV8125      Date: 09/02/1981         Time:
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                Transportation Link Closed?: N
Radioactivity Released: NONE     Search Code: FIRE
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier:   H & H X-RAY SERVICES INC       LOUISIANA
Location:  NEAR ROLL               OKLAHOMA
Shipper:   H & H X-RAY SERVICES      LOUISIANA
Consignee: H & H X-RAY SERVICES INC    LOUISIANA
Remarks:
CRASH AND FIRE, NO RAM DAMAGE: A MOBILE RADIOGRAPHIC VEHICLE WITH A
40 CI IRIDIUM-192 SOURCE CRASHED AND CAUGHT FIRE. THE SOURCE WAS
UNDAMAGED. H&H X-RAY AND STATE OF OKLAHOMA REPS RESPONDED TO
ACCIDENT.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

---Packages Involved ---
Description ID Code Category
SOURCE, SEALED UNKNOWN B
# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: TTC0189        Date: 10/26/1981         Time:
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                Transportation Link Closed?: N
Radioactivity Released: NONE                             Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier:   BILL MILLER, INC.                             KANSAS
Location:  HAVERHILL RD & OLD KECHI RD, EL DORADO        KANSAS
Shipper:   UNKNOWN
Consignee: NONE; ACCIDENT IN TRANSIT
Remarks:
COLLISION AND FIRE; NO DAMAGE TO RAM: A BILL MILLER RADIOGRAPHY TRUCK
CARRYING A 102 CI IRIDIUM-192 SOURCE WAS INVOLVED IN AN ACCIDENT. THE
ACCIDENT SITE WAS SURVEYED AND NO RADIATION ABOVE BACKGROUND WAS
NOTED. EL DORADO PUBLIC SAFETY AND DEPT OF HEALTH RESPONDED. (KS
REPORT).

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

---Packages Involved ---
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAMERA, SOURCE</td>
<td>MODEL 62</td>
<td>B</td>
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</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOII82122     Date: 11/03/1982         Time:  18:00
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                   Transportation Link Closed?: Y
Radioactivity Released: NONE                          Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier:   TRI-STATE MOTOR TRANSIT CO               MISSOURI
Location:  NEAR HILDA                              SOUTH CAROLINA
Shipper:   CHEM-NUCLEAR SYSTEMS INC                    SOUTH CAROLINA
Consignee: UNION CARBIDE CORP                  NEW YORK
Remarks:
COLLISION; NO DAMAGE TO RAM: A TRI-STATE TRACTOR-TRAILER WAS
RETURNING FROM A DELIVERY TO CHEM-NUCLEAR'S BARNWELL LOW LEVEL WASTE
SITE WHEN A CAR PULLED IN FRONT OF THE TRUCK. THE TRUCK WAS CARRYING
TWO 28,000 LB EMPTY CASKS. THE TRUCK OVER TurnED AND BOTH CASK
TIE-DOWNS GAVE WAY AND THE CASKS WERE THROWN FROM THE TRAILER. BOTH
CASKS WERE INTACT. THE TRACTOR CAUGHT FIRE AND THE DRIVER WAS KILLED.
THE STATE RESPONDED. THERE WAS NO RELEASE.

--- Materials Involved ---
Category: LLW
EMPTY CASK

---Packages Involved ---
Description     ID Code     Category
CASK            UNKNOWN     B

# Packages: Shipped: 2; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: TTC0072    Date: 03/11/1983    Time: 15:00
Mode: HIGHWAY             Vehicle: TRUCK, TRAILER
Accident Code: T          Transportation Link Closed?: N
Radioactivity Released: NONE    Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: HITTMAN NUCLEAR   MARYLAND
Location: ILL 59 & ILL 64   ILLINOIS
Shipper: POINT BEACH NUCLEAR POWER WISCONSIN
Consignee: U. S. ECOLOGY   WASHINGTON
Remarks:
COLLISION; NO DAMAGE TO RAM: TRUCK CARRYING CASK WAS SIDE-SWIPED BY
ANOTHER TRUCK. NO DAMAGE TO CASK. NO RELEASE. RADIATION READINGS WERE
15 MR/HR AT CONTAINER SURFACE. (ILL ID# I0007A)

--- Materials Involved ---
Category: LLW
LOW LEVEL WASTE

--- Packages Involved ---
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>CASK</td>
<td>HN-400</td>
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</tr>
</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
**Incident Number:** TTC0100  **Date:** 05/10/1983  **Time:**

- **Mode:** HIGHWAY  
- **Vehicle:** VEHICLE, SMALL  
- **Accident Code:** T  
- **Transportation Link Closed?:** N  
- **Radioactivity Released:** NONE  
- **Search Code:** IND  
- **Injuries and Deaths Due to Radioactivity Released:** 0, 0

- **Carrier:** INSPECTION AND TESTING INC  
  - **Location:** US-40, 5 MI N. OF HEBER CITY  
  - **Shipper:** INSPECTION AND TESTING INC  
  - **Consignee:** INSPECTION AND TESTING INC

**Remarks:**

COLLISION; NO DAMAGE TO RAM: (UTAH STATE REPORT) A PICKUP TRUCK CARRYING AN IRIDIUM-192 SOURCE WAS STRUCK HEAD ON BY ANOTHER VEHICLE. THE OTHER VEHICLE CROSSED THE CENTER LINE AND HIT THE INSPECTION AND TESTING TRUCK. THE IRIDIUM SOURCE WAS INTACT; THERE WAS NO CONTAMINATION NOR UNUSUAL READINGS.

