Decommissioning considerations

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Topics of convergence with fission facilities: the example of ITER decommissioning

- Decommissioning considerations for design and licensing
- Funding of decommissioning
- Provisions for decommissioning in facility design
- Feedback from fission facilities considered for ITER decommissioning

Topics of convergence with fission facilities: the example of ITER decommissioning

- **Decommissioning considerations for design and licensing**

  → *ITER licensing process regarding decommissioning is similar to any new nuclear facility: decommissioning has to be anticipated and considered in the early design phases*

- Funding of decommissioning
- Provisions for decommissioning in facility design
- Feedback from fission facilities considered for ITER decommissioning

Decommissioning is part of the licensing process

- As per Decree No. 2007-1557 dated 2 November 2007 concerning basic nuclear facilities and nuclear safety regulations for the transport of radioactive materials, request for Authorization of Creation of the ITER INB contains
  - The preliminary safety report with a chapter related to deactivation (permanent shutdown) and decommissioning
  - The dismantling plan explaining the methodology and phases for the dismantling of the facility and for the restoration and subsequent monitoring of the site. The plan shall specifically substantiate the dismantling time required between the final shutdown and the dismantling of said facility
- This led to the decree No 2012-1248 dated 9 November 2012 authorising ITER Organization to build the licensed nuclear facility called ITER in Saint-Paul-lez-Durance
- Note: additional information was asked on the measures taken throughout the operation of the facility to **ensure that the change of nuclear operator at the end of operation will take place in the best possible way from the point of view of safety**.

Decommissioning is part of the licensing process

Decree No 2012-1248 dated 9 November 2012 authorising ITER Organization to build the licensed nuclear facility called ITER in Saint-Paul-lez-Durance

- Article 5.[…]

*The **dismantling plan** - defined in point 10 of Article 8 of the above-mentioned Decree dated 2 November 2007 – **will be updated at least during each safety review**. For this reason, the operator shall provide in particular an update of the chemical and radiological conditions on the site and its immediate environment. A preliminary version this statement will be sent to the French Nuclear Safety Authority two years at the latest following publication of this decree.*

These statements are presented to the local information commission.

Decommissioning is part of the licensing process

Decree No 2012-1248 dated 9 November 2012 authorising ITER Organization to build the licensed nuclear facility called ITER in Saint-Paul-lez-Durance

- Article 6. - *The operator shall send the **French Nuclear Safety Authority and the dismantling advisory committee** defined in 5 of Article 6 of the appendix to the above agreement dated 7 November 2007, **at least each year**:*
  1. *Information related to facility changes that may have an impact on the waste disposal outlets.*
  2. ***Information related to facility changes that may have a significant impact on the risks and drawbacks related to dismantling**.*
  3. ***Generally speaking, any useful information for the final shutdown and dismantling of the facility**.*
- *In addition to this information, the operator shall append any of the following documents that have been updated since the last submission:*
  1. *Waste management assessment for the facility as mentioned in Article 20 of the above-mentioned Decree dated 2 November 2007.*
  2. ***Dismantling plan**.*
- *The updates of the dismantling plan shall be validated by the committee without prejudice to the regulatory measures that are applicable*

Main steps of Decommissioning

- 4 steps similar to fission reactors' decommissioning

Operations/ experiments	Deactivation / Preparation of decay and dismantling	Decay	Final dismantling

	Objective:
	• **Reduction of source term**
	  • Tritium and dust collection
	  • Removal of in-vessel components with (high activation)
	  • Drainage an treatment of effluents
	  • Radioactive cleaning of process and buildings
	  • Simple dismounting
	• **Performed under operation license**
		Objective:
		• **Decay of source term (ALARA)**
		• **Performed under decommissioning license**
			Objective:
			• **Going back to end state** (green field or brown field)
			• **Irreversible dismounting of process and buildings**
			• **Performed under decommissioning license**

Note deactivation can be extended after decommissioning license

Topics of convergence with fission facilities: the example of ITER decommissioning

- Decommissioning considerations for design and licensing
- **Funding of decommissioning**

  → *Funding mechanisms of ITER decommissioning is similar to any new nuclear facility*
- Provisions for decommissioning in facility design
- Feedback from fission facilities considered for ITER decommissioning

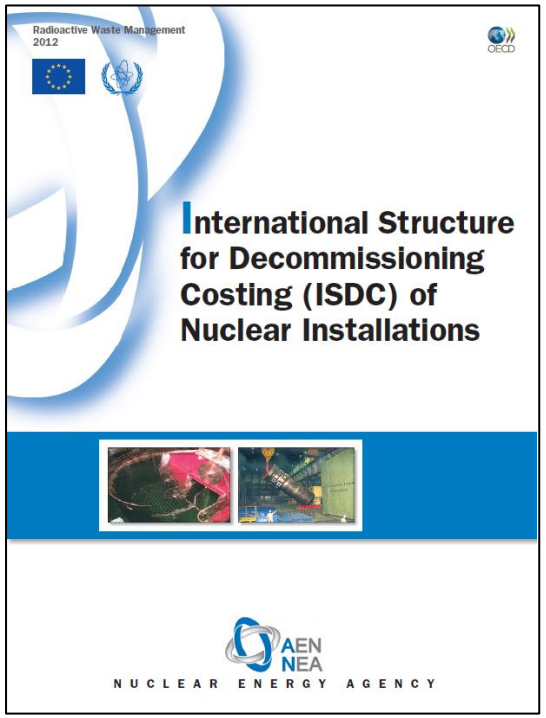
Decommissioning Fund needs to be provided before start of nuclear operations

- The **Article 16 of the ITER Agreement** states that:
  - a Decommissioning Fund shall be created by the IO (…);
  - The IO shall bring the ITER facilities into conditions to be agreed by the Host State following the final phase of experimental operations and within 5 years;
  - The IO shall hand over to the Host State the Fund and the ITER facilities for their decommissioning;
  - (…).

