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Institut für angewandte Ökologie
Institute for Applied Ecology

Decommissioning: Technical Aspects and Management of Risks

More than just a project

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Exploratory Seminar: Decommissioning, a new challenge for nuclear safety
Brussels, 6 February 2017



Agenda

1 Technical basis

2 Decommissioning activities

3 Decommissioning strategies

4 Risk management

5 Conclusions

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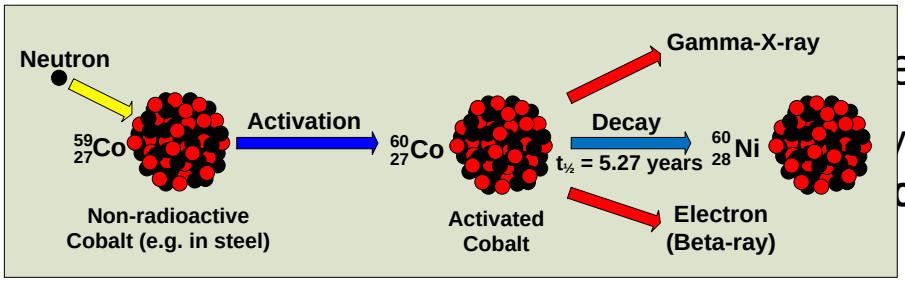
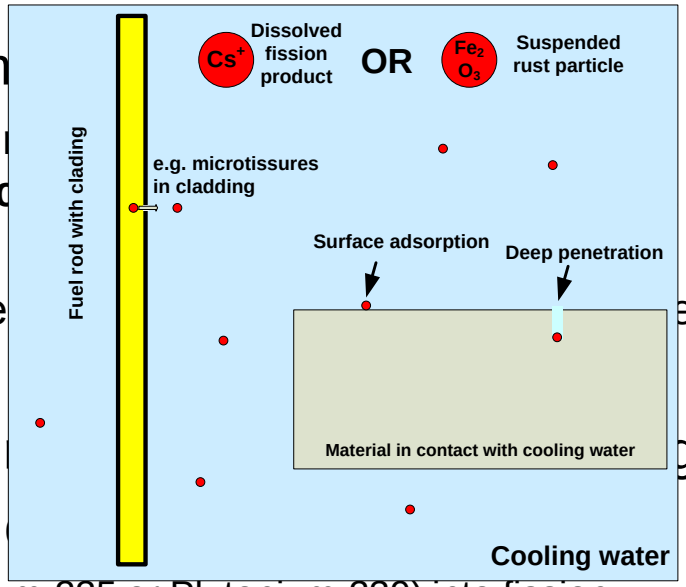
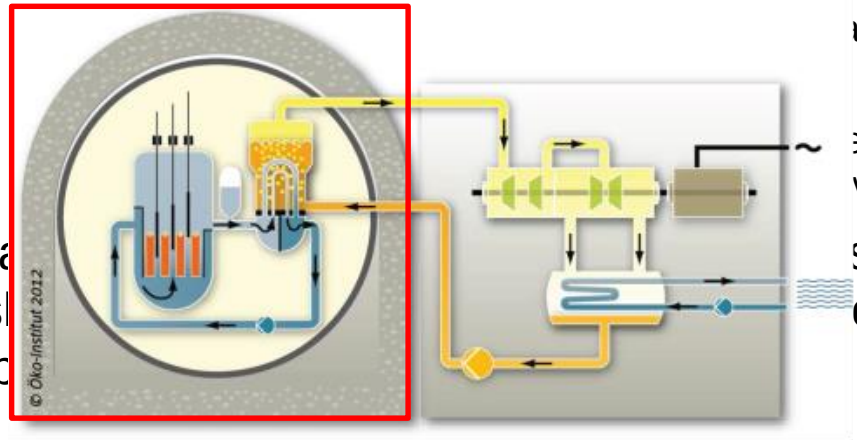
Technical basis of nuclear decommissioning: radioactive release under control





- ecom
  - Achieve a state without limitations – "below any re ete removal of construction.
- Mechanisms of radioactive contamination g
  - R Pressurised water reactor: controlled area actor
    - nium-235 or Plutonium-239) into fission to keep the fission process steady ⇒
    - ed in surrounding non-radioactive materials and ve in their whole.
  - R s and abrased activated particles (s es dissolve in cooling liquid and ab