--- Materials Involved ---

- **Category:** INDUSTRIAL  
  - **IRIDIUM-192**

--- Packages Involved ---

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>CAMERA, SOURCE</td>
<td>USA/9157/B</td>
<td>B</td>
</tr>
</tbody>
</table>

- **# Packages:**  
  - **Shipped:** 1; **Damaged w/ Release:** 0; **Damaged, No Release:** 0
**Incident Number:** 83080070  
**Date:** 07/14/1983  
**Time:** 21:15

**Mode:** AIR  
**Vehicle:** AIRCRAFT  
**Accident Code:** T  
**Transportation Link Closed?:** N  
**Radioactivity Released:** NONE  
**Search Code:** MED  
**Injuries and Deaths Due to Radioactivity Released:** 0, 0

**Carrier:** EMERY AIR FREIGHT CORP  
**Location:** TRI-CITY AIRPORT, BLOUNTVILLE  
**Shipper:** UNION CARBIDE CORP  
**Consignee:** GEORGIA TECH

**Remarks:**  
FIRE: ORION AIR INC SUBCONTRACT AIRLINE FOR EMERY AIR FRT. PLANE APPARENTLY OVERSHOT THE RUNWAY, CRASHED, BURNED. CASKS REMAINED IN FUSELAGE. TYPE A THROWN FROM PLANE & FOUND 30 FT. AWAY FROM WRECKAGE. OCCUPANTS OF 4 HOMES WERE EVACUATED BECAUSE OF RADIOACTIVE CARGO. AIRPORT WAS CLOSED BECAUSE OF CRASH. MORE DATA AVAILABLE.

--- Materials Involved ---  
**Category:** MEDICAL  
IRIDIUM-192  
YTTRIUM-90

--- Packages Involved ---  
**Description** | **ID Code** | **Category**
--- | --- | ---
CASK | USA/5597 | B
BOX, FIBERBOARD | UNKNOWN | A

# Packages: Shipped: 2; Damaged w/ Release: 0; Damaged, No Release: 0
# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
**Incident Number:** PNOIII83127  **Date:** 12/09/1983  **Time:** 14:00

**Mode:** HIGHWAY  **Vehicle:** TRUCK, TRAILER

**Accident Code:** T  **Transportation Link Closed?:** N

**Radioactivity Released:** NONE  **Search Code:** NFC

**Injuries and Deaths Due to Radioactivity Released:** 0, 0

**Carrier:** TRANSNUCLEAR INC  **Location:** 3 MI E IND/ILL STATE LINE

**Shipper:** WEST VALLEY NUCLEAR SERVICES  **Shipper:** COMMONWEALTH EDISON CO

**Consignee:** COMMONWEALTH EDISON CO  **Consignee:** COMMONWEALTH EDISON CO

**Remarks:**
NO DAMAGE TO CASK: TRACTOR SEPARATED FROM INTERMEDIATE SET OF AXLES (NEE JOE DOG) BUT REMAINED CONNECTED TO TRAILER. TRAILER STOPPED; THERE WAS NO LOSS OF INTEGRITY. SHIPMENT DELIVERED TO DRESDEN NUCLEAR PLANT.

--- Materials Involved ---
**Category:** SPENT FUEL

--- Packages Involved ---

<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>CASK</td>
<td>UNKNOWN</td>
<td>B</td>
</tr>
</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOII84044     Date: 07/16/1984         Time: 20:00
Mode: AIR                       Vehicle: AIRCRAFT
Accident Code: T                       Transportation Link Closed?: N
Radioactivity Released: NONE                             Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier:   EMERY AIR FREIGHT CORP                        TENNESSEE
Location:  TRI-CITIES AIRPORT, BLOUNTVILLE               TENNESSEE
Shipper:   OAK RIDGE NATIONAL LABORATORY                 TENNESSEE
Consignee: RADIATION PRODUCTS                            MASSACHUSETTS
Remarks:
PLANE LOST HYDRAULIC FLUID: AN EMORY AIR FREIGHT PLANE (CONVAIR-240)
LOST HYDRAULIC FLUID & RAN INTO THICK MUD AT THE END OF THE RUNWAY
WHILE LANDING. THREE SHIPMENTS WERE ON THE PLANE: 2 SHIPMENTS FOR
RADIATION PRODUCTS IN MA TOTALING 17,982 CI OF IR-192 AND A 3RD TO
INDUSTRIAL NUCLEAR CO, FOSTER CITY, CA WITH 3,846 CI OF IR-192. THERE
WERE NO INJURIES & NO DAMAGE TO RAM. DEPT OF ENERGY FROM OAK RIDGE
SURVEYED THE SHIPMENTS.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

