Management of Very Low Level Metallic Waste from NPP Decommissioning through Melting Technology

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1. Introduction

The Kori Unit 1, which is the first commercial NPP in Korea, will be shutdown in 2017 and decommissioned at a later date.

The activities involved in decommissioning will lead to the generation of radioactive waste with the largest volumes of very low level waste (VLLW) mainly composed of metal. Due to the limited capacity of a VLLW repository, however, it should be handled in a suitable way to reduce the waste volume.

In this paper, impact of melting for decontamination and recycling was studied to manage very low level metallic waste from NPP decommissioning.

2. Waste Management by Melting

2.1 Background

Melting is a high-temperature technology that completely destroys the metal components and redistributes the radioactivity among in ingots, slag, and dust. During melting, the volatile radionuclides such as ^{137}Cs will be accumulated in the dust collected by ventilation filters and removed. The dominant remaining nuclide ^{60}Co in the ingots can be removed by storing long enough for radioactive decay [1].

2.2 Advantage

Melting is considered as promising technology for slightly radioactive metal due to high possibility to reach the clearance level and release the ingots.

Metal melting provides several advantages such as:

- High volume reduction
- Homeogenous distribution and effective immobilizing of radionuclides in the ingots
- Suitable form and shape (ingots) for further use

2.3 Case Studies

A number of countries including Germany, Sweden, and France have been operating central metal melting facilities for handling radioactively contaminated metals. Their facility features are summarized in Table 1.

Table 1. Melting Facility Characteristics (Unit: t) [2]

Country	Facility	Facility Capacity	Furnace Capacity	Ingot Size
Germany	CARLA	4,000	3.2	1.0
Sweden	Studsvik	5,000	3.0	0.6
France	CENTRACO	4,500	4.0	1.5

2.3.1 Germany

The melting plant CARLA has been operated by Siempelkamp since 1989. 95% of the metals can be re-used after melting process, and only 5% of radioactive waste requires disposal. Metal ingots have been re-used within nuclear industry, re-used outside the nuclear industry after release, and returned to the customers [3].

2.3.2 Sweden

The Studsvik metal melting facility has been in operation since 1987. The final product ingots will be treated depending on their activity by free releasing or storing for a maximum of 20 years. The resulting ingots are subject to clearance and recycled in the steel industry.

In cases where ingots cannot be given clearance within 20 years, the ingots are returned to the owner.

2.3.3 France

French Society for Industrial Waste Treatment (SOCODEI) has operated the nuclear installations CENTRACO since 1999. Molten metal is cast into ingots or centrifuged in a tube. Final packages of

ingots are sent to the Center of storage l'Aube in Soulaines-Dhuys for a long-term storage. The tubes are reused for the manufacture of packaging for medium-level waste. The waste volume can be reduced by a factor up to 10 for ingots.

2.4 Application to NPP Decommissioning

All types of metallic waste categorized as VLLW can be applied for melting technology. Ingot and melting residues will be treated depending on their radioactivity.

2.4.1 Principle

Ingots which belong to clearance level will be free released immediately or after storing for further use within the nuclear industry. Otherwise they will be transported and disposed in a VLLW repository as radioactive waste with slag and dust generated during melting process.

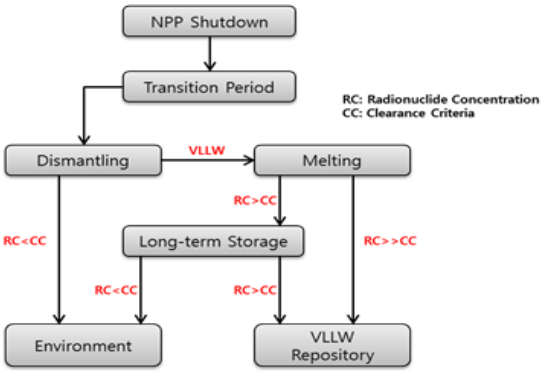

Fig. 1. Treatment Flow of Metal Waste.

2.4.2 Application and Expected Effect

The VLLW inventory of metal is assumed to be around 5,500 m^3 to quantify the impact of melting.

CARLA melting facility was chosen as a reference case to conservatively estimate the duration for metal waste treatment by melting. It is estimated that around 11 years is required to treat metallic waste using a melter with a annual capacity of 4,000 t/y.

Waste volume can be reduced from 27,500 drums to 1,375 drums (based on 200 L drums) when composition from melting is considered as 95% for free release and 5% for disposal. In addition, the waste volume can be reduced from 27,500 drums to 2,750 drums (based on 200 L drums) if a 10 times volume reduction factor for melting is considered.

3. Conclusion

In this study, melting technology was applied and analysed for managing metal wastes generated from NPP decommissioning. Significant economic effect through melting can be expected from volume reduction of waste disposal and recycling of metal waste after free release.

To handle huge amount of metal waste, a melting facility should be prepared in Korea. It can be an existing facility or a new licensed melting facility dedicated to VLLW.

However, a feasibility study is required including several affecting factors (i.e. economic, national policy, public acceptance and risk management issues). In the same context, ingot recycling should be carefully considered because of significant stakeholder issues.

4. Acknowledgements

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