

IRSN

INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

LESSONS FROM TRANSPORT EVENTS INVOLVING RADIOACTIVE MATERIALS OCCURRED IN FRANCE BETWEEN 1999 AND 2009

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LESSONS FROM TRANSPORT EVENTS INVOLVING RADIOACTIVE MATERIALS OCCURRED IN FRANCE BETWEEN 1999 AND 2009

- 1. NOTIFICATION REQUIREMENTS
- 2. ANALYSIS OF EVENTS
- 3. DESCRIPTION OF TWO SIGNIFICANT EVENTS
- 4. HUMAN AND ORGANIZATIONAL FACTORS
- 5. CONCLUSIONS

1. NOTIFICATION REQUIREMENTS

■ Regulatory requirement since 1997:

- Notify to the competent authority transport events involving radioactive materials occurred **in France**
- All modes of transport (road, rail, sea and waterways)
- All sectors of use (fuel cycle, medical, research and industry)
- Events occurred during:
 - transport
 - loading/unloading operations of the packaging
 - in-transit storage
 - intra-/intermodal transfer

IRSN database

- Record events since 1999
- For each event, **70 parameters** are recorded from the analysis of the notifications and reports of the events:
 - type of event,
 - type of package,
 - level on the INES scale,
 - ...

- "On-site" transportations are excluded from the present analysis



BESTSI Nb of package: 1 Event number: 11

Date of the event / Year: 13/02/2004
Time of the event: 2004
Date of notification: 13/02/2004
CDRES reference: C33/2004-015/FC

Localisation: Aéroport de Roissy Charles de Gaulle 95
Class: Incident
INES level: Hors échelle
Type of event: Choc sur colis en manutention intermodal
Causes: Cause humaine travailleurs
Release: Non
Subject: Colis endommagé lors de sa manutention dans les entrepôts de l'aéroport

Shipper: SCHERING CIS BIO
Recipient: ELECTRA BOX
Carrier: SAS
Freight forwarder:
Type of transport: Aérien
Exclusive use: Inconnu
Transport index: 2,1
Criticality safety index: Sans objet

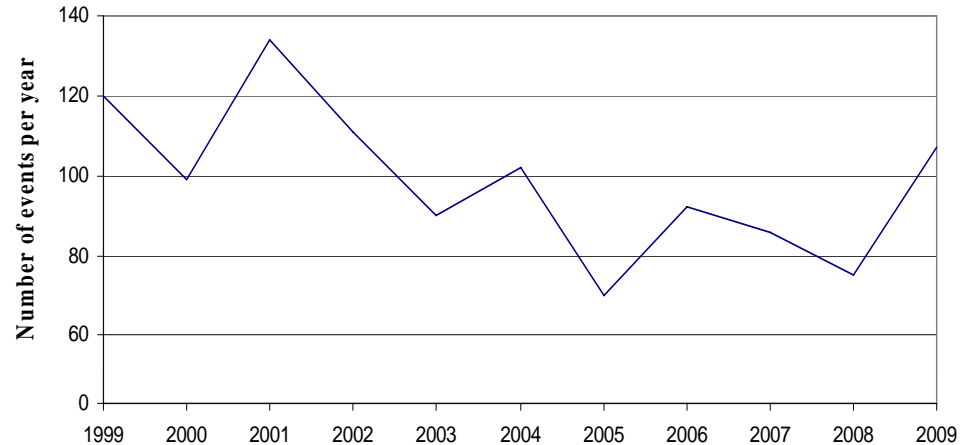
Reactive measures: Non Media communication: Non