---Packages Involved ---
DOT Description ID Code Category
UNKNOWN UNKNOWN B

# Packages: Shipped: 3; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: TTC0149        Date: 08/08/1984         Time: 11:10
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                Transportation Link Closed?: N
Radioactivity Released: UNKNOWN                          Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: WESTINGHOUSE ELECTRIC CORP                    IDAHO
Location: WESTINGHOUSE NRF 400FT NW ECF                 IDAHO
Shipper: WESTINGHOUSE ELECTRIC CORP                    IDAHO
Consignee: EG&G IDAHO                                     IDAHO
Remarks:
FELL IN TRANSIT: 125 TON IRRADIATED REACTOR CORE BARREL CONTAINER
TRANSFERRED FROM NRF TO RAD WASTE MGMT COMPLEX FOR BURIAL. TRAILER
TIPPED OVER WHEN I WENT THRU 90 DEGREE TURN. CONTAINER FELL, TIEDOWNS BROKE.

--- Materials Involved ---
Category: NFC
REACTOR WASTE

--- Packages Involved ---
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTAINER</td>
<td>UNKNOWN</td>
<td>B</td>
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</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
**Incident Number:** TTC0134  **Date:** 02/11/1985  **Time:** 22:30  
**Mode:** HIGHWAY  **Vehicle:** TRUCK, TRAILER  
**Accident Code:** T  **Transportation Link Closed?:** N  
**Radioactivity Released:** NONE  **Search Code:** IND  
**Injuries and Deaths Due to Radioactivity Released:** 0, 0  

**Carrier:** SCHAEPER TRUCKING CO  **Location:** I-57 EASTBOUND AT MP 160  
**Shipper:** UNKNOWN  **Carrier:** CALIFORNIA  **Transport:** ILLINOIS  

**Consignee:** NONE; ACCIDENT IN TRANSIT  
**Remarks:**  
ACCIDENT; NO CONTAMINATION: (IL ID 0018) THE SEMI-TRAILER JACKKNIFED DUE TO ROAD CONDITIONS. THERE WAS $1,000 DAMAGE TO THE TRAILER. THERE WAS NO RELEASE OR CONTAMINATION. (IR-192 SOURCE).  

--- Materials Involved ---  
**Category:** INDUSTRIAL  
**IRIDIUM-192**  

--- Packages Involved ---  
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
<th>DOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRUM</td>
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<td>B</td>
<td></td>
</tr>
</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: TTC0135        Date: 02/13/1985         Time: 14:30
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                Transportation Link Closed?: N
Radioactivity Released: NONE     Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0

Carrier:   YELLOW FREIGHT SYSTEM INC                     KANSAS
Location:  I-55 NORTH BOUND AT MP 228                    ILLINOIS
Shipper:   MAGNAFLUX CORP                                ILLINOIS
Consignee: INDUSTRIAL NUCLEAR CO                         CALIFORNIA

Remarks:
COLLISION; NO DAMAGE TO RAM: (IL ID 0019) THE VEHICLE OVER Turned ON ITS SIDE DUE TO ROAD CONDITIONS. THERE WAS A DENT ONLY IN A DRUM - THERE WAS NO CONTAMINATION. THE TRANSPORT INDEX (TI) WAS 0.5 WITH 2.0 MR/HR MAX LEVEL AT THE SURFACE. (IR-192 SOURCE).

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

--- Packages Involved ---
Description                  ID Code        Category
DRUM                         USA/9156       B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 1
Incident Number: TTC0195        Date: 12/04/1985         Time:  21:50
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                 Transportation Link Closed?: N
Radioactivity Released: NONE     Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0

Carrier: SIERRA TESTING, TULSA   OKLAHOMA
Location: S.E. 14TH ST., DES MOINES IOWA
Shipper: SIERRA TESTING          OKLAHOMA
Consignee: NONE; ACCIDENT IN TRANSIT

Remarks:
COLLISION, NO DAMAGE TO RAM: A TRUCK CARRYING A RADIOGRAPHY SOURCE
(AN IRIDIUM-192 GAUGE) COLLIDED WITH A CAR WHILE PULLING OUT OF A
PARKING SPACE. THERE WAS NO DAMAGE TO THE SOURCE. A SURVEY INDICATED
THERE WAS NO LEAK; NO RELEASE. THE SIERRA TRUCK WAS PLACARDED. (IOWA
REPORT; MORE DATA AVAILABLE).

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

--- Packages Involved ---
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAMERA, SOURCE</td>
<td>SPEC 11-T</td>
<td>B</td>
</tr>
</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: 86010198       Date: 01/10/1986         Time:
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                   Transportation Link Closed?: N
Radioactivity Released: NONE              Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier:      BAKER TUBULAR SERVICES                        OKLAHOMA
Location:      ST HIGHWAY 63 WEST, NEAR BLANCO               OKLAHOMA
Shipper:       BAKER TUBULAR SERVICES                        OKLAHOMA
Consignee:     BAKER TUBULAR SERVICES                        OKLAHOMA

Remarks:
TRUCK OVERTURNED; NO DAMAGE TO RAM (CS-137 GAUGE): A TRAILER WAS
TRAVELING ON A NARROW ROAD. WHEN THE TRUCK MOVED OVER TO LET A CAR
PASS, THE TRUCK WHEELS WENT ON TO THE SOFT SHOULDERS & THEN INTO THE
DITCH; THE CAB FLIPPED OVER. THE TRIPLY ENCAPSULATED SEALED SOURCES
WERE INTACT. LEAK TESTS CONFIRMED THERE WAS NO RELEASE.

