

ANALYSIS METHOD OF THE INDUSTRIAL RISK: INTERNAL EVENTS AND EXTREME NATURAL EVENTS

IAIA 2016 - Nagoya



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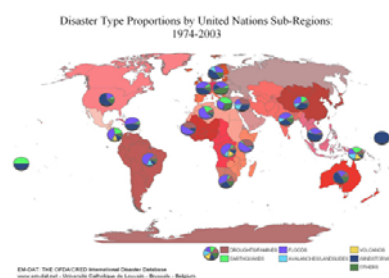
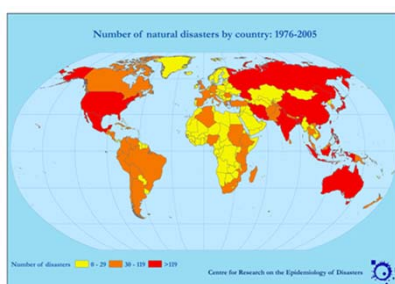


1 OBJECTIVES



In the industrial power world (classic industries and nuclear power plants):
Does a differentiated approach bring a difference between internal and natural risk control ?

1 ANALYSIS OF EXTREME NATURAL EVENTS



Number and type of natural disasters in the World
(Source : CRED)

1 ANALYSIS OF EXTREME NATURAL EVENTS

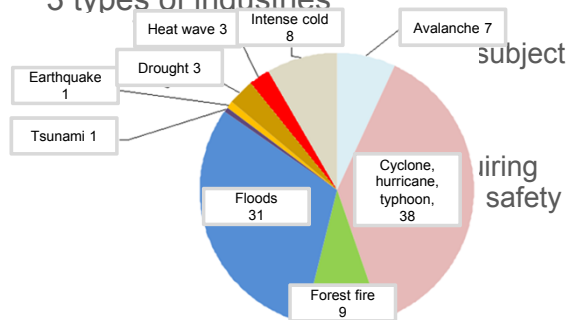


6 extreme natural events

- | Earthquake
- | Lightning
- | Hurricane
- | Flood
- | Snow
- | Extreme temperatures

French and World context

3 types of industries



Catastrophic events in France since 1900 (in %) (Source : MEDDE)



1 ANALYSIS OF EXTREME NATURAL EVENTS



Between 1992 and 2012, 920 natural events are responsible for industrial accidents in France:

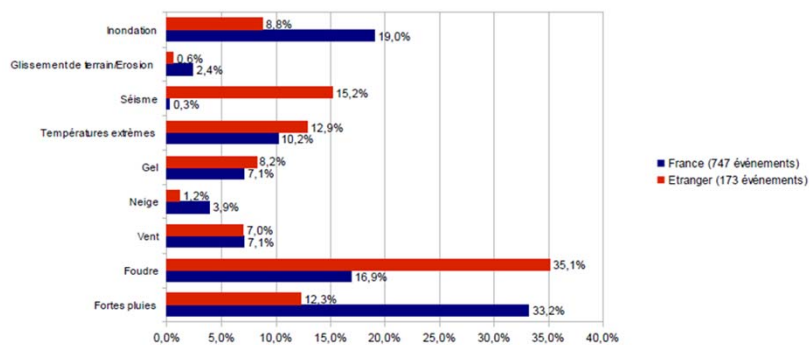
- | Storms and floods (> 50 % of the total industrial accidents)
- | Lightning (15-20 %)
- | Extreme temperatures (cold or heat) (10-15 %)
- | Wind (5-10%)
- | Frost (5-10%)



- ▶ Direct consequences : damage to property
- ▶ Indirect consequences : pollution, operating loss
- ▶ No direct human victims since 1900 in France

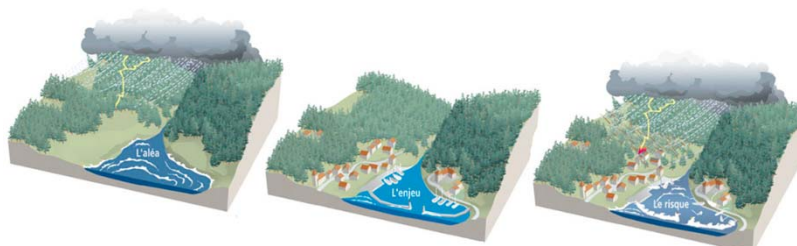


2 ANALYSIS OF EXTREME NATURAL EVENTS



Source?

