CONSIDERATIONS AND REFLECTIONS FOR THE DEVELOPMENT OF NEW STRATEGIES IN THE DESIGN OF NUCLEAR POWER PLANTS

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Abstract

The process of decommissioning of a nuclear facility involves technical and administrative actions related to dismantling, waste management, decontamination, and reuse. With many current nuclear facilities nearing the end of their lifetimes and set to begin decommissioning in the next two decades, it is important to consider ways to improve the process for future facilities. The solution proposed is to incorporate a methodology that prioritizes the ease of the decommissioning from the design and construction of nuclear facilities, without compromising safety or functionality. This can be achieved through the development of tools that assist in decision-making during the design process and by exploring additional options such as modular decommissioning or early decommissioning.

1. INTRODUCTION

The decommissioning of a nuclear facility is a complex process that requires various technical and administrative actions, including the dismantling, waste management, decontamination, and reuse of a nuclear installation. As two-thirds of the current nuclear facilities are approaching the end of their lifetimes and are set to begin decommissioning in the next two decades, it is an ideal time to consider ways to improve the decommissioning process for future facilities. The upcoming immense amount of resources that will be required for these efforts will highlight the need for actions to be taken to enhance the efficiency of the decommissioning process.

Given that this issue can be addressed at different stages of the nuclear facility lifecycle, it is important to focus on the design process as it is often the easiest and most economical stage where changes can be implemented. A possible solution is to adopt the paradigm that nuclear facilities should not only be as safe as possible but also as decommissionable as possible. This means that all components, both material and procedural, in the design and construction of a nuclear facility must meet safety regulations and also ensure the ease of the future process of decommissioning.

To achieve this, it is suggested to incorporate a methodology that allows the identification of the properties for structures, systems and components that contribute to ease of decommissioning from the design process and maximizing them as long as they don't compromise safety, performance, and functionality of the facility. By identifying and optimizing these properties, it is possible to build nuclear facilities where the efforts and resources required for the decommissioning process are lower than current standards.

The essence of this methodology lies in the development and implementation of techniques or tools that make possible to identify and quantitatively assess the contribution to the decommissionability of the different structures, systems and components, depending on the different properties and attributes they may have. In a simplified way, the first approach that can be taken is to consider that a component in a nuclear facility is more or less decommissionable depending on the degree of 3 factors:

(a) A structure, system or component is more decommissionable the cheaper the costs associated with its decommissioning process are.
(b) A structure, system or component is more decommissionable the faster the times associated with its decommissioning process are.
(c) A structure, system or component is more decommissionable the safer the procedures associated with its decommissioning process are.

These three factors are closely linked and give rise to various scenarios in different facilities in which decommissioning tasks are to be carried out. For example, there may be nuclear facilities in which expensive processes are determined that require little time but involve high risk due to high dose rates or relatively inexpensive processes with very long times and moderate risk due to lower dose rates.

The multiple scenarios that can arise with these three variables make possible to identify that it is not reasonable to optimize one of them if this results in a decline of the others. For example, it is not appropriate to contribute to the design of nuclear facilities in which very low decommissioning costs are expected if these involve very high times or risks. Another case are scenarios where the decommissioning processes can be carried out in a short time and with low risks but at high costs, which do not allow them to be competitive projects from an economic point of view.

It should be noted that there are more factors that could be taken into account such as the availability of technology for decommissioning or the social and economic impacts of the decommissioning of a nuclear facility. These factors that are determinant for selecting the appropriate decommissioning strategy could contribute for a more detailed assessment of the degree of decommissionability of a nuclear site, however as a first development the methodology could involve more basic considerations and be refined for more specific scenarios if needed. [1]

The development of a quantitative decommissionability analysis tool is an essential element for this methodology that should allow initially two things:

(a) Provide the ability to identify and assess the contribution to the decommissionability of the different properties for structures, systems and components.
(b) Assist the design process in the decision making towards the ease of the future process of decommissioning for a nuclear facility.

It is crucial to find solutions that improve the decommissioning process and lower the time and cost associated with these endeavours. Therefore, it is important to consider to ease the decommissioning from the design process of a nuclear facility. A tool that assists in the decision-making process for the design of a nuclear facility with the ease of decommissioning in mind can be a cost-effective and easy solution to incorporate.

This proposal opens the possibility for future work that identifies the specific ways in which the different properties of multiple structures, systems and components in a nuclear plant alter the costs, times and risks associated with the decommissioning processes. Additionally, it is worth considering that with the design, construction and future operation of small modular reactors, the knowledge and learning that will be obtained may allow us to glimpse other possible tools or mechanisms to optimize or complement the process of decommissioning such as thinking of a modular decommissioning or an early decommissioning.

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