--- Materials Involved ---
Category: INDUSTRIAL GAUGE
CESIUM-137

--- Packages Involved ---
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAUGE</td>
<td>UNKNOWN</td>
<td>B</td>
</tr>
</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
**Incident Number:** PNOII8658  
**Date:** 08/15/1986  
**Time:** 0:00

**Mode:** HIGHWAY  
**Vehicle:** TRUCK, TRAILER  
**Accident Code:** T  
**Transportation Link Closed?:** Y  
**Radioactivity Released:** NONE  
**Search Code:** NFC  
**Injuries and Deaths Due to Radioactivity Released:** 0, 0

**Carrier:** TRANSNUCLEAR INC  
**Location:** I-81 NEAR FAIRFIELD, VIRGINIA  
**Shipper:** LEHAvRE, FRANCE  
**Consignee:** EXXON NUCLEAR INC, WASHINGTON

**Remarks:**
COLLISION: TRACTOR-TRAILER WITH UF6 COLLIDED WITH A CAR TOWING ANOTHER CAR. 1 OF 3 OVERPACKS HOLDING THE CYLINDERS BROKE LOOSE, ANOTHER CYLINDER HAD A 14-INCH GASH IN ITS SIDE. MORE INFORMATION IS AVAILABLE.

--- Materials Involved ---
**Category:** UF6  
**URANIUM HEXAFLUORIDE**

--- Packages Involved ---
**Description** | **ID Code** | **Category**
--- | --- | ---
CYLINDER | 30B | B

# Packages: Shipped: 3; Damaged w/ Release: 0; Damaged, No Release: 1
**Incident Number:** PNOTMI8702  **Date:** 03/24/1987  **Time:**

**Mode:** RAIL  **Vehicle:** RAIL CAR

**Accident Code:** T  **Transportation Link Closed?:** Y

**Radioactivity Released:** NONE  **Search Code:** NFC

**Injuries and Deaths Due to Radioactivity Released:** 0, 0

**Carrier:** UNION PACIFIC RAILROAD

**Location:** 5200 MANCHESTER RR, ST LOUIS  **MISSOURI**

**Shipper:** GENERAL PUBLIC UTIL  **PENNSYLVANIA**

**Consignee:** U. S. DEPARTMENT OF ENERGY  **IDAHO**

**Remarks:**

COLLISION: A TRAIN CARRYING 2 SHIPPING CASKS CONTAINING TMI CORE DEBRIS (SPENT FUEL) STRUCK AN AUTOMOBILE AT A RAILROAD CROSSING. THE DRIVER OF THE AUTO SUSTAINED MINOR INJURIES AND WAS TAKEN TO A HOSPITAL. HE WAS ALSO CITED FOR FAILING TO OBEY A TRAFFIC SIGNAL AT THE CROSSING. THE SHIPPING CASKS WERE UN-DAMAGED; THE TRAIN'S ENGINE RECEIVED MINOR DAMAGE. THERE WAS NO RELEASE OF RADIOACTIVITY. THE TRAIN WAS DELAYED 45 MINUTES. MORE INFO AVAILABLE IN HARD COPY REPORTS.

--- Materials Involved ---

**Category:** NFC

CORE DEBRIS

--- Packages Involved ---

<table>
<thead>
<tr>
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<th>Category</th>
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</thead>
<tbody>
<tr>
<td>CASK</td>
<td>NUPAC 125</td>
<td>B</td>
</tr>
</tbody>
</table>

# Packages: Shipped: 2; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOI87100      Date: 10/26/1987         Time: 11:00
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T               Transportation Link Closed?: Y
Radioactivity Released: NONE           Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: UNKNOWN
Location: NJ TURNPIKE, EXIT 8, HIGHTOWN                NEW JERSEY
Shipper: EASTERN TESTING & INSPECTION                  NEW JERSEY
Consignee: NONE; LOST
Remarks:
LOST IN TRANSIT: A TRUCK CARRYING A RADIOGRAPHY EXPOSURE DEVICE
(IRIDIUM-192) OVER TurnED. THE RADIOGRAPHY SOURCE REMAINED INTACT AND
IN THE SHIELDED SHIPPING CONTAINER. THERE WAS NO RELEASE, BUT 2
PEOPLE WERE INJURED AS A RESULT OF THE VEHICULAR NATURE OF THE
ACCIDENT.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

--- Packages Involved ---
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOURCE, SEALED</td>
<td>UNKNOWN</td>
<td>B</td>
</tr>
</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOIV8803      Date: 01/09/1988         Time: 13:30
Mode: RAIL                         Vehicle: RAIL CAR
Accident Code: T                   Transportation Link Closed?: U
Radioactivity Released: NONE        Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0

Carrier: NEBRASKA PUBLIC POWER
Location: COOPER NUCLEAR PLANT, BRWNVILLE
Shipper: NEBRASKA-COOPER NUCLEAR PLANT
Consignee: NONE; ACCIDENT IN TRANSIT

Remarks:
DERAILLED: ONE SET OF RAIL CAR WHEELS DERAILED. A TRACK SWITCH WAS IN THE WRONG POSITION WHEN THE CAR WAS BEING MOVED BETWEEN 2 SETS OF TRACKS. (EMPTY SPENT FUEL).

