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

Decommissioning of nuclear facilities

Feedback from France

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Content

- Dismantling of nuclear facilities in France: what is at stake?
- Radioactive Waste Management in France:
  - Regulation,
  - Current situation,
  - Remaining issues.
- Radiation protection and dismantling of nuclear facility: some feedback from current operation in France.

Current situation - Actors

- Many actors dealing with the dismantling of nuclear facilities:
  - EDF (58 operating NPP,1 EPR under construction, 9 NPPs under dismantling at various stages),
  - CEA (research facilities and reactors, hot cells, etc.)
  - AREVA (reprocessing plant, enrichment plant, etc.)
  - ANDRA (managing radioactive waste storages),
  - ASN (Nuclear Safety Authority),
  - IRSN (Public expert),
  - Public (NGOs, etc.).
- Numerous and various nuclear facilities are currently under dismantling. Different licensees and many (new) undertakings - lack of nuclear industry culture -.
- Keep in mind that stakeholders engagements is a crucial issue for successful dismantling program.

2

Current situation - Regulator' position

- Current position of the ASN:
  - Objective of dismantling activities: reach a final state with a residual risk considered as ALARA. But without providing any regulatory target…
  - Favor an immediate dismantling strategy (but this could be further discussed in the near future):
    - Future generation should not support dismantling activities,
    - Use current knowledge and skills,
    - Use existing funding for dismantling activities.

3

Radioactive Waste Management in France

- The law of June 2006 dealing with radioactive waste establishes a radioactive waste management road map that is reviewed every 3 years by the Authority and various stakeholders (utilities, public agencies, NGOs, etc.). The plan must be 'accepted' by the French Parliament. Available (in French) on the web.

- General objectives:
  - To ensure that management solutions either exists or are sought for each category of waste,
  - To take into account of older, possibly "forgotten" waste,
  - To take into account of the concerns of the public, who may be worried about the fate of radioactive waste,
  - To optimise waste management,
  - To contribute to better management of the waste from other sectors generating radioactive waste: more conventional industries, medical sector, sites polluted by past activities.

4

Management option for radioactive material and waste

<table>
<tr><th></th><th>Very short life $T_{1/2}$ < 100 days</th><th>Short life $T_{1/2}$ < 30 years</th><th>Long life $T_{1/2}$ > 30 years</th></tr>
<tr><td>Very low level
≈ 1 to 100 Bq/g</td><td rowspan="4">Management by radioactive decay</td><td colspan="2">Dedicated surface repository
Recycling channel</td></tr>
<tr><td>Low level
≈ 0,1 to 100 kBq/g</td><td rowspan="2">Surface repository (CSA)</td><td>Dedicated shallow depth repository (under study)</td></tr>
<tr><td>Medium level
≈ 0,1 to 1 MBq/g</td><td></td></tr>
<tr><td>High level
> 1 MBq/g</td><td colspan="2">Under study (Bures laboratory – Deep geological repository)</td></tr>
</table>



Management of VLLW

- Dismantling of the 9 EDF facilities will generate over the next 20 years:
  - **500 tons of low and medium level / long life,**
  - 18 000 tons of graphite waste (low level / long life),
  - 41 000 tons of low and medium level / short life,
  - **105 000 tons of very low level waste**,
  - 800 000 tons of conventional waste.
- Need also to take into account dismantling activities from AREVA - key issue associated with George Besse 1, at least 130 000 tons of metal scrap considered as VLLW - and CEA…
- VLLW management is an important issue.
- ^{3}H currently also as a key issue as difficult to trap in a storage facility. Definition of a dedicated storage for tritied wastes under progress according to PNGMDR (EDTSF).

6

Management of VLLW

- On the contrary of most EU countries, there is no clearance level in the French regulations (neither conditional or unconditional). This will not change with the implementation of the new EC BSS - http://ec.europa.eu/energy/sites/ener/files/documents/CELEX-32013L0059-EN-TXT.pdf -.
- Any material that is localized in an area where it may have been or is activated or contaminated is considered as a radioactive waste - without any measurement - and must be managed as such (most of the time stored in dedicated facilities).
- Currently, most of VLLW that are produced by dismantling activities are sent to a dedicated storage facility - VLLW SF -:
  - In operation since 2003 - cost 40 M€ -,
  - Capacity: 650 000 m3,
  - Currently stored: 227 449 m3 (end 2012),
  - Storage cost ≈ 400 to 500 €.m-3 (+ transportation).

7

Management of VLLW

- The production of VLLW is higher than planned, leading to a decrease of operating time of the VLLW SF (initially 30 years). Difficulty associated with the building of new radioactive waste storage site lead to implement any technical way to increase the site capacity.
- It may be pointed out that the National Plan for the Management of Radioactive Material and Waste mentioned “For particular cases, for wastes with a very low quantity of radioactivity, recycling within specialized facility may be considered if followed by a re-use in the nuclear industry”.

8

Management of VLLW
Storage of VLLW

- Advantages:
  - No dissemination of radioactivity into the environment due to the management of large amount of VLLW,
  - No sophisticated measurements is needed to ensure that clearance criteria are met,
  - A practical way to dispose VLLW which may be beyond clearance levels which are very low and at reasonable cost,
  - Public acceptance.
- Drawbacks:
  - Difficulties to clearly define the materials considered to be radioactive as opposed to those be conventional,
  - Hard to apply in NORM and other industries generating radioactive wastes,
  - A clear way of proving a radioactive or conventional nature (at least for technicians, but not for the public),
  - Problem of harmonisation.