PACKAGE N°1 PACKAGE N°2

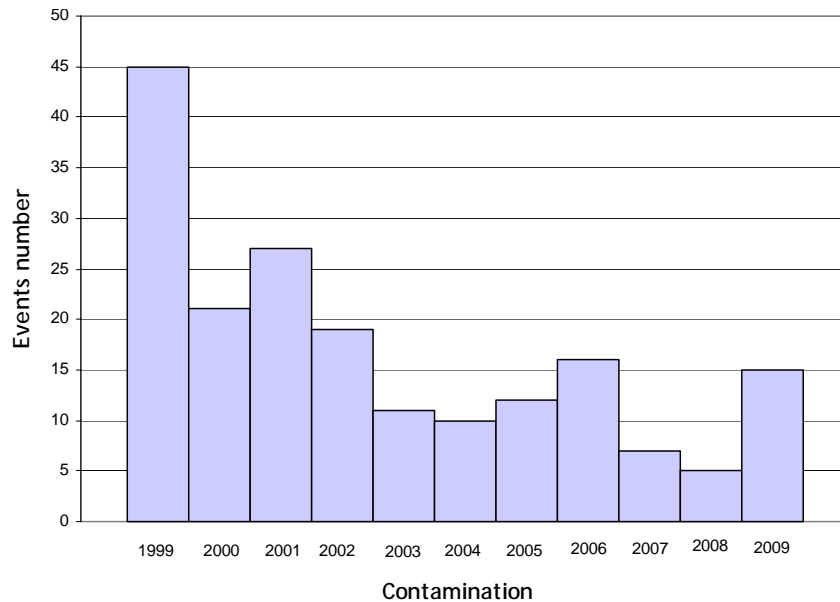
Type of package: A
Nb package of this type: 1
Fissile: Non
Type of damage: Mécanique
Label: III Jaune
Package state: Endommagé légèrement
Type of material: Radioéléments
Name of the material: Mo99TC99m
Material form: Inconnu
Activity: 90,6 GBq
Quantity: Sans objet
Use: Médical
Loss of confinement: Non
Loss of criticality control: Sans objet
Loss of thermal dissipation capacities: Sans objet
Radiological consequences: Non

2. ANALYSIS OF EVENTS

- From 1999 to 2009: 1,086 events
- Between **75 and 134 events/year**
- Number of events is closely linked to the **consignors strictness** in applying the notification instructions



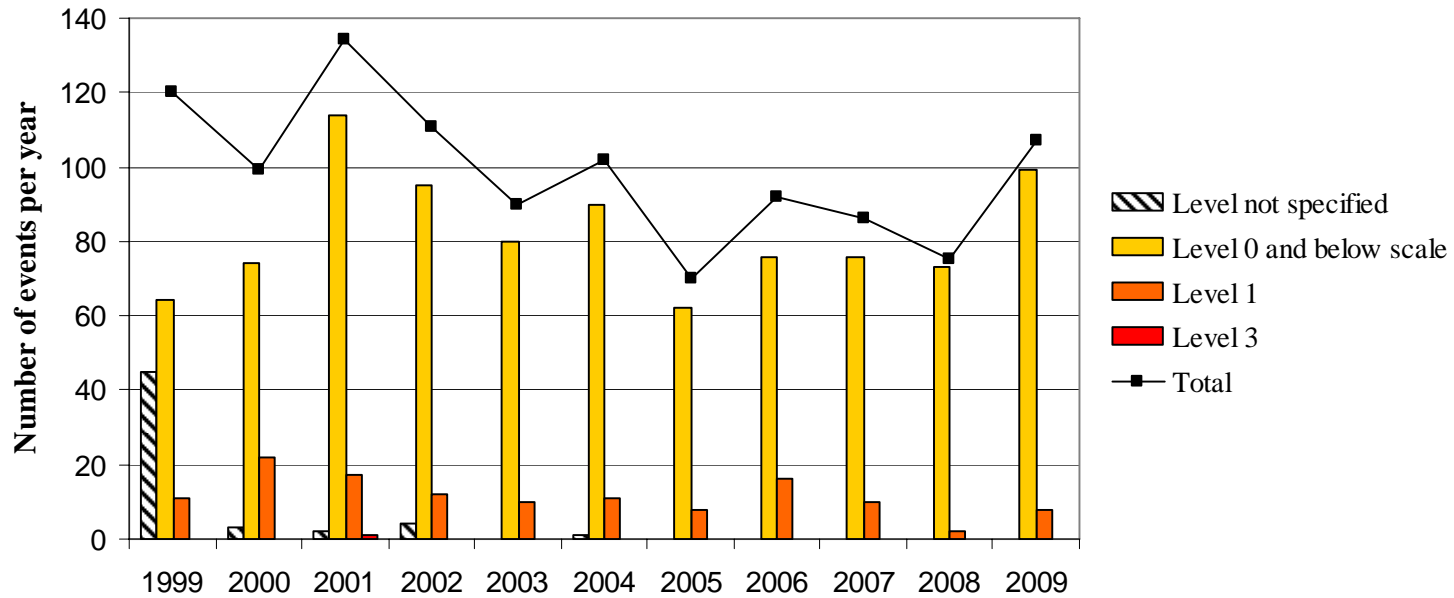
- Events related to contamination:



