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Development and Application of a Radioactive Material Transport Event Database in Germany: A 10-year review of incidents and accidents

Background

- The transport of RAM in the public domain is subject to stringent regulations and safety requirements agreed upon internationally to control the hazards involved to levels deemed to be acceptable
- However, in spite of all measures taken to ensure compliance with the relevant regulatory provisions and performance requirements, practical experience shows that non-compliances and abnormal occurrences can and do inevitably occur during the handling and carriage of RAM shipments for various reasons and with different outcomes and safety implications



Background (Cont.)

- It is therefore important to learn from any such event so that - as far as possible - appropriate corrective actions can be taken:

- To prevent their recurrence
- To ensure that the likelihood of events and - where relevant - their potentially adverse consequences are further reduced
- To enhance compliance with the relevant transport regulatory and safety requirements



- In order to allow full use to be made of any lessons learned from events involving RAM requires the **development, application and maintenance** of an appropriately designed system of reporting, compilation, analysis, and evaluation of the type, nature, effect, cause, and safety significance of such events

Experience Feedback

- Collection, analysis and evaluation of transport event information can also provide useful information feedback for the regulatory process, e.g. to assess the efficacy of the Regulations and the measures employed to ensure protection and safety, and is believed to be a reasonable and pertinent (proactive) approach in driving good operational performance and minimising non-compliances and human errors
- Other essential purposes of event information and experience feedback include, *inter alia*:
 - To guide and support compliance assurance
 - To guide and support emergency preparedness and response planning
 - To identify needs and trends in national and international transport activities
 - To provide factual information and to help meet public information needs



Radioactive Material Transport Event Review & Analysis System

- The work undertaken has resulted in the establishment of a Radioactive Material Transport Event Review and Analysis System and a computerised Transport Event Database, which is operated/maintained by GRS on behalf of the governmental agencies concerned
- The Transport Event Review and Analysis System covers all modes, i.e. road, rail, air, sea and inland waterways, and all stages of transport, i.e. all operations involved in the preparation, handling, carriage, in-transit storage and delivery of radioactive material packages from the point of origin to the point of delivery or intermodal transfer

Radioactive Material Transport Event Review & Analysis System

- The **Transport Event Database** has been periodically updated and reviewed and contains currently event data for the 10-year reporting period from about 1995 - 2006 (2006 data preliminary)
- Transport events excluded from the database include:
 - Defence-related transport events
 - Transport events within fixed establishments
 - Events involving consumer goods
 - Excess surface contamination events involving spent nuclear fuel shipments

Sources of Event Information

The factual event information available and included in the Transport Event Database has been obtained and derived from a variety of sources including, *inter alia*:

- Information provided by national competent authorities (BfS, EBA, LBA, BMVBW etc.) and regulatory agencies for the transport of dangerous goods including Class 7 material
- Compilations of events associated with the use and handling of RAM, e.g. consignor and consignee facilities
- Event occurrence reports and the public media, e.g. for spectacular events or events with serious consequences

Transport Event Database: Factual information

- **The information reported or available on transport events varies usually significantly**
- **The main event details recorded include - where available:**
 - **date of occurrence**
 - **location of event or event discovery**
 - **mode of transport**
 - **type of material involved**
 - **stage of transport**
 - **event description**
 - **type and severity of adverse impact**
 - **primary cause of event**
 - **emergency response activities**

Event Classification

Categorisation and description of the type and nature of events has been based on the EVTRAM classification scheme which divides events in seven broad categories:

- **Unlawful interference:** theft, malevolent acts (sabotage)
- **Documents, marking, labelling:** improper/absent documents, error in documents, improper/missing labels or markings etc.
- **Preparation for shipment:** undeclared material, wrong package, excessive radiation level etc.
- **Handling during transport:** package dropped, crushed etc.
- **Loss of control of package:** package lost, package misdirected
- **External influences:** conveyance in accident, fire
- **Unspecified:** unknown, others

Event Severity Classification

- Rating of the event safety significance has been based on the EVTRAM severity scale for RAM transport¹⁾
- The IAEA EVTRAM severity scale categorises events in seven categories (level 1 - 7) based on the type & severity of the (i) radiological consequences, (ii) level of degradation of safety provisions and non-compliance:
 - **7:** Major accidents
 - **6:** Severe accidents
 - **5:** Accidents with significant (radiological) consequences
 - **4:** Accident with appreciable (radiological) consequences
 - **3:** Accident with limited consequences
 - **2:** Incident with complications (but no release)
 - **1:** Incident resulting in disruption of normal transport
 - **(0):** Non-incident/false alarms (additional non-EVTRAM category)