9

Management of VLLW
Storage of VLLW

- In France, the Authority outlined that the driving factor for the choice of one option for waste management is the cost and availability of storage facility.
- An operator should choose the cheapest way to manage its radioactive wastes as far as it is in line with the regulation: if storage is cheaper than clearance, waste producer will move for storage.
- A remaining question is: what is the cost of clearance? It seems very difficult to get reliable information on that issue.

10

Management of other waste

- In France, still miss some facilities to ensure the safe storage of some of the wastes to be produced by nuclear facilities dismantling activities. This could increase the length and then the cost of the projects.
- Costs of dismantling projects is a major issue :
  - Public acceptance,
  - Cost of nuclear electricity,
  - Etc.
- International feedback: dismantling of a nuclear reactor can be roundly estimated to 600 to 700 M€, 40% are staff costs.

11

Some key points

- Management of radioactive waste is a very sensitive issue for all concerned stakeholders and the public.
- Dismantling of nuclear facilities cannot be achieved if an optimized radioactive waste management plan has not been set up, taking into account all kind of radioactive materials, before starting the work.
- Management of VVLW should rely on a flexible approach with a balance between storage facilities and possibly “clearance” options. **But an agreement between all stakeholders is needed**.
- Key issues for the coming years :
  - Low Level and Long Life radioactive waste (graphite): dismantling of gas cold reactors will stop without an operational dedicated waste storage facility,
  - Medium and High radioactive waste (CIGEO),
  - Process and techniques for soils remediation - defining reasonable target for final state -.

Occupational radiation protection and dismantling of nuclear facilities

- Lessons learnt from a few case studies (France).
- Management of radiation protection for dismantling activities was derived from what is achieved for operating facilities, optimization being the pillar of the radiation protection system.
- Exposure assessment (before the activity):
  - Allow to appreciate radiation protection stakes for a dismantling activity and so to provide adequate resources (human, technical and financial) for radiation protection management.
  - But in some of our projects, this exposure assessment is very conservative for dismantling activities compared to what is observed for operating site.

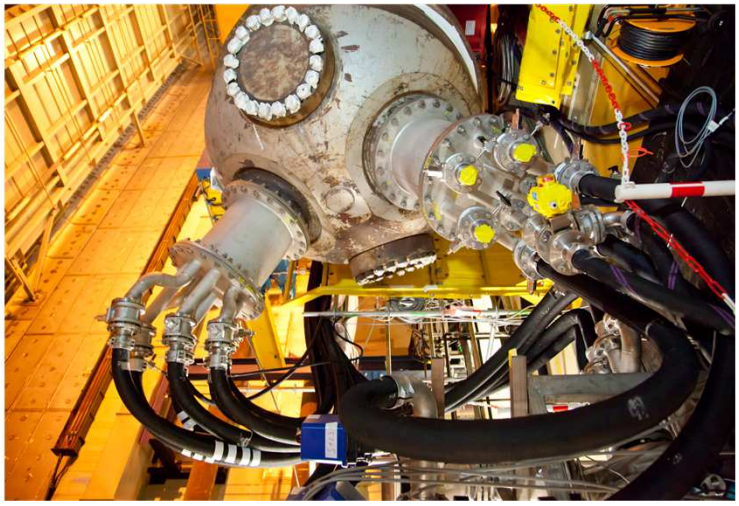
Occupational radiation protection and dismantling of nuclear facilities

- As a consequence:
  - Wrong allocation of resources - loss of time and money -,
  - Abnormal evolution may not be detected as exposures remains quite lower than what was planned: optimization is not reached,
  - How to convince the Authority that you control you activity?
- If progress can be achieved, exposure assessment for dismantling activities is not as efficient as for operating activity:
  - Not enough benchmarking information,
  - Loss of operating memory,
  - Lack of radiation protection culture.
- Way to improve RP management for decommissioning activities:
  - Radiological characterisation,
  - Develop a radiation protection culture among new players,
  - Knowledge management during operation,
  - International benchmarking activities (Germany, USA, etc.).

Radiation Protection - Feedback from Chooz A

- Key characteristics:
  - Westinghouse PWR, 305 MW_E, shut down in 1991,
  - Alpha contamination,
  - Built in a cavern (issue with radon progeny and alpha measurement).
- Currently achieving primary circuit dismantling activities, except reactor vessel (planned collective dose ≈ 650 H.mSv). 100 people working.
- In order to improve radiation protection management for the future dismantling project (EDF currently operate 58 PWR among which Fessenheim), need to draw lessons learnt from Chooz A.

Radiation Protection - Feedback from Chooz A



Radiation Protection - Feedback from Chooz A

- Some key issues:
  - Characterisation of the facility,
  - Workers training,
  - Organization and management.

Radiation Protection - Feedback from Chooz A

- Characterisation stage:
  - The most important stage to ensure the success of the overall decommissioning project. As far as possible: favour characterisation rather than modelling,
  - Detailed areas mapping - several dose rate measurement per room/location -,
  - Several smears in all rooms - 3 or 4 for 10 to 20 m^2 -,
  - Sampling all circuits, especially those in contact with primary fluid,
  - Pictures and 3D mapping,
  - Gamma camera - especially for hot spots characterisation -,
  - Lead and asbestos should be also taken into account when characterising the facility.
- Need for a detailed description of components to be dismantled (thickness and nature of steel, etc.).

Radiation Protection - Feedback from Chooz A

- Management of α risk:
  - Avoid 'over protection syndrom' regarding α contamination,
  - Be flexible,
  - Adapt collective as well as individual protection action to real expected risk,
  - Need for trained workers (undressing a key issue),
  - As far as feasible: full system chemical decontamination before starting work (AREVA CORD or other process, see German feedback).
- Training:
  - Need to spend some time on the spot to get skills (time) and develop the so-called RP culture,
  - Dismantling ≠ operation and training must be adapted

Thank you for your attention