→ practices improved thanks to actions carried out:

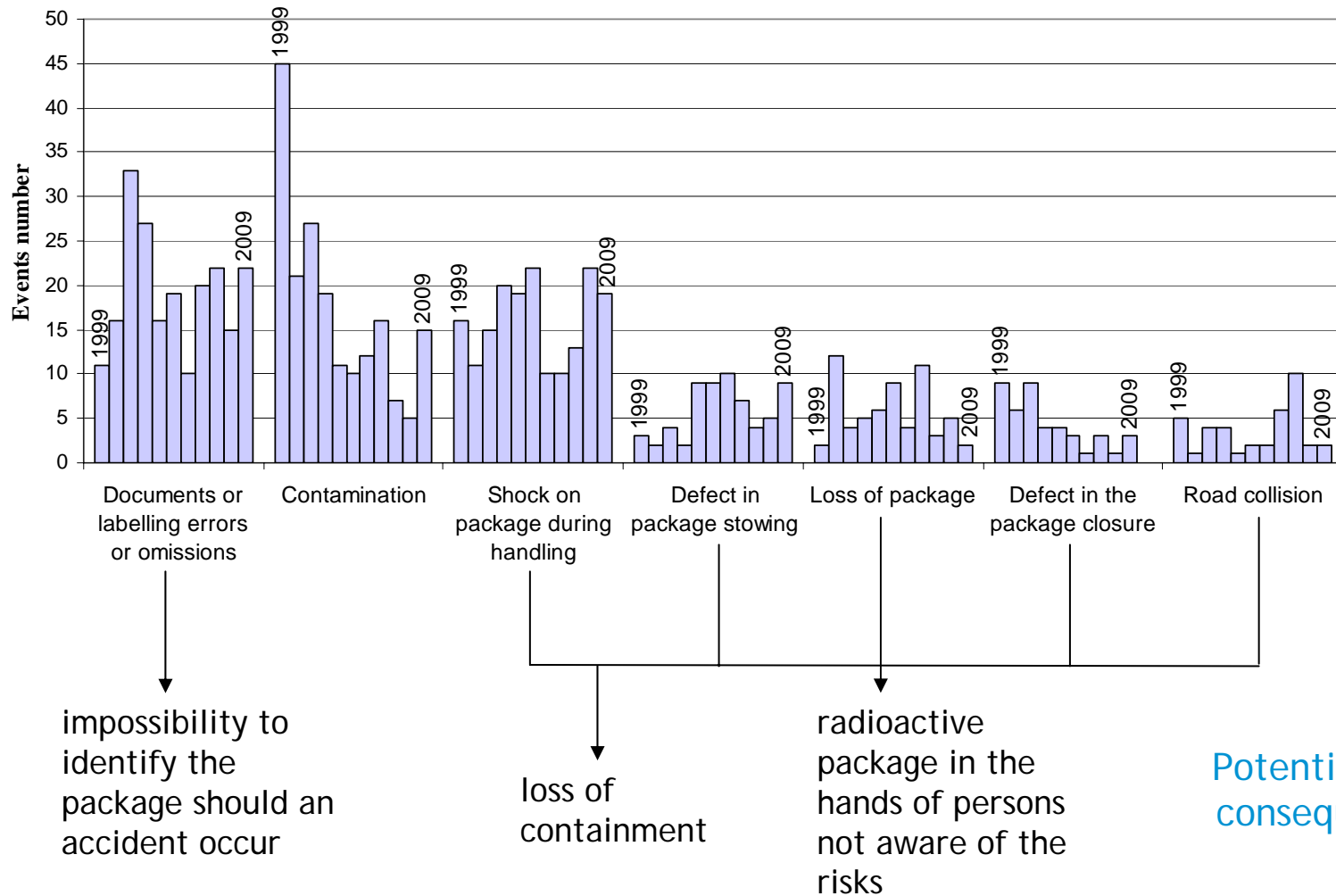
- definition of **priority topics of inspection** linked to the most frequent events
- **requests to consignors**

Rating of the events on INES scale



- One event rated at level 3
- 127 events rated at level 1, with an average of 11/year
- More than 80% rated level 0 and below scale
- Importance of “weak signals”

Most frequent types of events



3. DESCRIPTION OF TWO SIGNIFICANT EVENTS

- *Events involving a non complying type B package in transit in PARIS-CDG airport*
- *Road traffic accident with collision and fire on a type B package*

