Guide for risk assessment studies required for transport infrastructures

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I. AZF explosion and national regulatory infrastructure

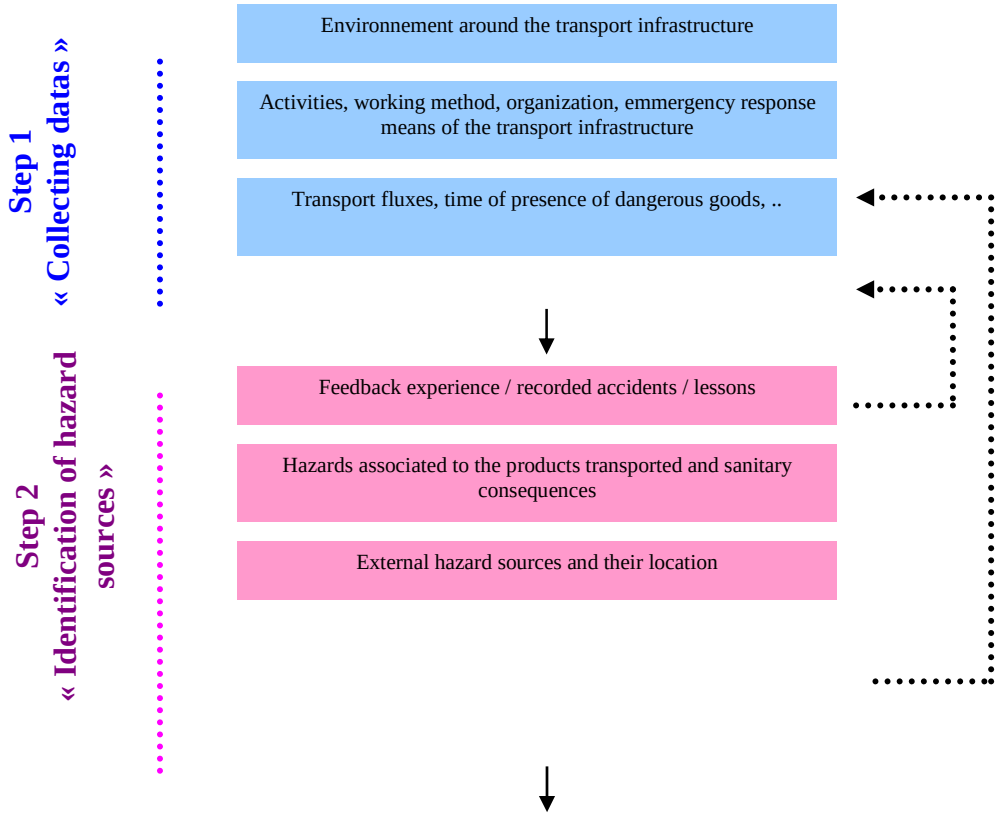
- 2001 : major AZF explosion, in the French city of Toulouse
- The 2003 “AZF-law” requires that the operator of the facilities where dangerous goods in large quantities are handled or processed, including the most important transport infrastructures, provides to public authorities an Impact Assessment which must be updated every five years
- 2007, 2009, 2010 : decrees and acts to precise the content of the impact assessment
- October 2010 : ASN guide (realized with the help of IRSN) will make easier and harmonized the expected studies for transport of radioactive material (class 7)

- Transport infrastructures concerned :
  - Marshalling yards
  - Main truck parking areas on motorways
  - Harbour
  - Multimodal areas

- Transport infrastructure operator develops a risk assessment of accident scenarios with estimation of probabilities, seriousness, kinetics and health consequences. Accident severity may exceed the regulatory accident conditions of transport. “Domino” effects are to be considered. The result will be appreciated in terms of seriousness and probabilities using a criticality matrix with acceptance criteria. Means to reduce the risk are then operational measures or procedures able to reduce either probabilities or consequences.

