

The Main Issues of Large Components From Decommissioning to Storage and Disposal of a Nuclear Facility

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1. Introduction

This paper is intended to facilitate the review of the issue at stake through a case-by-case approach, addressing all intermediate steps, such as treatment and conditioning, transportation and relevant decision-making parameters, in order to determine the overall relevancy of potential management routes depending upon given circumstances.

2. The relevant issues of managing large components

2.1 Main relevant actors in the technical process of managing large components

Managing radioactive waste involves many actors at various stages, including operators, regulators and a range of stakeholders. The actors are considered as the operator of the nuclear facility, the decommissioning organization, the transportation organization, the treatment of storage organization, and the operator of the disposal facility.

2.2 Management stages for large disused components

In order to assess the relevancy of a waste management option for large disused components, different aspects have to be investigated such as technical aspects, regulatory aspects, stakeholder aspects, and economic aspects. Those aspects must be considered at every stage throughout the management of disused large components such as decommissioning, transportation, waste treatment or storage, either performed at or away from the decommissioned site, and disposal.

3. Interdependency of activities and overall optimization

The assessment may be performed on the basis of an evaluation matrix that is described as shown in Table 1~5. Such an approach itself and the existing situation in the decommissioning facility, but also on the storage or disposal opportunities, the assessment results may vary. The evaluation matrix considers main issues such as regulatory and licensing issues, technical and operational issues, safety and ALARA issues, economic and schedule issues, and public-acceptance and stakeholders issues.

Table 1. Evaluation matrix considering the regulatory and licensing issues

Stages/Processes	Decommissioning	Transportation	Waste treatment/Interim storage	Disposal
Parameters	Prior references for similar projects	Waste classification	Free release limits and processes	Need to develop for special licensing process for non-standard packages, including the preparation of specific safety cases
	'First-of-a-kind' issues (processes, containers, etc.)	Acceptability of industrial packages	Conditional clearance limits and processes	Need to develop dedicated acceptance criteria for non-standard package
	Overall D&D project ALARA compliance	Licensed packages	Treatment and conditioning process for disposal	
	Required changes in waste acceptance criteria and/or processes and facilities of disposal site	Regulatory exemptions (e.g., transport without packaging)	Interim-storage licensing	
	Applicability of free release/clearance criteria			

Table 2. Evaluation matrix considering the technical and operational issues

Stages/Processes	Decommissioning	Transportation	Waste treatment/Interim storage	Disposal
Parameters	Availability of mature and tested technologies for the proposed concept	Number of expected expeditions	Evaluation of applicable waste-treatment techniques/processes (decontamination, segmentation, volume reduction, etc.)	Evaluation of modifications required at the disposal site for handling large non-standard packages

Previous references in similar projects	Packaging issues (e.g., external shielding, shock absorbers, etc.)	Need for new ancillary facilities	Need to design new dedicated storage cells for large non-standard packages
Feasibility/ease of deployment	Handling issues (availability and flexibility of handling means)	Minimization of secondary waste	Need to develop a new conditioning process at the disposal site in order to accommodate large non-standard packages
Use of original plant systems and load-handling means	Required changes in transport infrastructure	On-site handling issues	Need to develop new characterization strategies for large non-standard packages
Number and extent of required plant modifications			
Primary and secondary waste disposal policy			

Table 3. Evaluation matrix considering the safety and ALARA issues

Stages/Processes	Decommissioning	Transportation	Waste treatment/Interim storage	Disposal
Parameters	Expected external and internal workers exposure	Compliance with transport dose limits	Expected doses to the workers due to treatment processes	Need to re-evaluate conventional and radiological risks for handling, conditioning and disposal non-standard packages
	Expected public exposure	Transport security and waste retrievability issues	Potential new risks/hazards (e.g., chemical, aerosols, etc.)	Expected doses to workers from the handling, conditioning and disposal of waste packages
	On-site radiological risks (irradiation contamination, etc.)	Optimization of waste itinerary (road, railway, and sea options)	Doses resulting from waste handling	Validity evaluation of the disposal site's performance assessment for large non-standard packages, including human-intrusion scenarios
	Off-site radiological risks (uncontrolled activity release)			
	On-site conventional risks			

Table 4. Evaluation matrix considering the economic and scheduling issues

Stages/Processes	Decommissioning	Transportation	Waste treatment/Interim storage	Disposal
Parameters	Total project schedule duration	Container cost	Cost-benefit analysis (reduction of transport, storage and disposal costs vs treatment)	Overall disposal costs, including design, licensing, new process

Total project cost	Containers design, testing, and licensing costs	Potential risk schedule in case of treatment contingencies	development and investment in new facilities
Potential internal risks for schedule and cost	Timely procurement of containers	Costs of interim-storage facilities	Potential internal risks for schedule and cost (e.g., design and test delays, analyses uncertainties, etc.)
Potential external risks for schedule and cost	Impact on schedule of transport-related contingencies (e.g., road blockage, weather, etc.)		Potential external risks for schedule and cost (e.g., licensing delay, intervenor action, etc.)
	Liabilities, cost of insurance		

Table 5. Evaluation matrix considering the public acceptance and stakeholder issues

Stages/Processes	Decommissioning	Transportation	Waste treatment/Interim storage	Disposal
Parameters	Overall project risk perception by public	Number and visibility of off-site expeditions	Need to justify the need for interim storage to public	Public involvement in disposal site re-licensing (if required)
	Waste minimization via recycling/clearance	Avoidance of large population areas	Public positive perception on the reduction of waste for disposal	
		Impact of transport route restriction		

4. Conclusions

The optimization process should be discussed with respective regulators and the acceptability of the management option to regulators is an integral part of the successful delivery of the project in some cases, that may lead to the specific approval of all or part of the decommissioning plan. Good practice includes making the process and decisions readily available to stakeholders.

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