Context

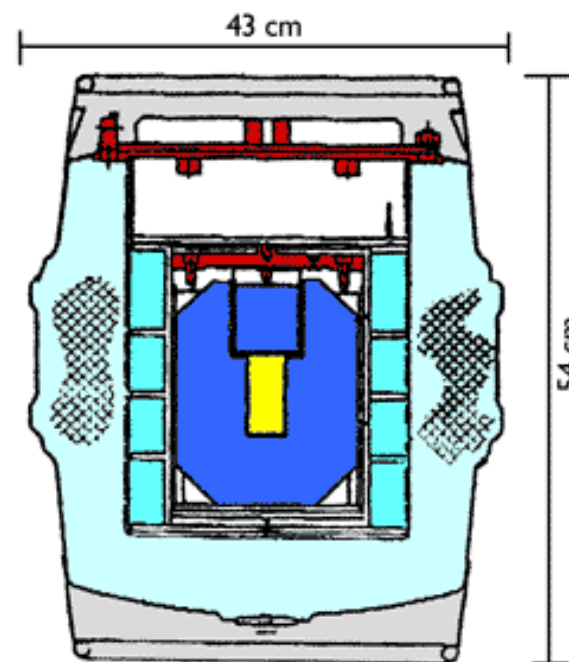
Type B package

UK and USA approvals

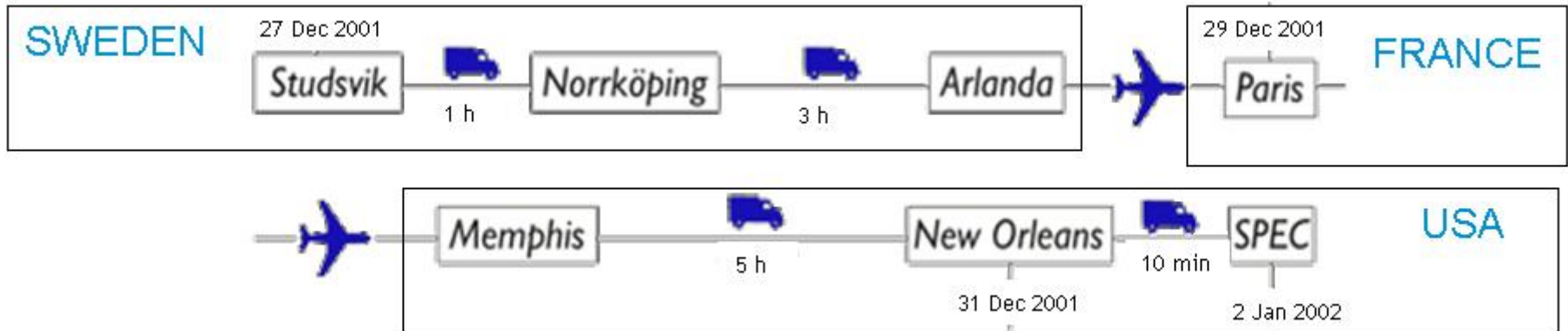
Carrying 366 TBq of iridium-192

In 1,078 solid discs (confetti-shaped)

To be used in industrial radiography



Dec. 2001, non complying type B package in PARIS-CDG airport 2/5



Detection

Abnormal dose rate detected by the driver dosimeter of the route between the New Orleans airport and the consignee's site

Dose rate was checked at consignee's site:

Measured at 25 m	Estimated at 1 m	Regulatory limit at 1 m
4 mSv/h	430 mSv/h	0.1 mSv/h