II. Content expected for the Impact Assessment

SCHEME GIVING THE MAJOR STEPS TO REALIZE AN IMPACT ASSESSMENT



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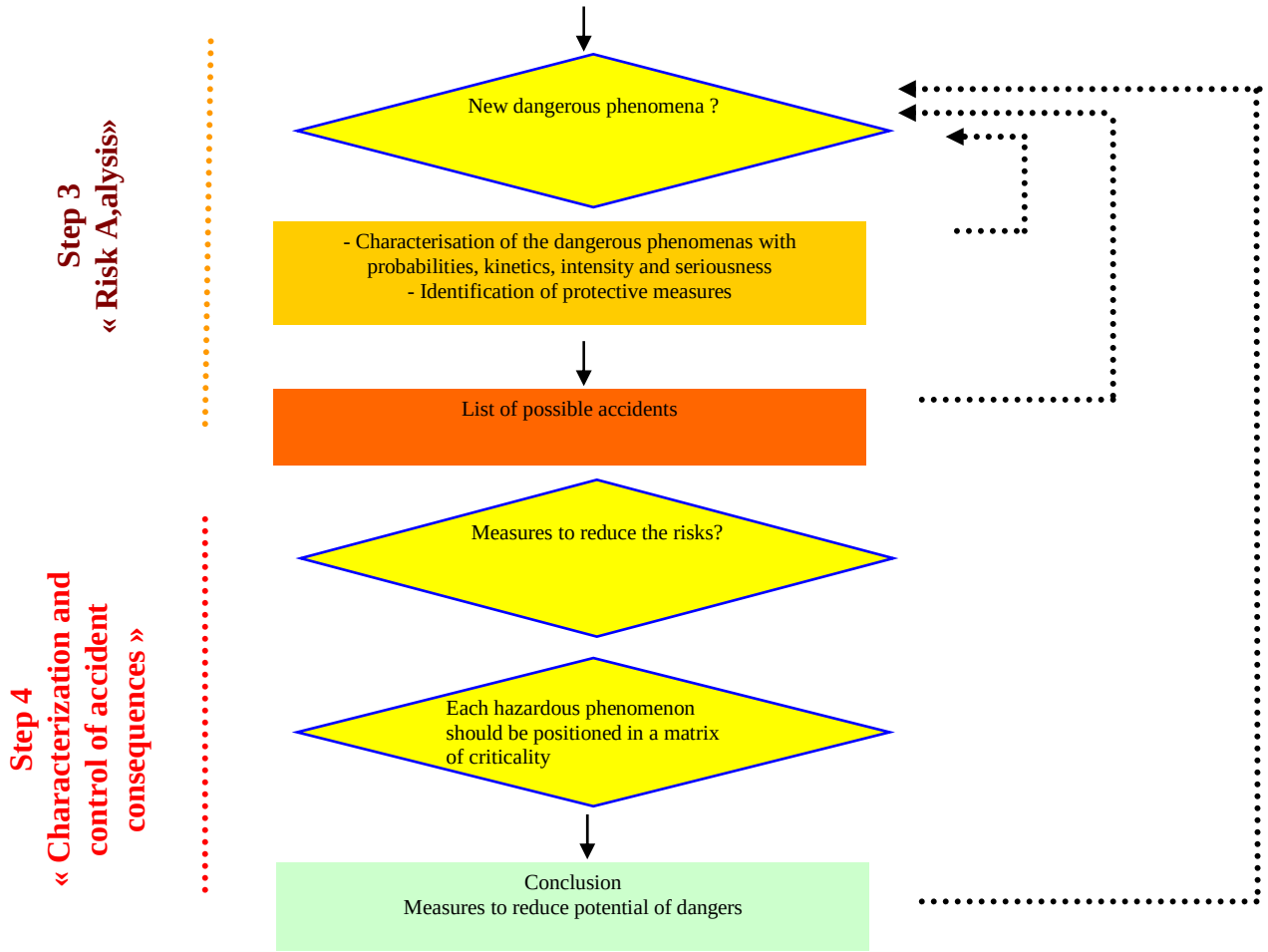


Probability scale proposed for transport infrastructures and consequence scale

Category of probability		E	D	C	B	A
Nature of estimation and order of magnitude	Qualitative	Extremely unlikely	Very unlikely	Unlikely	Probable	Ordinary
	Quantitative	Below 10^{-5}	Between 10^{-5} and 10^{-4}	Between 10^{-4} and 10^{-3}	Between 10^{-2} and 10^{-3}	Above 10^{-2}

Consequences seriousness level	Number of persons present in the zone where the threshold of 50 mSv is exceeded
Disastrous	> 1 000
Catastrophic	between 100 and 1 000
Important	between 10 and 100
Severe	< 10
Moderate	<1

Three acceptability domains are defined:

a red area: probability and number of exposed persons corresponding to accidents in these areas have to be reduced out of the red zone,

an orange area: where accidents have a probability and a number of exposed persons that correspond to these areas, an intermediate priority applies to risk reduction measures ; these measures should however be proposed in the impact assessment,

a green area: it corresponds to accidents with lower priority risk characteristics

Gravity : People exposed above 50 mSv	**Probability (per year and per infrastructure)**				
	E	D	C	B	A
Above 100 000					
10 000 – 100 000					
1 000 – 10 000					
100 – 1 000					
10 - 100					
1 - 10					
None					

III. Application to class 7 model

ASN guide aim to providing elements of methodology and data needed for characterizing the dangers related to the radioactive substances. Given the variety of packages of radioactive materials, it has been chosen to retain, by type of radioactive material (and therefore by risk type), only one package.