--- Materials Involved ---
Category: NFC
SPENT FUEL

--- Packages Involved ---
<table>
<thead>
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</thead>
<tbody>
<tr>
<td>CASK</td>
<td>UNKNOWN</td>
<td>B</td>
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</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOI8823       Date: 01/23/1988         Time:
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                Transportation Link Closed?: U
Radioactivity Released: NONE     Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: CONAM INSPECTION SERVICE PENNSYLVANIA
Location: MONTCHENEN RD & RT 100, WILMINGTON DELAWARE
Shipper: NUCLEAR ENERGY SERVICES TEXAS
Consignee: NONE; ACCIDENT IN TRANSIT
Remarks:
TRUCK RAN OFF ROAD: A CONAM INSPECTION TRUCK RAN OFF THE ROAD AT MONTCHENEN RD AND ROUTE 100 NEAR WILMINGTON, DELAWARE. THE NEW CASTLE COUNTY POLICE RESPONDED TO THE ACCIDENT AND REQUESTED ASSISTANCE FROM THE DE DEPT OF TRANSPORTATION. THE DE DEPT OF TRANSPORTATION SENT A PERSON TO SURVEY THE AREA. THERE WAS NO RELEASE AND THE SOURCE (IR-92 RADIOGRAPHY SOURCE) WAS INTACT.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

--- Packages Involved ---
DOT
Description                  ID Code    Category
CAMERA, SOURCE              UNKNOWN  B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOIV8880      Date: 09/23/1988         Time: 
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER 
Accident Code: T                  Transportation Link Closed?: N 
Radioactivity Released: NONE             Search Code: IND 
Injuries and Deaths Due to Radioactivity Released: 0, 0 
Carrier:   CENTRAL TESTING INC                              LOUISIANA 
Location:   LAKE CHARLES                      LOUISIANA 
Shipper:   CENTRAL TESTING, INC.                      LOUISIANA 
Consignee: NONE; ACCIDENT IN TRANSIT 
Remarks: 
COLLISION & FELL OFF TRUCK: A RADIOGRAPHY TRUCK RAN OFF THE ROAD ROUNDED A CURVE NEAR LAKE CHARLES. THE RADIOGRAPHY CAMERA WAS THROWN OFF THE TRUCK BUT IT WAS RECOVERED INTACT. 
--- Materials Involved --- 
Category: INDUSTRIAL 
IRIDIUM-192 
---Packages Involved --- 
Description  ID Code  Category 
SOURCE, SEALED  UNKNOWN  B 
# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOIII8922     Date: 03/27/1989         Time:   6:50
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                 Transportation Link Closed?: U
Radioactivity Released: NONE     Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0

Carrier: THE AMERICAN INSPECTION CO. ILLINOIS
Location: NEWTON SQUARE PENNSYLVANIA
Shipper: THE AMERICAN INSPECTION CO. ILLINOIS
Consignee: NONE; ACCIDENT IN TRANSIT

Remarks:
COLLISION: DELAWARE CO. (PA) EMERG. MGMT RESPONDED TO A TRUCK ACCIDENT INVOLVING A RADIOGRAPHIC CAMERA WITH A 25-CI IRIDIUM-192 SOURCE. SOURCE WAS CONTAINED IN A SPEC 2T CAMERA WHICH WAS THROWN FROM THE TRUCK, BUT WAS INTACT & UNDAMAGED. AN AMERICAN INSPECTION SAFETY OFFICER PERFORMED A RADIATION SURVEY & FOUND DEVICE HAD NOT BEEN IMPAIRED.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

--- Packages Involved ---
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
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</thead>
<tbody>
<tr>
<td>SOURCE, SEALED</td>
<td>SPEC 2T</td>
<td>B</td>
</tr>
</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: TTC0232          Date: 05/19/1989          Time:  23:15
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                Transportation Link Closed?: U
Radioactivity Released: NONE            Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier:  HITTMAN NUCLEAR                MARYLAND
Location:  RT 90, EAST OF BOZEMAN            MONTANA
Shipper:  GPU NUCLEAR CORP              PENNSYLVANIA
Consignee:  U. S. ECOLOGY              WASHINGTON
Remarks:
CAR STRUCK TRACTOR, NO DAMAGE TO RAM: A PASSENGER CAR WAS PASSING THE
HITTMAN TRACTOR TRAILER ON THE RIGHT WHEN THE DRIVER LOSS CONTROL OF
THE CAR AND STRUCK THE TRACTOR FRONT TIRE AND FUEL SADDLE TANK. THE
FUEL TANK LEAKED AND FOLLOWING REPAIRS, THE SHIPMENT CONTINUED TO
HANFORD. THERE WAS NO DAMAGE TO THE TRAILER OR CASK. (REPORT FROM GPU
#50-320-89-022.)

