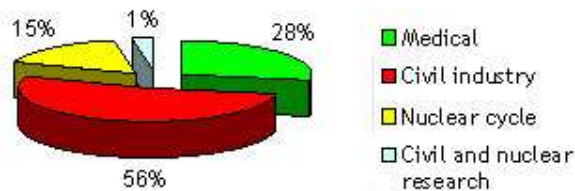


Information report

Incidents in transport of radioactive materials for civil use: IRSN draws lessons from events reported between 1999 and 2007

Some 900,000 packages of radioactive materials for civil use are transported each year in France. The great majority of these shipments involve radioactive materials used in the fields of medicine, pharmaceuticals, industry or property. Transport of radioactive materials linked to the nuclear fuel cycle actually represents only 15% of transport.

Distribution of transport of radioactive materials
by type of use



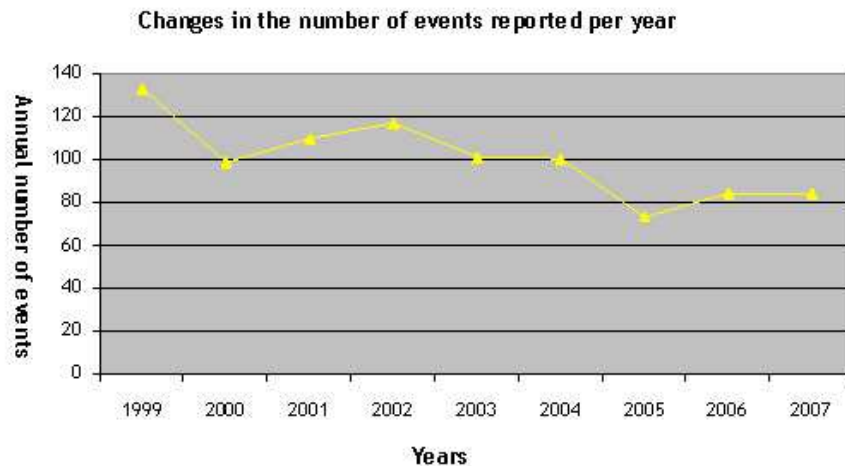
A great variety of material is transported, differing in weight (from a few grammes to tens of tonnes), form, activity and packaging. The associated risks are also different: radioactive contamination, external exposure to ionising radiation, chemical risk etc.

In its role of technical support to safety and radioprotection authorities, **IRSN's mission is to assess** the design, manufacturing, testing and use of packaging and transport systems. **The Institute is also involved in the management and analysis of events** that occur during transport of radioactive materials. To assist with this, the IRSN manages a database which lists reported deviations, anomalies, incidents and accidents (known in a generic way as "events") relating to transport.

With an aim of reduction of the risks related to transport, **the feedback resulting from the thorough analysis of the notified events** is capitalized by IRSN, just as **the feedback of the assessments** of the safety analysis reports of the various package designs. Based on these feedbacks, **IRSN proposes axes of improvement** relating to package designs and transport operations, and **regulatory evolutions**, as well as **priority topics for the inspections** carried out by the French Nuclear safety authority (ASN).

The IRSN has carried out a transversal analysis of all events in transport of radioactive materials that occurred in France from 1999 to 2007 as listed in its database (i.e. 901 events). For each event, some 70 parameters have been recorded from the analysis of the notifications and reports of

the events, transmitted by the operators (type of event, type of package, level on the INES¹ scale...). This analysis illustrates the annual change in the number of events in transport of radioactive materials, with the associated levels of seriousness. It also provides a brief description of some of the events (those with radiological aspect and the main events occurred in 2007 and an analysis of the most frequent types of events over the period 1999-2007, giving the observed trends. Finally, the main elements that could be deduced from this feedback are presented. This report could be useful for ASN in order to improve safety of radioactive material transports.



The principal lessons learned from events in transport of radioactive materials that occurred in France between 1999 and 2007

