Experience Review of Transportation of Large Components for Decommissioned NPPs

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1. Introduction

The decommissioning of nuclear power plant (NPP) has been growing steadily in the word. The number of shutdown NPPs is totally 163 and decommissioned NPPs is 20 in the world.

Recently, Kori-1 has permanent shutdown and 16 NPPs in Korea will come to an end of their lifetime as a 45years until 2060 based on NPP lifetime.

In the Korea nuclear safety act, the "decommissioning" means the dismantling of facilities and sites or the removal of radioactive contamination, after a person who has been granted permission to operate a nuclear facility has permanently suspended the operation of facilities.

The decommissioning of NPP is a series of processes consisting of planning and management, removal of radioactive material, dismantling and demolition, waste disposal, and site restoration. All these activities should be carried out in accordance with the purpose of the regulation of decommissioning considering the health and safety needs of workers, the general public and the environment.

According to decommissioned NPPs, the periods and cost for decommissioning of NPPs are impacted by decommissioning waste.

In this study, it was investigated that classification of radioactive waste in the world and volume of large components and applied technologies for decommissioned NPPs.

2. Transportation of Large Components Activities

2.1. Classification of Radioactive Waste

IAEA recommended a new classification of radioactive waste for the purpose of establishing general classification standards for various types of waste and disposal methods, and for the safety analysis of international disposal facilities in 2009 [1]. This classification of waste and disposal methods of waste are summarized as Table 1, Figure 1.

Exempt waste consists of exclusion waste, exemption, clearance waste. Exclusion waste means that regulatory control of radiation sources or activities is practically impossible and not regulated. Exemption waste and clearance waste are excluded from regulation because the radiation source associated with the source or activity are minimal. Exemption waste means the exclusion of regulated substances from the beginning, and clearance waste means exclusion from the existing regulatory substance.

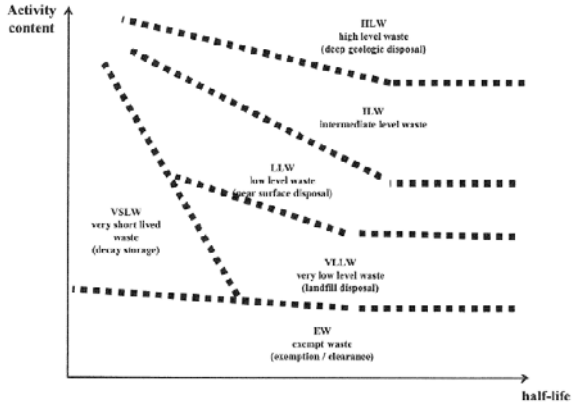

Figure. 1. Conecpetual illustration of the waste classification scheme

Table. 1. Classifciation of radioactive waste and methods of disposal

Classification	Contents
Exempt Waste	· Exclusion, exemption, clearance waste · IAEA RS-G.1.7
Very Short Lived Waste	· Half-life less than 100 days · Disposal after storage until disintegration below to exempt waste
Very Low Level Waste	· One or two orders of magnitude above the level for exempt waste · Disposal in engineered surface landfill type facilities
Low Level Waste	· Needs of isolation and containment for hundreds of years · Limit : - 400 Bq/g for alpha radionuclides - Up to kBq/g for Beta / gamma radionuclides · Disposal at depth from the surface down to 30m
Intermediate Level Waste	· Long lived radionuclides · Needs a greater degree of isolation and containment than near surface disposal · Disposal at depth of between a few tens and a hundreds of meters
High Level Waste	· Heat dissipation is an important factor · Activity concentration in the range of 10^4-10^6 TBq/m^3 · Deep geological disposal

2.2. Experience of Decommissioned NPPs

As shown in the table 2, this is example of transportation for decommissioned large components to repositories in USA.

Table. 2. Large components of decommissioned NPPs in USA

NPPs	Scope	Weight (ton)	Transport
Shippingport	RI, RPV, NST	820	Transporter Barge
Trojan	RI + RPV	950	Transporter Barge
Yankee Rowe	RPV	917	Transporter rail

*RI: Reactor Internal / RPV: Reactor Pressure Vessel
NST: Neutron Shielding Tank

In 1989, Shippingport nuclear power plants in Ohio River in Pennsylvania transported about 820 tons of decommissioned large components which contained reactor vessels and integrated pressure vessel structures to the repository.

Based on the experience of the Shippingport nuclear power plant, the Trojan nuclear power plant transported decommissioned large components for one months in 1998, after approval of license from the NRC in 1996. This large components was transported to Hanford repository, which was transported by special transporter on land and barge on the Columbia River. Large components is 5.2m in diameter, 13m in length and 950 tons in weight, which injected low density concrete and packed with a shielding material [2].

Figure 2. Transportation for reactor vessel of Trojan by Barge

Transportation for decommissioned large components of Yankee Rowe nuclear power plant was carried by truck to the vicinity of the track, and it was transported to the disposal facility using combination of transporter and railroad. The 165 ton nuclear pressure vessel was placed in steel container (3-inch thick, 100-ton) by certification of NRC, and then 80 tons of concrete was injected and lid was welded [3].

Figure 3. Disposal for reactor vessel of Yankee Rowe

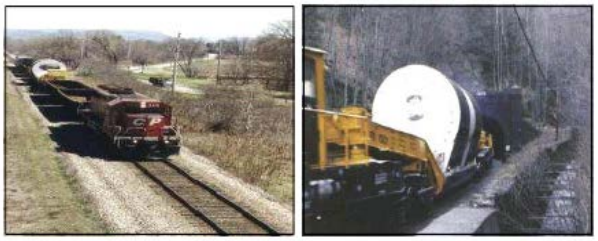

Figure 4. Transportation of reactor vessel of Yankee Rowe by rail

3. Conclusions

Review of the experience for transportation of large components show that decommissioned NPPs were conducted considering the residual radioactivity and safety. Also, it is important to conduct planning and appropriate method considering scope of components, weight and exposure dose.

As shown in transportation for large components of decommissioned NPPs, the methods of transportation varies depending on size of components and distance between decommissioned NPP and the repository.

In the Korea, the best strategy to consider the safety of worker and the public should be planned and implemented above all.

Acknowledgment

This research was supported by the Nuclear Safety Research Program funded by the Nuclear Safety and Security Commission (No. 1305009).

REFERENCES

[1] IAEA, Classification of Radioactive waste, General Safety Guide No. GSG-1, (2009)
[2] EPRI, Trojan Nuclear Power Plant Reactor Vessel and Internals Removal – Final Report, Oct. 2000

[3] EPRI, Yankee Rowe Decommissioning Experience Record, Dec., 2006.