¹⁾ Should not be confused with the INES-scale

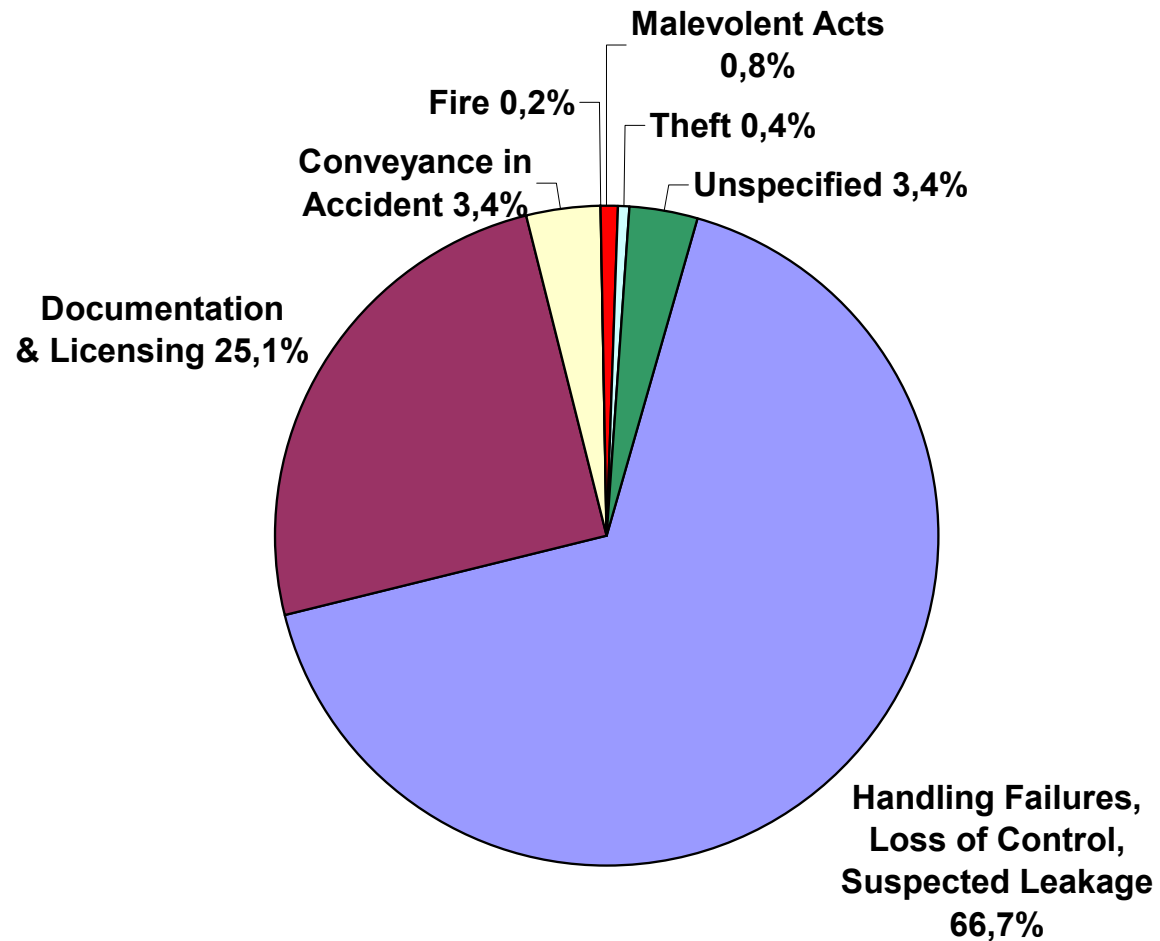
Transport Event Database: 10-year event record

Reporting Period	≤1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006 ^b	Total
Road	--a	--a	--a	5	3	8	3	3	3	0	0	4	29
Rail	9	3	3	6	4	0	0	0	1	*	*	9	35
Air	--a	--a	--a	--a	--a	46	17	50	118	97	27	60	415
Sea	--a	--a	--a	--a	--a	--a)	2	1	1	--a	1	1	6
Unspecified							5	1	1	3	1		10
Total	9	3	3	11	7	54	27	55	123	100	29	74	495

