Forecasting, estimating, evaluating and communicating the environmental and public health effects of a major nuclear accident: How can Fukushima contribute to the development of international best practice?

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Summary

- Brief introduction to IRSN
- The challenges resulting from a nuclear accident
- French nuclear emergency preparedness concepts and organisation
- Four lessons from the Fukushima experience (outside reactor safety issues)
- Conclusion
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French institutional nuclear safety system

Designers and contractors

Nuclear Operator

Public authorities

Parliament

Public

authorities

ASN, ASND

IRSN, Public expertise

Research into risks

Stakeholders (CLIs)

THE PUBLIC

National Committee for Transparency and Information on Nuclear Safety - HCTISN

IRSN: the French nuclear safety expert body

1700 staff, 300M€/year

- Research in the fields of safety and radiation protection
- Technical expertise in support to Safety and Security Authorities, and other administrations concerned by ionizing radiation nuclear material and proliferation issues
- Radiological surveillance of exposed people and of the environment
- Support to public authorities in nuclear emergencies
- Public information, education and training
- Services to foreign or national clients
Key scientific challenges for the coming years

**Barrier effectiveness and defense in depth**
- Design safety of processes, components and safety equipment
- Neutronics/criticality
- Ageing
- Radiation protection design
- Discharge and waste management
- Integration of concepts

**Barrier integrity during accident situation**
- Natural phenomena (earthquake, flooding...)
- Predictable technological events (internal: fuel, external: grid...)
- Fire
- Human and organizational factor
- Malicious acts
- Theft of nuclear materials/radioactive sources

**Emergency situations**
- Current and future state of safety barriers, components and safety equipment
- Mitigation systems
- Anticipation of radioactive releases /environmental dispersion

**Technical diagnostics**
- Radioecology
- Radiobiology/low doses effects
- Epidemiology

**Understanding chronic exposure situations**
- Communication/information/transparency
- Pluralism/risk control
- Risk perception
- Economics of nuclear risks
- Local economy sensitivity

**Human/ecosystem exposure**
- Metrology/Dosimetry
- Workers
- Patients
- Public
- Environment
- Polluted sites

**Societal approach to risk**
- Medical diagnostics/therapies

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The challenges resulting from a nuclear accident

- Capability to anticipate correctly the evolution of the situation in order to take the right decisions at the right time, at the nuclear facility, and beyond
  - In the initial period of the accident inception
  - During the radiological emergency in the context of environmental releases
  - After the land contamination

- Capability to remain in control of the situation in different time scales
  - During the initial emergency phase
  - During the urgency phase when radioactive releases are threatening / occurring
  - During the post-accident phase, when the society and economy have to cope with the consequences of radioactive contamination, and the consequences of the fear of contamination and of the relocation of part of the population (indirect consequences)

- Capability to generate long term trust within society on the validity of emergency management and protection measures

- Capability to co-operate actively with the international community whilst coping with a complex situation in the country
  - Nuclear safety issues
  - Radiological issues
  - Trade issues
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French nuclear emergency preparedness concepts

■ **Anticipation**
  - Preparedness through planning of resources at national and local levels
    - Availability of fast response expertise tools (reactor safety systems evaluation, source term prediction, environmental releases real time prediction, agricultural consequences evaluation, ...)
    - Rapid availability of trained expert personnel, at operator and public services level
  - Frequent exercises in realistic simulated situations, with scenarios unknown to the actors

■ **Operational interconnection at all levels and real time feed back**
  - Safety / radiation protection
  - Nuclear Operator / IRSN technical emergency centre (CTC)
  - National / Local
  - Modelling predictions / in the field measurement results (environment, food and water, people)

■ **Transparency**
  - Expertise / decision / action results
  - Public communication
  - Public access to information
IRSN risk assessment methodology

Current status analysis (plant; env; population)
Operational recommendations
Protection recommendations
Publicly available info

Comparisons with operator
› Sharing output of 3D3P method
› Harmonisation of Cons. (if possible)
› Harmonisation of overall message

Diagnosis of the situation
› Gathering info on the accident
› Assessment of the plant status
› Consequence evaluation (env. & pop.)

Prognosis of the situation
› Considering envisaged/planned actions
› Assessment of Radiological consequences
› Further failure prognosis (if necessary)
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Four lessons that could be drawn from the Fukushima experience

- The high costs of a nuclear accident in a developed, densely populated country with a fragile environment
  - A need for more research on economic costs, beyond direct radiological costs
  - A need to evaluate insurance, compensation, and other mechanisms (OECD/NEA)

- The complexity of international dialogue in a mediatised and interconnected world
  - A need for technical intercomparisons, based on real situations in Japan
  - Cautioning about harmonisation of limit values: a potential trap...

- Managing radiological risk: empowering people to become actors of their own protection, and stakeholders in the decision processes is a source of radiological efficiency and of overall optimisation in risk management

- Government’s role in crisis management
  - The complexity of governmental posture and communication in such circumstances
  - The complications which may result from government statements as time goes by...
  - The need for exercising also ministerial levels in nuclear crisis management...
  - This also applies to some extent to local executives (mayors,...) who have a responsibility in risk management
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- Nuclear accident situations are extremely complex and the understanding of their consequences needs further research beyond the safety or radiation protection specialized fields.

- Sharing internationally broad lessons from such rare events as the Fukushima accident is probably more important than trying to harmonize technical protocols, protection limits etc, which need to be suited to the actual situation caused by an accident, different from case to case ...

- Taking stakeholders on board decision making processes, and providing meaningful information to the public are attitudes that will probably result in a more economically and societally efficient crisis management, once the initial emergency phase is over.
Thank you for your attention
Made to modelise the atmospheric transfer behavior of radionuclides at larger scale (> 10 km to global scale)

- Eulerian dispersion model (lat-long) with full radioactive filliation
- Realistic 4D meteorology (Météo France and/or ECMWF)
- Turbulence schemes of Louis (stable) or Troen & Mahrt (unstable)
- Use of forecast or observed rain for wet deposition

Numerous qualification cases

Comparing evaluation tools: exemple of large scale atmospheric dispersion

Real case of Fukushima conditions

Ensemble framework

ETEX-I comparisons

Ibaraki

Tokyo

Managing radiological risk: a complex chain

Problem: there are different perceptions by Specialists, Decision makers and People.

Risk assessment
Rules/Experience/Science/Cultural references

Doses
Exposure scenarios/measurements
msv

Risk management: decisions, actions and communication to reduce contamination (Bq), reduce doses (msv) and optimize risk impact (not only radiological).

Modelling/measures
Bq

Radiation risk to the public and how this is perceived by the public

Low dose risk perception in France

Mean exposure of the public in France

TOTAL DOSE = 3.7 mSv/year

% answers:
Very high or high risk
60%

Low dose risk perception in France

Radon
Natural radiation
Medical Exposure
Nuclear power plants
Chernobyl
Wastes

20%
30%
40%
50%
60%
Access to expertise, development of ETSON

Expertise capability at the highest level requires permanent, carefully coordinated management and appropriate resources.