Exposures

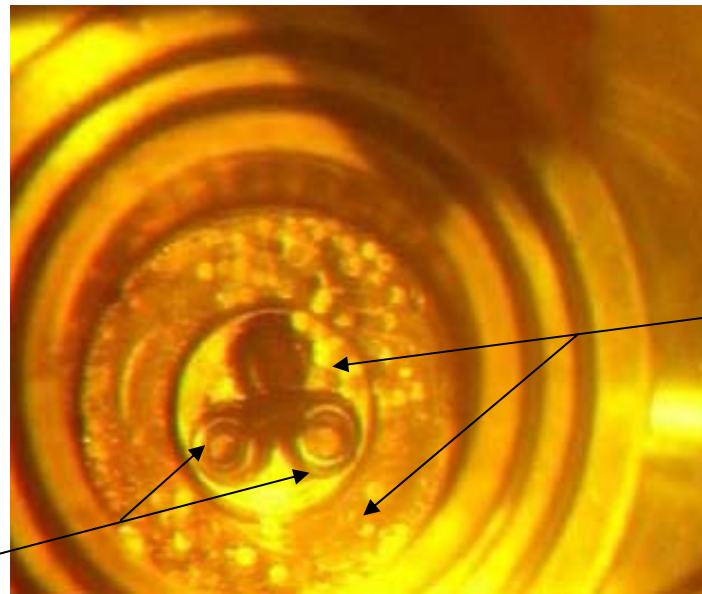
- Dose to driver during road transport between the New Orleans and the consignee site evaluated between 1.6 and 3.4 mSv
- Analyses of blood samples taken on the employees in charge of the package handling at Paris-CDG airport: **much higher values but not exceeding 100 mSv**

Cause

Defect in primary containment of the Ir192 confetti-shaped discs

Two of the three metal cans were found opened on arrival → dispersion of the discs outside of the radiation protection

Package once opened:



Dispersal of discs at the bottom of the cavity and in shielding plug lodgement

Opened metal cans

Lessons

- Confirmation of need for precise definition and operating controls for primary containments

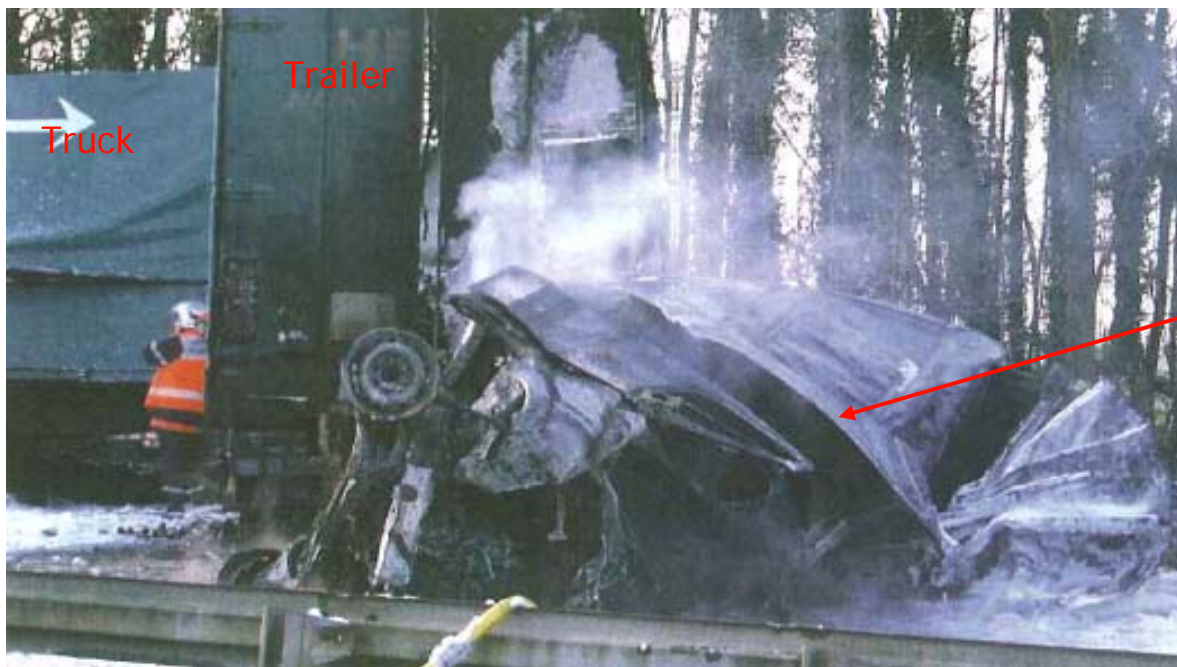
- Urgent implementation of appropriate radiation protection programs for transport, with definition of the surveillance measures to be implemented (earlier detection would have led to reduced exposure)

- Need for human factor risk analyses

Apr. 2007 traffic accident involving a type B package 1/6

In Champaign area, at road works: a van carrying a type B package entered in collision (violent shock) with a trailer carrying dairy products, before taking fire (between 15 and 50 minutes)

