International Conference on the Safety of Radioactive Waste Management, Decommissioning, Environmental Protection and Remediation: Ensuring Safety and Enabling Sustainability

Contribution ID: **144** Type: **ORAL**

Circular economy in nuclear industry, through the prism of Material and Waste Management

According to the IAEA's definition, a circular economy is a policy in which resources are kept in reuse or recycling for as long as possible, retrieving the maximum value from them, then recovering and regenerating products and materials at the end of each lifecycle. It is an approach focused on delivering positive society-wide benefits by limiting waste production and preserving natural resources.

The objective of this paper is to illustrate the application of circular economy principles within the nuclear industry and particularly in the waste management and decommissioning activities. In this regard, this paper will address the necessary conditions (regulatory, social, industrial, economic and environmental) to deploy circular economy, its expected assets as well as its benefits and outcomes.

The paper will also provide some perspectives of the different challenges to be addressed in order to increase the efficiency and better acceptance within the nuclear industry of the reuse and recycling principles on which circular economy mainly relies.

In the frame of waste management and decommissioning activities, the commonly recognised driving principle is waste hierarchy. Based on this latter, the paper will demonstrate how, over the last decades, the worldwide nuclear industry gathers international experiences to improve waste management and decommissioning to implement circular economy in its activities.

Consequently, taking advantage of the increase of decommissioning projects and induced materials and waste, nuclear operators have developed specific methodologies to:

- Significantly reduce the amount of type, nature and volumes of ultimate waste to be disposed of in order to preserve raw or rare resources;
- Implement reuse and recycling principles since the design phase in new nuclear projects as well as in maintenance and dismantling activities in all of them;
- Increase the importance and relevance of characterization items (skills, labs, methodologies⋯) to enhance the volumes of generated materials devoted to proper reuse and recycling.
- Identify the various criteria enabling sustainable strategies: cost efficiency, environmental aspects, social acceptance, regulatory constraints, available technologies as well as R&D needs and young generations attractiveness.
- Foster innovations to reduce secondary waste or improve nuclear facilities'design;
- Promote circular economy and sustainability within the nuclear industry activities through some identified remaining challenges to be addressed.

Relying on the above-mentioned items, the paper will be strengthened with evidence and case studies currently implemented in global nuclear industry. The paper will further promote international cooperation in the strive towards circular economy.

Last but not least, the paper will illustrate how the implementation of circular economy in the entire nuclear lifecycle will enable to increase the credibility and relevance of global nuclear industry as a sustainable low-carbon energy source.

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Track Classification: Track 4 - Integrating the views of society into decision-making considering technical, environmental, social, and economic factors