Effective Decontamination Treatment Process of Steam Generator

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1. Introduction

The decommissioning of a nuclear power plant requires a large amount of time and cost. The treatment and disposal of radioactive waste also requires significant costs. The quantity of radioactive waste is to be diminished using several selective combinations of decontamination and treatment. The workers must be safe from exposure to radiation [1-3].

In this study, to design an effective treatment process for decommissioning radioactive waste, effective decontamination techniques for decommissioning radioactive waste were selected with their application to decommissioning radioactive waste of the steam generator. The three treatment processes were discussed with decommissioning radioactive waste of the steam generator.

2. Planning of Treatment Process for Decommissioning Steam Generator

2.1. Treatment Process for Decommissioning Steam Generator

Table 1 shows application techniques for selecting decontamination method.

Table1. Application Techniques for Selecting Decontamination Method

Part of Steam Generator	Application of Decontamination Techniques and Decontamination Effect
Outer Surface	* Outer Surface is slightly Contaminated with Radioactive Nuclide. *Selected Decontamination Techniques for Treatment Process of Outer Surface Radioactive Waste are to be Blasting Abrasive and HF series Chemical Decontamination (KAERI/RR-3478/2010). *Application of Blasting Abrasive and HF series Chemical Decontamination to Outer Surface Radioactive Waste with Decontamination Factor 80.
Water Chamber	*Radioactive Contamination of Water Chamber is Higher about 100 times than that of Outer Surface (Sweden Ringhals3). *Selected Decontamination Techniques for Treatment Process of Water Chamber Radioactive Waste are to be Electro-Chemical (German KRB-A) and MEDOC(Belgium BR3). *Application of Electro-Chemical and MEDOC* to Water Chamber Radioactive Waste with Decontamination Factor 100. Application of Melting to Water Chamber. *Application Electro-Chemical Decontamination Technique (German KRB-A) to Water Chamber Radioactive Waste. -Its Effect: Reduction from Initial Surface Contamination (20,000Bq/㎠) to unlimited Release Level and Generation of 1.5% Radioactive Waste from Initial Radioactive Waste. *Application MEDOC Decontamination Technique (Belgium BR3) to Water Chamber Radioactive Waste. - Its Effect: Reduction from Initial Radioactivity of Metal Radioactive Waste (80%) to 0.1Bq/g.
U-type Tubes	*Radioactive Contamination of U-type Tubes is Higher about 100 times than that of Outer Surface (Sweden Ringhals3). *Selected Decontamination Techniques for Treatment Process of U-type Tubes Radioactive Waste are to be Dry Blasting Abrasive (Sweden Ringhals3) and Loop Chemical Decontamination (Kori3). *Application super Compression (272-14,965 ATM) to activated U-type Tubes Radioactive Waste. -Its Effect: Reduction from Initial Volume of Radioactive Waste to 1/7 Volume of Radioactive Waste. *Application of Dry Blasting Abrasive and Loop Chemical Decontamination to U-type Tubes Radioactive Waste with Decontamination Factor 100. *Application Dry Blasting Abrasive Decontamination Technique (Sweden Ringhals) to U-type Tubes Radioactive Waste. -Its Effect: Reduction from Total Radioactivity (650GBq) of Steam Generator to 510GBq (85%) of U-type Tubes Radioactive Waste. *Application high Frequency Furnace Melting Technique to Remnant Radioactive Waste. -Its Condition: Ingot: ~ 95%, Slag: ~2-3%, Sampling & Vapor: very small Quantity.

**Metal Decontamination by Oxidation with Cerium*

3. Results of Effective Treatment Process for Decommissioning Steam Generator

3.1. Treatment Process for the Decommissioning Radioactive Waste of Outer Surface of Steam Generator

From Table 2, the outer surface of the steam generator is to be estimated as clearance waste (about 100%) through decontamination.

3.2. Treatment Process for the Decommissioning Radioactive Waste of Water Chamber of Steam Generator

The water chamber of the steam generator is to be estimated as partial clearance waste and partial radioactive waste through decontamination and melting.

3.3. Treatment Process for Decommissioning Radioactive Waste of U-Type Tubes of Steam Generator

The u-type tubes of the steam generator is to be estimated as partial clearance waste and partial radioactive waste through decontamination, melting [3-4], and compression process [5].

Table 2. Results of Treatment Process of Steam Generator

Part of SG	Treatment Process	Results of Treatment Process
Outer Surface	Decontamination	*Outer Surface of Steam Generator is slightly Contaminated with Radioactive Nuclide. *Application selected Blasting Abrasive Decontamination Process and HF Series Chemical Decontamination Process to Outer Surface Radioactive Waste of Steam Generator with Decontamination Factor 80 is to be Estimated as Clearance Waste (about 100%).
Water Chamber	Decontamination	*Radioactive Contamination of Water Chamber of Steam Generator is higher about 100 times than that of Outer Surface. *Application selected Electro-Chemical Decontamination Process and MEDOC Process to Water Chamber Radioactive Waste of Steam Generator with Decontamination Factor 100 is to be Estimated as Partial Clearance Waste (>70%) and Partial Radioactive Waste(< 30%).
	Melting	*Remnant Radioactive Waste is to be Estimated as Partial Clearance Waste (>20%) and Partial Radioactive Waste (<10%) through Melting Process.
U-Type Tubes	Decontamination	*Radioactive Contamination of U-Type Tubes is higher about 100 times than that of Outer Surface. *complicated U-Type Tubes is Activated due to Erosive Oxidation. *Application selected Dry Blasting Abrasive Decontamination Process and Loop Chemical Decontamination Process to U-Type Tubes Radioactive Waste of Steam Generator with Decontamination Factor 100 is to be Estimated as Partial Clearance Waste(>50%) and Partial Radioactive Waste(<50%).
	Melting	*Application Melting Process to Remnant Radioactive Waste from Water Chamber and U-Type Tubes is to be estimated as Partial Clearance Waste, Partial Recycling Waste(>20%) and Partial Radioactive Waste(<10%).
	Compression	*Application Super Compression on the activated Waste from Water Chamber and U-Type Tubes is to be estimated as Radioactive Waste(<20%).

4. Conclusion

Effective decontamination techniques for decommissioning metal radioactive waste were selected with their application to outer surface, water chamber, and u-type tubes of the steam generator. The outer surface of the steam generator is to be estimated as clearance waste (about 100%). The water chamber of the steam generator is to be estimated as partial clearance waste (>70%) and partial radioactive waste (<30%) through decontamination process, partial clearance waste (>20%) and partial radioactive waste (<10%) through melting process. The u-type tubes of the steam generator is to be estimated as partial clearance waste (>50%) and partial radioactive waste (<50%) through decontamination process, partial clearance (>20%) and partial radioactive waste (<10%) with melting process, and radioactive waste (<20%) through compression.

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