--- Materials Involved ---
Category: LLW
CLASS C WASTE

--- Packages Involved ---
DOT
Description     ID Code     Category
CASK             10-142     B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOIV9115      Date: 06/08/1991         Time:
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                 Transportation Link Closed?: U
Radioactivity Released: NONE      Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: HIGH MOUNTAIN INSPECTION, INC   WYOMING
Location: MINNEWAUKAN            NORTH DAKOTA
Shipper: HIGH MOUNTAIN INSPECTION, INC   WYOMING
Consignee: NONE; ACCIDENT IN TRANSIT
Remarks:
TRUCK OVERTURNED: A TRUCK TRANSPORTING A RADIOGRAPHY CAMERA ROLLED
OVER ON A RAIN-SLICKED HIGHWAY. THE DRIVER RECEIVED MINOR INJURIES.
THE STATE RADIOLOGICAL RESPONSE TEAM RESPONDED AND RECOVERED THE
CAMERA INTACT.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

---Packages Involved ---
DOT
Description                  ID Code   Category
CAMERA, SOURCE              UNKNOWN   B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
**Incident Number:** 91100100       **Date:** 09/15/1991         **Time:**   4:00
**Mode:** HIGHWAY                     **Vehicle:** VEHICLE, SMALL
**Accident Code:** T                   **Transportation Link Closed?:** U
**Radioactivity Released:** NONE          **Search Code:** IND
**Injuries and Deaths Due to Radioactivity Released:** 0, 0

**Carrier:** X-RAY INSPECTION        **LOUISIANA**
**Location:** I-10, HANCOCK            **MISSISSIPPI**
**Shipper:** X-RAY INSPECTION, INC      **LOUISIANA**
**Consignee:** X-RAY INSPECTION, INC     **LOUISIANA**

**Remarks:**
TRUCK CAUGHT ON FIRE: A PICKUP TRUCK CARRYING A 34-CI IRIDIUM 192 CAMERA WAS INVOLVED IN A FIRE. IT IS BELIEVED THAT A FUEL LEAK IN THE ENGINE STARTED THE FIRE. THE MS HIGHWAY PATROL & MS EMERGENCY MGMT RESPONDED. THE SPEC 2T RADIOGRAPHY DEVICE WAS UNDAMAGED. THE DEVICE WAS TAKEN TO SOURCE PRODUCTION & EQUIPMENT FOR TESTING & VERIFIED THAT THERE WAS NO RELEASE OF RADIOACTIVE MATERIAL.

--- Materials Involved ---
**Category:** INDUSTRIAL
**IRIDIUM-192**

--- Packages Involved ---
**Description** | **ID Code** | **Category**
--- | --- | ---
DRUM | USA/9056 | B

--- Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOI9179       Date: 11/03/1991         Time: 4:00
Mode: HIGHWAY                   Vehicle: UNKNOWN
Accident Code: T               Transportation Link Closed?: U
Radioactivity Released: NONE                                          Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: CERTIFIED TESTING LABORATORIES                               NEW JERSEY
Location: HIGHWAY 34, HOWELL TOWNSHIP                                NEW JERSEY
Shipper: CERTIFIED TESTING LABORATORIES                               NEW JERSEY
Consignee: NONE; ACCIDENT IN TRANSIT
Remarks:
COLLISION: An employee of CERTIFIED TESTING was driving a company vehicle with an IR-192 source when he was involved in a one-vehicle accident. The driver was killed & a passenger was injured. The source was being transported in an overpack. There was no damage to the device & its overpack. There was no release. The company's radiation officer retrieved the source.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

--- Packages Involved ---
Description ID Code Category
GAUGE UNKNOWN B
# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: TTC0300        Date: 02/07/1992         Time:  19:00
Mode: HIGHWAY                   Vehicle: VEHICLE, SMALL
Accident Code: T                   Transportation Link Closed?: U
Radioactivity Released: NONE                             Search Code: IND
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier:    TEI ANALYTICAL INC                     PENNSYLVANIA
Location:    RT 51, 6 MILES NORTH OF UNIONTOWN         PENNSYLVANIA
Shipper:     TEI ANALYTICAL INC                     PENNSYLVANIA
Consignee:  NONE; ACCIDENT IN TRANSIT

Remarks:
TRUCK OVERTURNED; NO DAMAGE TO RAM: A TEI ANALYTICAL PICKUP TRUCK WAS
SOUTHBOUND ON ROUTE 51 WHEN IT OVERTURNED. THE TRUCK WAS CARRYING A
RADIOGRAPHY CAMERA WITH A 29 CI IRIDIUM-192 SOURCE. THE DRIVER, A RAD
TECHNICIAN, AND A FRANKLIN CO RAD OFFICER SURVEYED THE AREA AND FOUND
NO CONTAMINATION. THE CAMERA WAS INTACT. THE PA DEPT OF ENVIRONMENTAL
RESOURCES WAS NOTIFIED. THE POLICE RESPONDED. THE TRUCK WAS UPRIGHTED
AND CONTINUED ON.

