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CENTRE D'ÉTUDES SUR L'ÉVALUATION DE LA PROTECTION DANS LE DOMAINE NUCLÉAIRE

Radiation Protection Challenges associated with the dismantling of Nuclear Power Plant

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Context (1/2)

- For various reasons - economical, political, ageing, etc. -, the number of NPP that are concerned by dismantling activities is going to increase in the coming years in numerous countries: Germany, Switzerland, France, USA, etc.

- Numerous topics to be taken into account at the different stages of dismantling activities and specially at the planning stage:
  - Waste management (a driving factor),
  - Radiation protection,
  - Industrial safety,
  - Final Status Survey,
  - Activated large component cutting (internals and vessel),
  - Costs.

- Importance of planning and flexibility so as to decrease the length of the work and then to save money (> 40% of project costs are staff costs) and some occupational exposure.

Context (2/2)

- In the same time, numerous projects have already been achieved up to green or brown field (mainly in the USA and Germany). A number of projects are also currently undergoing (USA, Germany, Spain, France, etc.). Information is thus available for new and current ‘players’ (improvement of current practices).
  - GDZ Suez achieved numerous benchmarking visits in the USA and Germany for the planning of Doel units 1 and 2 dismantling.
  - EDF achieved visits in the USA (EPRI) and Germany (VGB support) to improve current EDF work on dismantling issues (9 units at various stages).
  - ENRESA partly relies on USA experiences (EPRI) for the decommissioning of Spanish units (Jose Cabrera).
  - Etc.

- Current activities as well as benchmarking visits help to outline (some) key RP issues associated with dismantling activities and some good practices to deal with these issues.

Some decommissioning specific features (1/3)

- As far as radiation protection is concerned, it is well known that decommissioning shows some particular features when compared to operation:
  - Loss of memory affecting the ’knowledge’ of the facility (specially when immediate dismantling was not the chosen strategy),
  - Management of highly activated pieces (vessels and internals),
  - Cutting of ‘containment’ barriers (primary circuit, etc.),
  - Work in highly contaminated areas,
  - High level of alpha emitters in contamination spectra,
  - Training of workers,
  - Etc.

- Even if each facility may have its own operating history and specific features, sharing of experiences is very useful to improve our ability to dismantle in ‘safe’ conditions taking into account a complex and continuously changing environment.

Some decommissioning specific features (2/3)

- Another issue is to keep occupational exposures ALARA in a complex environment and for jobs rather different compared to what is achieved during ‘routine’ operating - there is no routine during dismantling -.

- Sharing of experience, taking into account radiological conditions and other elements, outline some factors of success (at least from an RP point of view):
  - Characterisation,
  - Full System Decontamination,
  - Cold versus hot cutting techniques,
  - Under water or dry cutting,
  - External versus internal management exposure,
  - Etc.

Some decommissioning specific features (3/3)

- Discussions must take into account national context and practices to fully understand the rationale behind some choice, particularly:
  - Radioactive waste storage availability and costs,
  - Final target (green or brown field, residual contamination objectives, future re-use, etc.),
  - Clearance of radioactive material,
  - Etc.

Characterisation stage

- Facility characterisation stage:
  - Dose rate measurement and follow up (remote monitoring tools are useful as for operation),
  - Radionuclides finger print(s) definition and use,
  - Circuits sampling and analysis,
  - Smears and associated analysis,
  - Use of CZT,
  - Pictures,
  - 3D gamma camera,
  - Alpha camera,
  - Use of modelling tools and comparison with measurement data (Modelling may lead to an over estimate of actual dose rate (close to a factor of 10).

- As part of knowledge management, details regarding components and circuits characteristics are important (steel thickness, etc.).

Full System Decontamination

- Full System Decontamination (or system decontamination):
  - Dose rate reduction factors (decrease occupational exposure for future work),
  - Waste management issues (clearance and recycling versus storage) may influence targeted DF,
  - Management of produced resins must be anticipated,
  - Collective exposure associated with FSD implementation (can easily exceed 100 person.mSv),
    - Need for an overall balance of pros and cons.

Cutting techniques

- Cutting techniques:
  - Numerous techniques:
    - Mechanical cutting techniques (band saw),
    - Plasma torch,
    - Abrasive water jet,
    - Laser.
  - Influence of cutting techniques on:
    - Time,
    - Secondary wastes,
    - Contamination dispersion,
    - Water clarity.
  - RP staff must be associated to the choice of cutting techniques.

- In any case: rely on experienced company and staff, proved and robust techniques. Internals and vessel cutting is on the critical path for the dismantling NPP projects.

Alpha risk management

- Alpha risk management:
  - Collective protection:
    - Cleaning and decontamination before work,
    - Engineering barriers,
  - Individual protection:
    - Protective clothes (full plastic suits),
    - Respiratory mask,
    - Gloves.
  - Monitoring of air alpha contamination in dusty atmosphere may be difficult.
  - Monitoring of individual exposures with PAS.

Alpha risk management

- Internal versus external:
  - Working with protective clothes will increase working time and thus external exposure,
  - Need (in theory) to balance between internal and external exposure but internal exposure is usually not well accepted by Authority, utilities and workers.
- Importance to share experience with facilities that may face alpha risk in their day to day operation (reprocessing plant for instance).
- Encourage a pragmatic approach and rely on skilled workers.
- EPRI Alpha guidelines - www.epri.com -.

Some concluding remarks

- NPP dismantling is a growing challenge for utilities and RP Authority. The development of a RP culture adapted to that challenge is necessary.
- Some key issues have been identified and may be considered well before the shut down of NPP (knowledge management, FSD strategy, characterisation, etc.).
- Global approach of RP, industrial safety and waste management is required.
- Importance of ISOE WGDECOM to promote lessons learnt from past and current dismantling project
  - Be in position to justify technical choices,
  - Demonstrate to the Authority exposures are kept ALARA.

Thank you!