- The paragraph 4 of Article 16 of the ITER Agreement and the Article 6 of the Annex of the Headquarters Agreement on Procedures for Cooperation between the French Authorities and the ITER Organization provide for the :
  - modalities of establishment of the Decommissioning Funds and its planned final value;
  - changes to be taken into account for the adjustment of the planned final value;
  - hand-over of the ITER facilities and Decommissioning Fund from the IO to the Host State;
  - creation of the Decommissioning Advisory Committee (DACo) and its role and responsibilities.

Funding of ITER Decommissioning

- Main cost drivers will be identified into a detailed cost breakdown following OECD/NEA costing methodology



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Decommissioning integrated into design process

- Nomination of ITER Decommissioning Officer
- For each ITER system passing Preliminary design Phase a specific system's decommissioning plan has to be provided.
- Guidelines to establish systems decommissioning plan jointly established with CEA including international feedback from fission facilities
- Tracking of evolutions that may impact decommissioning
- Experts are invited to design reviews and can make recommendations to IO regarding decommissioning and raise issues whenever necessary, based on their feedback from fission experimental facilities

Maturity of System Design Documents at the end of the Design Phases	Design Phases		
	Conceptual	Preliminary	Final
On Site Testing and Commissioning Plan	Preliminary	Complete	Minimal update
Decommissioning Plan		Preliminary	Complete

Decommissioning Plan

- Describe the decommissioning operations if the system specifics require additional information besides the ITER overall decommissioning strategy

OR

- Justify that the system does not require any specific decommissioning requirement

Required for Preliminary Design Review

- The decommissioning plan shall be complete in order to propagate the associated detailed requirements to the design.
- The major requirements of this decommissioning plan shall be included in the System's Requirement list update prepared during this phase.

Document Type		Decommissioning Plan
Objectives		The objective of this document is to either: • Describe the decommissioning operations if the system specificities require additional information besides the ITER overall decommissioning strategy OR • Justify that the system does not require any specific decommissioning requirements
DBS	Folder	Definition Justification folder (DJF)
	Sub Folder	Commissioning folder (TCF)
Maturity Level	Conceptual Design	Not required
	Preliminary Design	The decommissioning plan shall be complete in order to propagate the associated detailed requirements to the design. The major requirements of this plan shall be included in the SRD update prepared during this phase.
	Final Design	Updated consistently with design maturity level.

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Assessing feasibility of decommissioning at design stage

Based on feedback from fission, it shall be identified:

- Openings and pathways for removal of big components
- Available handling tools

- Process or space reservation for decommissioning
- Risks:
  - What is the safe state before starting decommissioning?
  - What are the risks during decommissioning?

- Identification of all decommissioning radwaste and flow
- Specific materials that may not be accepted by the French Repository (ANDRA)

Basic rules for selecting decommissioning techniques (same as for fission)

- Minimize Radiological Doses to operator, according to ALARA strategy
- Minimize secondary waste production
- This requirement is dominant both for selecting the waste route and for managing the dismantling process (it can be also applied for operation and maintenance waste management)

Remote cutting techniques investigated based on feedback from fission

- Laser cutting:
  - Limited cutting depth
  - Not adapted to multilayers
  - Generate fumes
- Waterjet cutting
  - Very precise cutting
  - too much secondary waste (water + abrasive)
  - Not adapted to Hot cell environment
- Diamond wire cutting
  - Fast and precise
  - May require water cooling of the wire (secondary effluents difficult to manage)
  - Frequent replacement of the wire to be expected
- Band saw cutting
  - Most simple to put in place
  - Slow process
- Milling
  - Most efficient in terms of volume reduction if coupled to a compaction unit
  - No secondary waste (tested dry)

Identification of all decommissioning radwaste

- Based on bill of material vs location in rooms classified with radwaste zoning
  - → Study of possible relocation of components
  - → Re-estimation to be performed at each design gate
  - → Data to be put under configuration control
  - → Identification of specific materials that may not be accepted by the French Repository (ANDRA):
    - Tritiated materials
    - Reactive waste will require specific passivation treatment (e.g. LiH, LiPb)
    - Fission chambers require specific conditioning for acceptance (U)
    - Electronic waste…rare earths, etc.
- Materials activation is calculated using same tools as for fission
- Waste classification approach is the same as for fission
- Waste management solutions are similar than for fission except specific considerations for the tritiated waste: detritiation, outgassing measurement or decay

Conclusion

- ITER will take benefit from the best practices of fission facilities decommissioning:
  - Early taking into account of decommissioning in the design and licensing process
  - Methodologies for estimating resources
  - Anticipating waste management solutions and interfacing with disposal
  - Remote cutting techniques

Thank you!

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