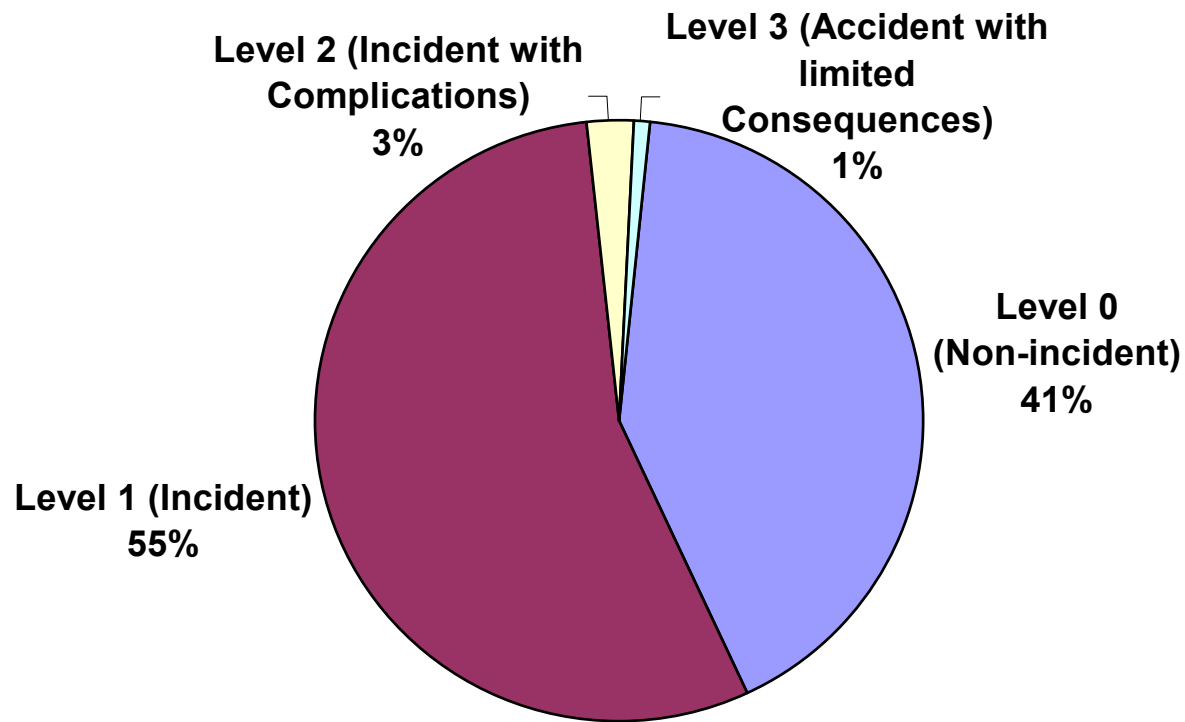
a) No data available

b) 2006 data preliminary

Analysis of Transport Events by Type of Event



Analysis of Transport Events by Safety Significance



Discussion

- Compared to the large number of radioactive material shipments in Germany (700.000 packages/yr), the number of reported abnormal occurrences and non-compliances is rather small
- Handling failures and minor administrative non-compliances represent the vast majority of recorded abnormal occurrences and non-compliances in transport of RAM. These types of events are likely to be attributable primarily to **poor preparation, lack of information, and human carelessness.**

It is believed that there is a potential for improvement of the safety record by reducing these numerous minor administrative events, for example, by providing appropriate information and additional training of the transport personnel involved

Discussion (Cont.)

- In the 10-year review period there have been no reported transport events giving rise to **significant personal exposures or serious human health effects** (e.g. physical injuries, fatalities) **attributable to the radiological material properties**
- There were **two reported events** in the 10-year review period giving rise to **environmental releases** of the package contents
- There is no firm evidence for any **significant deficiencies in the national/international regulatory controls and requirements** governing the safety and security in transport of RAM
- It is of interest to note that the impact of transport events **where there have been no or minor radiological consequences** can nevertheless be **significant in terms of resources required and cost involved to regain control and to return the conditions to normal**

Discussion of the Results (Cont.)



**1996 Road
Transport Acci-
dent involving a
Load of Radio-
pharmaceutical
Packages**

**No radiological
Impact !!!**

Conclusions and Recommendations

- **A systematic review and analysis of event information and the lessons learned from such events can, *inter alia*, provide useful experience feedback to the regulatory process to improve protection and safety in transport and is believed to be a reasonable and pertinent (proactive) approach in driving good operational performance and for minimising non-compliances and human errors**
- **The comprehensive review and analysis of the national 10-year transport event database provides evidence that implementation and application of the national and international controls and requirements is effective in ensuring a high level of protection and safety of people, property and the environment by minimising the potentially adverse radiological consequences**

Conclusions and Recommendations (Cont.)

- The comprehensive review underpins the understanding that transport operators have generally designed their transport programs and operations to comply with the relevant transport safety and security requirements for RAM
- However, there is no room for complacency and further development and monitoring of safety and security trends remains a continuous challenge for the parties with responsibilities for the safe transport of radioactive material