2 RISK ANALYSIS PROCESS

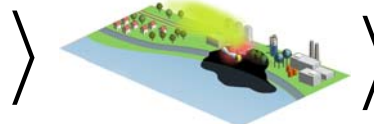


$$\text{Hazards} * \text{Vulnerability (stake)} = \text{Risk}$$

2 RISK ANALYSIS PROCESS



Hazard



Potential
adverse event



Consequences

Risk process: global approach (Source : Egis)

2 RISK ANALYSIS PROCESS

2 kinds of approaches



Deterministic:

- Definition of the hazard through a norm,
- Definition of a fixed threshold of the adverse event probability and checking its consequences.

Probabilistic:

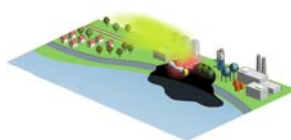
- Statistical analysis of the hazard in order to conduct a risk analysis
- Checking of the risk acceptability by potential adverse event probability

2 RISK ANALYSIS PROCESS

Risk process: Deterministic Approach applied to nuclear plants
(Source : Egis)



Lightning impact 200 kA
 (level I NF EN 62305-2)



Lightning conductor
 installation (Protection
 level I)



Maximum probability of
 human loss caused by
 lightning: 10^{-5} per year

2 RISK ANALYSIS PROCESS

Risk process: Deterministic Approach applied to nuclear plants
(Source : Egis)



Statistical definition of the
 hazard with 11 floods
 scenarios in order to cover
 a probability of 10^{-4} per year



Materials and
 equipment for safety out
 of floods hazard level
 &
 Alarm system in order
 to put out of water
 nuclear reactor core



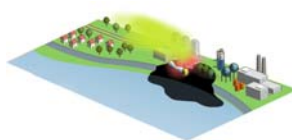
Tacit consequences

2 RISK ANALYSIS PROCESS

Risk process: Probabilistic Approach applied to nuclear plants (Source : Egis)



Seismic waves hazards



Curve of fragility of structures and equipments

Objective: maximal annual probability for fusion of a nuclear reactor's core of 10^{-5}



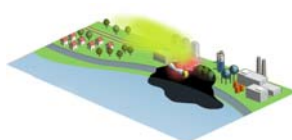
Possible modeling of the releases in the environment (with several levels)

3 INTERNAL EVENTS VS EXTREME NATURAL EVENTS APPROACHES

Process of internal events Risk Analysis (Source : Egis)



Initiating components



Potential adverse event



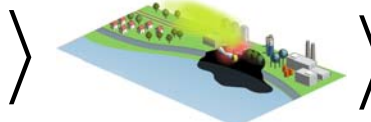
Consequences

3 INTERNAL EVENTS VS EXTREME NATURAL EVENTS APPROACHES

Internal events Risk analysis : Deterministic Approach (Source : Egis)



Zoning Definition wrt explosion risk



Reduction Measures wrt explosion risk :

- Making the process neutral
- Adapted equipments
- Signs, Alarm ...



Reduction Measures of the consequences:

- Compartment planning
- Windbreaks, Fireproof walls...

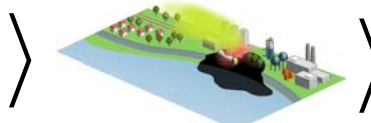


3 INTERNAL EVENTS VS EXTREME NATURAL EVENTS APPROACHES

Internal events Risk Analysis : Probabilistic Approach (Source : Egis)



Evaluation of the frequency of the initiating events (corrosion, aggression)



Calculation of the probability of the dreaded event (leak)...



Evaluation of the consequences (exposed people)
Objective: acceptable scenario on the "industrial risk management" table



3 INTERNAL EVENTS VS EXTREME NATURAL EVENTS APPROACHES

Regulations of the industrial installations

- | Probabilistic approach of accidents scenarios,
- | Exclusion from certain external events (of which natural events).

Regulations of the nuclear plants

- | Careful deterministic approach,
- | Completed by probabilistic approach (applied for the internal events and at R&D level for the natural events)



CONCLUSION AND PERSPECTIVES

- | The deterministic approach and the probabilistic approach are **complementary**
- | **Ensure a good communication between the actors** of the analysis process (statisticians, risk engineers, civil engineers)
- | **Carry on the development of the probability approaches** associated with the extreme natural events

ACKNOWLEDGEMENTS



ANALYSIS METHOD OF THE INDUSTRIAL RISK

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THANK YOU FOR YOUR ATTENTION

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