The drivers of the van and of the truck died

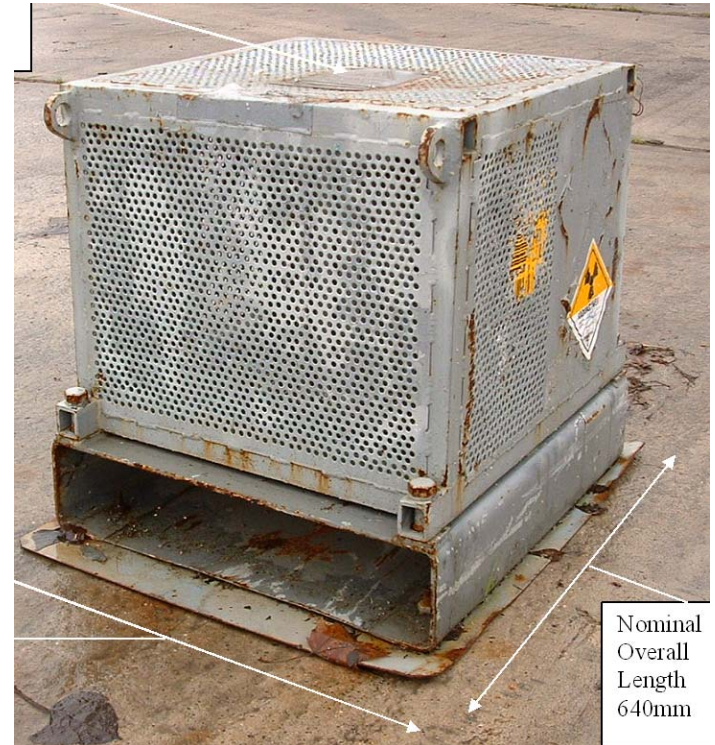


Van carrying
the radioactive
package



Context

- Type B(U) package design approved by the Russian CA
- Special form source of 73 TBq of **Cs-137**, approved by the UK CA
- Manufacture and controls of the source certified by Russian company
- German consignor, German carrier
- French consignee



Typical view of package with external protective hull before accident

Emergency response difficulties

➤ **Difficult package identification**

- Driver did not survive the accident
- Transport documents destroyed by fire
- Package markings with characters from the Cyrillic alphabet
→ difficulties to identify the design identification mark
- Inconsistency between transport documents and package marking



Emergency response difficulties

- **Package design and special form approval certificates not notified** to French CA thus not immediately available to emergency response organization
- **Special form approval certificate not sufficiently precise** to quickly confirm good behavior of source in estimated shock and fire circumstances

Following features missing:

- dimensions
- number of envelopes
- material grade
- classification of the guaranteed performances for the source

➔ **Long delay before the diagnosis of the package state and in the response actions**

IRSN team sent to the accident scene in order to put in safety the package and determine particular measures required for its evacuation
→ late arrival (12 h after accident)

Examination results

- absence of surface contamination
- no change in dose rates on package surface
- all nuts and bolts were loosened



Package with external protective hull after fire



Package without protective hull

Lessons

→ importance of the information contained in the transport documents and the certificate of approval

- Increase **strictness of notifications**

- Include in approval certificate a short **list of components important to safety**
 - Containment components
 - Shielding components
 - Confinement system
 - Heat dissipation system

→ proposed to IAEA

- Develop an **international database**, accessible to emergency response teams, where features relevant for emergency management are described

4. HUMAN AND ORGANIZATIONAL FACTORS

- Involved in a large number of events (60% of the failures for events non related to the fuel cycle sector)

Examples: - defect in conditioning the radioactive contents
- presence of unauthorized hydrogenated materials in a package
→ could lead to **significant consequences**

- The human and organizational factors are not yet analysed **in a systematic way**
- Promote the use of “casualty tree” when analysing events
- But also when elaborating the transport operating procedures: FMECA (*Failure Modes, Effects and Criticality Analysis*)
- Apply for **preventive measures** as needed

5. CONCLUSIONS

- Few anomalies (127 events rated at level 1 over the 11 years considered)
- Only one incident (level 3)
- Radiological consequences of these events remained low

The corresponding situations were managed without risk for the population or the environment

But some events are potentially serious → necessity to maintain vigilance and to pay attention to “weak signals”

→ Importance of the EVENT REVIEW SYSTEM allowing a transverse analysis of the events and drawing lessons

The complete analysis of the events, especially when human and organizational factors are involved, should still be improved

Thank you for your attention

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