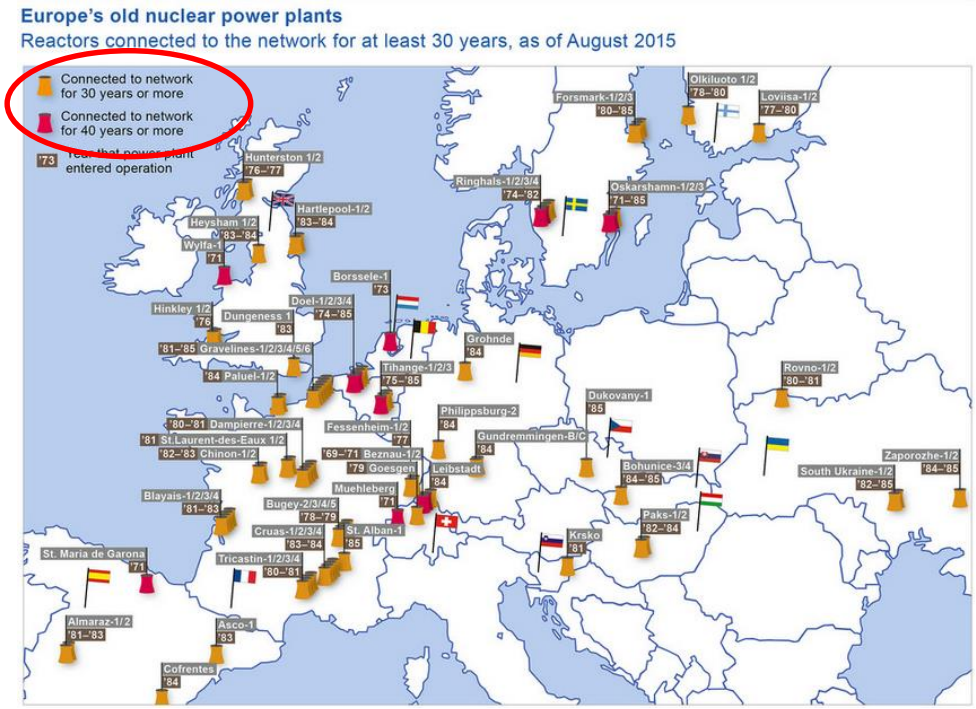


Source Figures: Oeko-Institut e.V.

Operation time and decommissioning complexity

Longer reactor operation time accumulates more contaminated radioactive material

- More fuel
- Higher neutron activation of reactor internals and the bio shield
- Deeper contamination of surfaces and structures
- Higher risk of internal release events - cause additional contamination of locations and materials to be cleaned-up



Source Figure: Oeko-Institut e.V.

Decommissioning activities

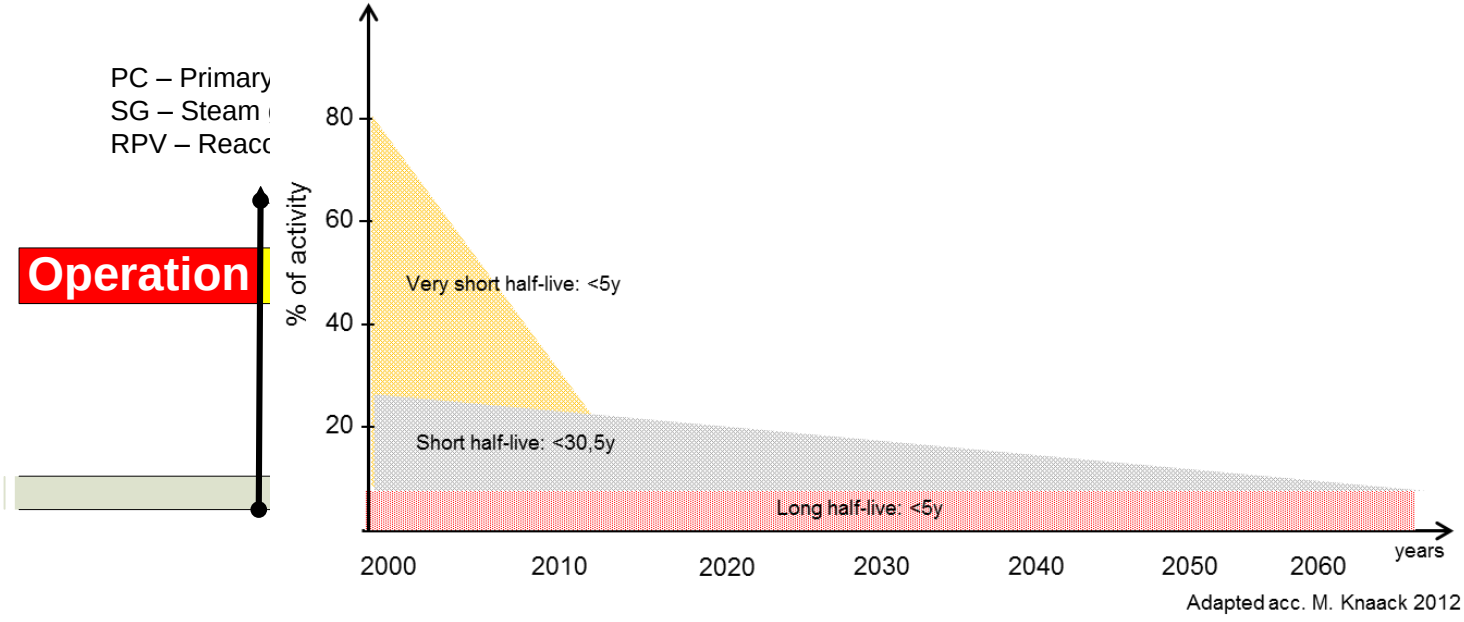
Challenge to remove activated and contaminated material and safely dispose; involves sophisticated technologies:

- Removing radioactive equipment and contamination from surface of selected materials
- Sorting all materials according to their (measured) degree of activation/contamination
- Cutting, solidifying or compacting those materials and package the materials
- Proper radioactive waste treatment and management:
  - The relevant space for the flow of waste (esp. radioactive) must be preplanned
  - Disposal under defined conditions involving interim storage and final disposal strategy

Source Figures: Oeko-Institut e.V.; OECD/NEA Decommissioning of Nuclear Facilities

Decision on decommissioning strategy: pros and contras

- Decision on decommissioning strategy - immediate or deferred dismantling (allowing activity decline), entombment - and the relevant time line must consider all radiological risks and determines the decommissioning plan development.
- Use of work force knowledge diminish with postponing.
- Entombment as a last resort only in special cases (no recommended by IAEA)
- Further generation burden to be avoided.



Adapted acc. M. Knaack 2012

Source Figure: Oeko-Institut e.V.

The terms ‘risk’ and ‘project management’ within decommissioning

- Decommissioning phase differs from the operational phase: it requires different organization structure, workforce, work planning.
- *Risk* in broad sense: identifying all aspects with potential to negatively influence the decommissioning performance (critical flow path).
- Project and risk management comparable with construction, but construction knowledge and works differs significantly: no construction to be newly developed but to be “discovered” how the construction developed in the past.
- Respective risk management system (RMS): series of arrangements for early detections, analyzing, evaluating and limiting risks of different kinds + solution analysis.
- Integral part of RM is risk communication culture.

Organizational aspect	Construction	Deconstruction/Dismantling	Operation
Project management	**Crucial:** to plan far ahead, to understand complex interactions, to understand consequences, to create optimized flows, to manage experiences, to fit plans to changes		**Scarcely necessary:** major refitting of the facility or outage planning and control
Risk management	**Crucial:** to understand all technical, organisational and financial risks in respect to their consequences for the critical flow path, risk communication culture necessary		**Small relevance:** Limited scope and uncertainties, most risks known

Source Table: Oeko-Institut e.V/ Nuclear decommissioning: Management of costs and risks

Risk management as integral part of decommissioning plan

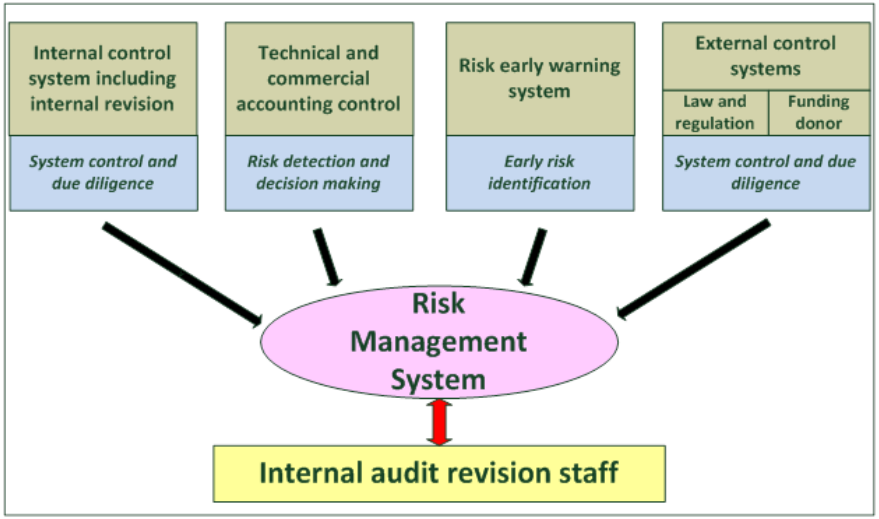
- Risk management governs the whole planning process of the decommissioning project and should be incorporated within the overall management structure.
- RMS considers technical, organizational and financial risks with respect to their consequences for the critical flow path.

Risk is interpreted in a broad sense

Special consideration to management of technical risks

Early risk identification to be assured

Internal and external control system involved



Missing or insufficient RM and/or RM wrongly implemented in to the management structure

dangerously affects the successful decommissioning implementation

Source Figure: Oeko-Institut e.V/Oeko-Institut e.V/ Nuclear decommissioning: Management of costs and risks

Conclusions

- Decision on decommissioning strategy should consider all risk over long term.
- Sophisticated technologies developed but every reactor is a “special case”.
- Radiological risks associated with pre-planned longer time delays are considerable; the expectation to achieve cost reductions is highly doubtful: no workforce/ no knowledge, extended works (e.g. problematic decontamination)
- Considerable delays beyond responsibility towards future generations, entombment not recommended also by IAEA and should be a last resort.

The term risk in nuclear decommissioning:

No risk = ~~no~~ fun!

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Thank you for your attention!

Do you have any questions?