Nuclear Regulation: The impact of operating experience

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Improving Risk Regulation
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Background

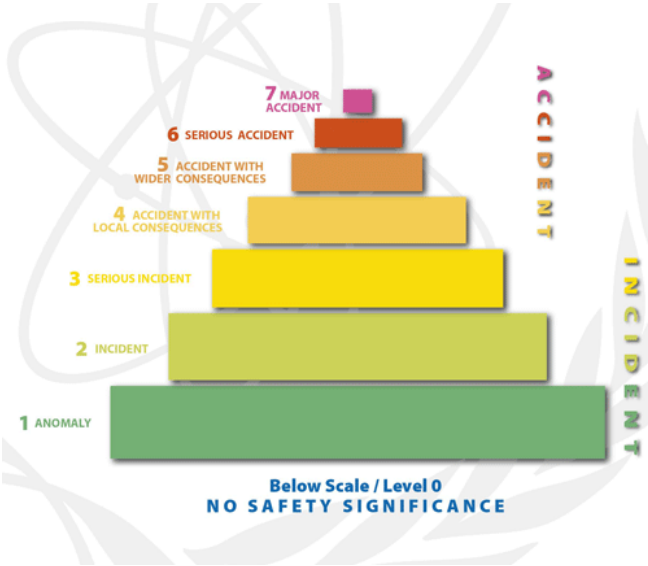
- ✓ Safety first
- ✓ Prime responsibility for safety rests with the industry
- ✓ Accident consequences (From public health to social disruption)
- ✓ Deterministic vs. Probabilistic (Risk-informed)
- ✓ Technological evolution (Knowledge and practices)
- ✓ Crisis and Operating Experience feedback
- ✓ Defence-in-Depth concept

Operating Experience

- Regulatory side
  - Incident Reporting System (IRS). NEA 1978. IAEA/NEA

  2400 events. Precursors. Topical studies. Corrective actions
  - International Nuclear Event Scale INES)

  Communication tool. Safety significance. 48h
- Industry side
  - WANO 1987. Cooperation vs competition
- Common goals
  - Reducing frequency and severity
  - Improvements in systems, procedures and training



Crisis studies – TMI (1979)

- Main challenges/problems
  - System problems. Operator mistakes. Organizational problems
- Main improvements
  - Operator training
  - Operating procedures
  - Feedback of operating experience
  - Control room design
  - Emergency response
  - Regulatory changes (Severe accident)

Crisis studies – Chernobyl 1986

- Main challenges/problems
  - Operator mistakes. System problems. Organizational problems. International impact. Health effects.
- Main improvements
  - Emergency response
  - System improvements
  - Radiation protection and Public health
  - Organizational aspects
  - Research

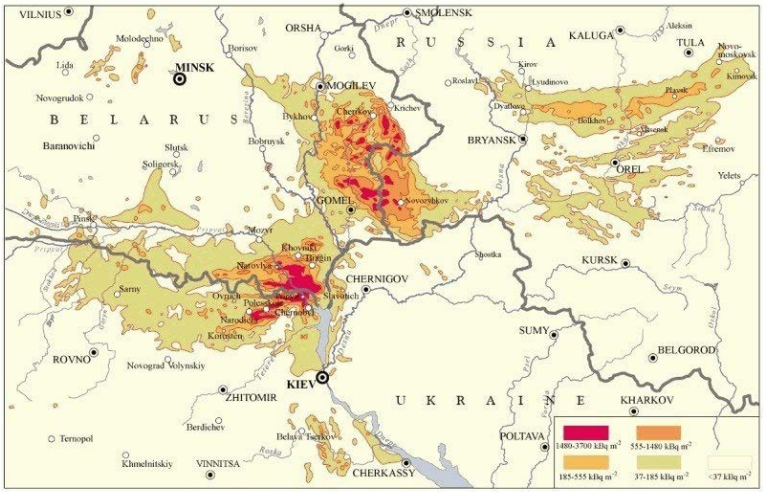
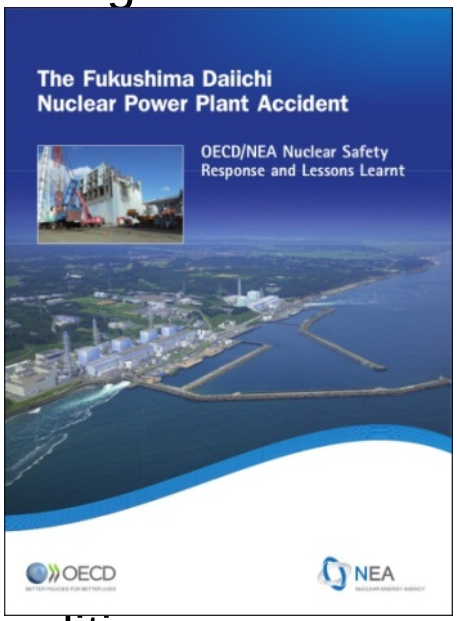


Figure VI. Surface ground deposition of caesium-137 released in the Chernobyl accident [I1, I3].

Crisis studies – Fukushima Daiichi 2011

- Main challenges/problems
  - External event. Multi unit scenario. Design problems. Organizational problems. Single country impact.
- Main improvements
  - External events. Risk assessment
  - Design changes
  - Emergency response. Evacuation.
  - Design extension conditions. Long term.
  - Human and organizational factors under extreme conditions
  - From public health to social disruption



Conclusions

- 1975 WASH 1400 Measuring probability for Reactor Safety
- What can go wrong ➔ How likely is it
- Risk informed regulation, but …
- Low frequency, high consequences
- Common cause failures
- Human and organizational factors
- Need to combine deterministic criteria with risk regulation to ensure that adequate nuclear safety is achieved
- Broad social impact considerations. Accident costs.
- Continuous learning and sharing information