⇨ This package is called “package model”

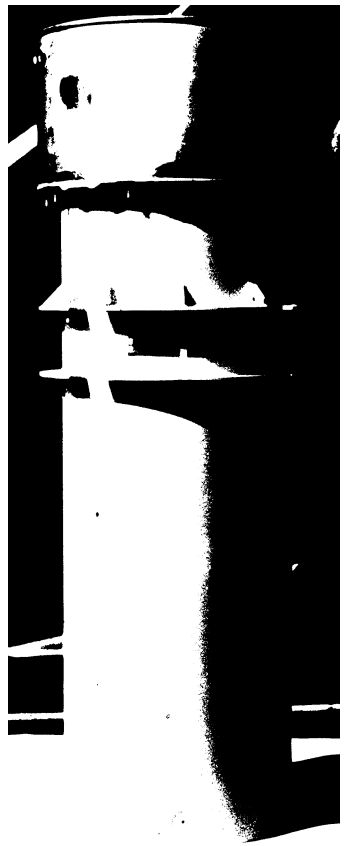
- Nine package-models have been retained:
  - type B packages containing high activities:
    - ✓ a package of spent nuclear fuel,
    - ✓ a package of plutonium oxide,
    - ✓ a portable gamma gauge used for radiography,
    - ✓ a package for high activity sources
  - an industrial package containing fresh nuclear fuel,
  - industrial packages containing uranium hexafluoride or uranyl nitride due to the chemical toxicity of these compounds and their products of reaction;
  - a type A package, containing moderate activity, but carried in large number.

- Events :
  - the impact of a projectile resulting from a handling failure,
  - the impact of a projectile resulting from an explosion in a vehicle or an equipment in the vicinity,
  - the impact of a conveyance on the package,
  - the impact of a package on an item of infrastructure, the impact velocity depending on speed of vehicles authorized on the infrastructure, as well as on handling heights when applicable,
  - fire affecting a package with a variable severity (temperature and duration).

Example : Type B package for PuO2 powder

Infrastructure :	Road and Harbour
Probability of presence :	1 % Road 0,2 % Harbour
Events :	Impact of a projectile resulting from an explosion in a vehicle or an equipment in the vicinity Opening of the package
Quantity of plutonium per package :	< 20 kg

DISTANCE TO PACKAGE (m)	150	400	1 000	3 000	10 000
EFFECTIVE DOSE (mSv)	221	53	11	1,3	0,1



IV. Exemple of application

A motorway parking area showed that type B packages carrying plutonium oxide are the only kind of package for radioactive material encountered.

This area can also receive packages, tanks or containers of all other dangerous goods

Frequency of loss of containment of a tank for flammable liquid : 1.48 x10-6 per tank stop

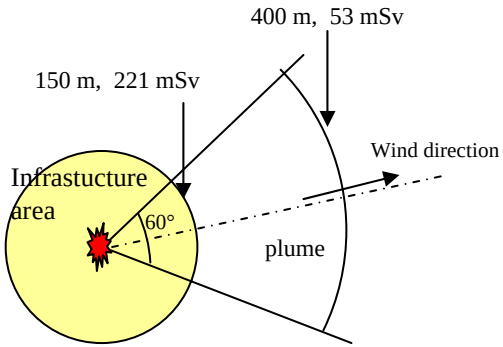
This road parking area is experiencing an annual traffic of 100 tank stops

The fraction of explosions among containment losses is taken 1

The rate of presence on the parking area of packages carrying plutonium oxide is assumed 1%.

Finally, the probability of occurrence of the hazardous phenomenon is 1.48 x10-6 (100 x 1.48 x10-6 x 0.01 x 1)

1 g of plutonium is dispersed



Gravity : People exposed above 50 mSv	Probability (per year and infrastructure)				
	E	D	C	B	A
Above 100 000					
10 000 – 100 000					
1 000 – 10 000	x				
100 – 1 000	x				
10 - 100	x				
1 - 10	x				
None	x				