--- Materials Involved ---
Category: INDUSTRIAL
IRIDIUM-192

--- Packages Involved ---
DOT
Description                                      ID Code    Category
CAMERA, SOURCE                                  UNKNOWN   B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: PNOIV938       Date: 03/04/1993         Time:   6:00
Mode: HIGHWAY                   Vehicle: TRUCK, TRAILER
Accident Code: T                     Transportation Link Closed?: U
Radioactivity Released: NONE               Search Code: LLW
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier:   FT. ST. VRAIN           COLORADO
Location:  I-82, NEAR CABBAGE MOUNTAINS    OREGON
Shipper:   PUBLIC SERVICE CO OF COLORADO  COLORADO
Consignee: U. S. ECOLOGY              WASHINGTON
Remarks:
TRUCK SLID OFF ROAD: A SHIPMENT OF LOW LEVEL WASTE FROM FT ST VRAIN
LEFT THE HIGHWAY AND STRUCK A GUARD RAIL. THERE WAS NO DAMAGE TO THE
TRAILER & CASK BUT THERE WAS SOME DAMAGE TO THE TRACTOR BUT IT WAS
FUNCTIONAL. WHILE WAITING FOR THE ROAD TO BE SANDED, THE SEMI WAS
STRUCK BY ANOTHER SEMI THAT SLID OFF THE ROAD; THIS TIME DAMAGING THE
TRAILER. THERE WAS NO RELEASE AND NO DAMAGE TO THE CASK.

--- Materials Involved ---
Category: LLW
COBALT-57                  COBALT-58
COBALT-60                  TRITIUM

--- Packages Involved ---
Description    ID Code    Category
CASK            USA/6574    B

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
### Incident Information

<table>
<thead>
<tr>
<th>Incident Number: 94110502</th>
<th>Date: 10/10/1994</th>
<th>Time: 15:05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode: HIGHWAY</td>
<td>Vehicle: OTHER</td>
<td></td>
</tr>
<tr>
<td>Accident Code: T</td>
<td>Transportation Link Closed?: Y</td>
<td></td>
</tr>
<tr>
<td>Radioactivity Released: NONE</td>
<td>Search Code: IND</td>
<td></td>
</tr>
<tr>
<td>Injuries and Deaths Due to Radioactivity Released: 0, 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrier: SUN-RAY TESTING INTERNATIONAL</td>
<td>CALIFORNIA</td>
<td></td>
</tr>
<tr>
<td>Location: POMONA</td>
<td>CALIFORNIA</td>
<td></td>
</tr>
<tr>
<td>Shipper: SUN-RAY TESTING INTERNATIONAL</td>
<td>CALIFORNIA</td>
<td></td>
</tr>
<tr>
<td>Consignee: SUN-RAY TESTING INTERNATIONAL</td>
<td>CALIFORNIA</td>
<td></td>
</tr>
</tbody>
</table>

### Remarks

### Materials Involved
--- Category: INDUSTRIAL
IRIDIUM-192

### Packages Involved
<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOURCE, SEALED</td>
<td>MODEL 660</td>
<td>B</td>
</tr>
</tbody>
</table>

# Packages: Shipped: 1; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: TTC-0365       Date: 12/23/1994         Time:
Mode: RAIL                      Vehicle: RAIL CAR
Accident Code: T                      Transportation Link Closed?: Y
Radioactivity Released: NONE                       Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: UNKNOWN
Location: LOUISVILLE                                    KENTUCKY
Shipper: PADUCAH GASEOUS DIFFUSION PLANT KENTUCKY
Consignee: PORTSMOUTH GASEOUS DIFFUSION PLANT OHIO
Remarks:
THE PADUCAH GASEOUS DIFFUSION PLANT NOTIFIED THE NRC THAT A RAIL CAR
CARRYING A 14-TON CYLINDER OF LOW ENRICHED URANIUM HEXAFLUORIDE (UF6)
HAD DERAILED IN LOUISVILLE, KY. THE CAR WAS ONE OF 5 DESTINED FOR
THE PORTSMOUTH GASEOUS DIFFUSION PLANT NEAR PIKETON, OH. THE
CYLINDER OF UF6 WAS NOT DAMAGED AND THE RAIL CAR HAD BEEN PLACED BACK
ONTO THE TRACK AND WAS AWAITING FINAL INSPECTION PRIOR TO COMPLETING
THE TRIP TO THE PORTSMOUTH PLANT.
---Packages Involved ---                                            DOT
Description                              ID Code                Category
CYLINDER                                  *                          B
# Packages: Shipped: 5; Damaged w/ Release: 0; Damaged, No Release: 0
Incident Number: EN-29722       Date: 12/14/1995         Time:  17:45
Mode: RAIL                      Vehicle: RAIL CAR
Accident Code: T                Transportation Link Closed?: N
Radioactivity Released: NONE     Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0