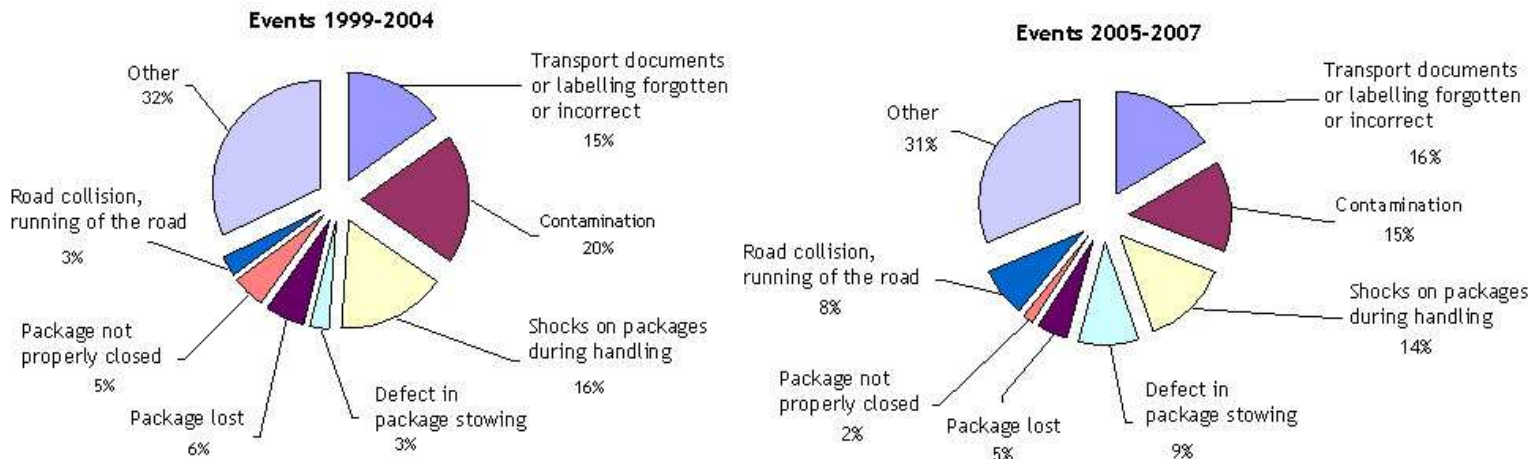
It can be seen that events linked to transport of radioactive materials decreased by 27% during the period 2005-2007 compared to the period 1999-2004 (80 events on average per year against 110 previously), although the number of shipments remained stable overall. With regard to this, the corrective measures implemented, particularly for the most frequent types of event (for example, exceeding of the regulatory limits for surface contamination), have proved effective. Fluctuations observed, particularly the relative increase in the number of events occurring in 2006, then in 2007, in comparison to 2005, reveal the importance of making actions for improvement an ongoing process. Indeed, it is necessary that the corrective actions set up punctually, following incidents, be deployed within the framework of a **global improvement process**.

Similarly, **out of all events in transport of radioactive materials, few are classified as "anomalies" and very few as "incidents"** (10 events graded level 1 in 2007), and the corresponding situations

¹ This scale, intended to facilitate perception by the media and the public of the importance of the nuclear incidents and accidents in terms of safety, comprises 8 levels of gravity, noted 0 (deviation), 1 (anomaly), 2 and 3 (incident) and 4 to 7 (accident). Other "events" of less importance, described as "interesting transport", are out of scale.

were managed without risk to the population or the environment. There is, in particular, good mutual trust and collaboration between those involved in action in the field. This is partly due to in-depth work undertaken via training, exercises and analysis of the experience feedback.

Changes to the distribution of events



More specifically, transversal analysis of events in transport of radioactive materials that occurred in France from 1999 to 2007 has highlighted the following essential axes of improvement:

- Reports of events known as "involving" transport, ranked out of the INES scale, are a rich source of analysis and all the actors involved should be aware of the importance of notifying and analyzing them. These events are indeed "weak signals" and they should be interpreted correctly in order to avoid the occurrence of more serious events.
- Events where there is **contamination of packages and means of transport**, although clearly decreasing, were still frequent in 2007. The efforts observed on irradiated fuel transports must be extended to all transports.
- The number of events related to a **defect in package stowing** remains significant, in spite of the decrease recorded in 2006 and 2007. The same applies to events linked to **shocks on packages during handling**. It is advisable, consequently, to remain attentive with these events. Analysis of these two types of event reveals failures of information or training of the operators. In particular, control of service companies which carry out the operations of loading/unloading and handling of the packages (particularly at airports) is essential.
- A number of events have been induced by human error in conditioning the radioactive contents of the packages, leading to significant consequences on the safety of the package. In particular, the incident with the highest level of gravity on the INES scale since 1999 (an incident which occurred on 27th December 2001 at Roissy airport during transit between Sweden and the United States) is linked to an error in packaging iridium capsules in the package, which led to their displacement in a portion of the cavity without radiation

protection. Moreover, a certain number of events caused by a packaging error may have significant consequences for the safety of the package. For example, the presence of water in a package because of incomplete drying can induce risks of overpressure associated with the saturated vapour pressure as well as risks of ignition related to production of flammable gases by water decomposition under radiation (radiolysis). Particular attention should therefore be paid to procedures for preparation of packages before shipment and associated controls should be thoroughly checked.

- Finally, efforts should continue to prevent **losses of packages** and, if necessary, to find the lost packages quickly in order to avoid significant risks to uninformed persons in the event of unsupervised opening of these packages.

> [Download the complete report \(in French\) in pdf format.](#)

Safety rules for transport of radioactive materials

In order to **maintain a high level of safety and radioprotection** during transport by limiting the probability of occurrence, severity and consequences of incidents and accidents, **strict rules must be observed under the supervision of authorities**. Safe transport of radioactive materials therefore relies on an approach of **in-depth defence**, which is declined according to the three following axes:

- **safety of the package design;**
- **reliability of the package transport operations** (packaging and contents);
- **Effectiveness of the actions taken** in the event of anomalies, incidents and accidents (called in a generic way “events”).

The technical and operational requirements applicable to shipments of radioactive materials are based mainly on the IAEA regulations on transport safety. These regulations were conceived according to a deterministic approach with the aim of guaranteeing a uniform level of safety, whatever the mode and place of transport or the material transported. They postulate hypothetical accident situations and define a set of tests simulating the different transport conditions (called "routine", "normal" and "accidental") that the package must be able to withstand without losing its safety functions. Its purpose is to limit exposure of workers and the public, in line with radioprotection regulations, and it requires the implementation of an optimization process in order to reduce radiological exposures.