Carrier:   CP&L RAIL
Location:                                                NORTH CAROLINA
Shipper:   HARRIS                                        NORTH CAROLINA
Consignee: NONE; ACCIDENT IN TRANSIT
Remarks:
A RAILWAY CAR, USED BY CP&L TO TRANSPORT SPENT FUEL, WITH EMPTY CASKS
(HAD BEEN USED BEFORE TO TRANSPORT SPENT FUEL) ON IT, HAD 4 OF ITS 8
WHEELS SLOP OFF THE RACK, CAUSING DERAILMENT INSIDE THE EXCLUSION
AREA BOUNDARY.  NO PLANT DAMAGE OR PERSONNEL INJURY OCCURRED.
RADIATION SURVEYS AROUND THE CAR WERE BEING TAKEN.  STATE AND LOCAL
OFFICIALS WERE NOTIFIED OF THE EVENT.

---Packages Involved ---                                            DOT
Description                              ID Code                Category
CASK                                                                 B

# Packages: Shipped: N/A; Damaged w/ Release: N/A; Damaged, No Release: N/A
Incident Number: 96100714       Date: 09/09/1996       Time:
Mode: AIR                       Vehicle: AIRCRAFT
Accident Code: T                Transportation Link Closed?: N
Radioactivity Released: NONE     Search Code: FIRE
Injuries and Deaths Due to Radioactivity Released: 0, 0
Carrier: FEDERAL EXPRESS
Location: NEWBURG               NEW YORK
Shipper: UNKNOWN                 MASSACHUSETTS
Consignee: UNKNOWN              TENNESSEE
Remarks:
WHILE THE AIRCRAFT WAS IN ROUTE TO BOSTON, MA FROM MEMPHIS, TN SMOKE
ALARMS IN POSITIONS 7, 8, 9 WENT OFF. THE AIRCRAFT DIVERTED TO
NEWBURG, NY AIRPORT. UPON LANDING THE CREW AND ONE JUMPSEATER EXITED.
THE PLANE WAS SUBSEQUENTLY ENGULFED IN FLAMES FROM A STILL
UNDETERMINED SOURCE. THERE WAS 8 TYPE A PACKAGES AND 2 TYPE B
PACKAGES ABOARD. NONE OF THE PACKAGES RELEASED THEIR CONTENTS. FOR
FURTHER INFORMATION ON INDIVIDUAL PACKAGES PLEASE SEE 96100714 A-J OR
PNO-I-96063.

---Packages Involved---

<table>
<thead>
<tr>
<th>Description</th>
<th>ID Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOX, FIBERBOARD</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td></td>
<td># Packages: Shipped: 8; Damaged w/ Release: 0; Damaged, No Release: 0</td>
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</tr>
<tr>
<td>CONTAINER, METAL</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td></td>
<td># Packages: Shipped: 2; Damaged w/ Release: 0; Damaged, No Release: 0</td>
<td></td>
</tr>
</tbody>
</table>
Incident Number: PNO-III-97004  Date: 01/24/1997  Time:  7:00
Mode: HIGHWAY                 Vehicle: TRUCK, FLATBED
Accident Code: T               Transportation Link Closed?: Y
Radioactivity Released: NONE   Search Code: NFC
Injuries and Deaths Due to Radioactivity Released: 0, 0

Carrier: UNKNOWN
Location: INTERSTATE 80 NEAR WALCOTT       IOWA
Shipper: PORTSMOUTH GASEOUS DIFFUSION PLANT
Consignee: SIMENS POWER CORPORATION       WASHINGTON
Remarks:
A FLAT BED TRAILER TRANSPORTING FOUR 2.5 TON SOLID URANIUM HEXAFLUORIDE CYLINDERS IN PROTECTIVE OVERPACKS, WAS INVOLVED IN AN ACCIDENT ON INTERSTATE 80 IN SCOTT COUNTY NEAR WALCOTT, IOWA. THE ACCIDENT WAS DUE TO A SNOW AND ICE STORM. THE TRUCK WAS TRANSPORTING CYLINDERS FROM THE PORTSMOUTH GASEOUS DIFFUSION PLANT TO SIEMENS POWER CORP. IN RICHLAND, WA. ALL FOUR CYLINDERS AND THEIR OVERPACKS REMAINED INTACT AND NO INJURIES WERE REPORTED. SURVEYS SHOWED NO CONTAMINATION.

---Packages Involved ---
DOT
Description        ID Code  Category
CYLINDER           B

# Packages: Shipped: 4; Damaged w/ Release: 0; Damaged, No Release: 0
A TRAFFIC ACCIDENT INVOLVING A TRUCK TOWING A TRAILER WITH A PORTABLE
DARKROOM FACILITY WHICH CONTAINED AN Iridium-192 SOURCE OCCURRED AT
THE CORNER OF U. S. 19 AND HIGHWAY 121 IN INGLIS, FLORIDA. THERE WAS
NO DAMAGE TO THE VEHICLES OR TO THE SOURCE, AND THERE WERE NO
PERSONNEL INJURIES. THERE WAS NO RELEASE OF RADIOACTIVE MATERIAL.
THIS ACCIDENT DID INVOLVE A TYPE B PACKAGE.
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