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The Geological Disposal Concepts for the Metal Wastes from Spent Fuel Recycling Process in KOREA

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1. INTRODUCTION

Since the first commercial nuclear power plant in 1978, Kori unit 1, there are 20 operating nuclear power plants in 4 sites. The electricity from the nuclear power plants is around 40 % of total required electricity in Korea and according to the basic energy development plan, the proportion will be raised up to about 60 % in the near future. To implement this plan, the most important factor is the back-end fuel cycle, namely the safe management of the spent fuel or high level radioactive wastes from the nuclear power plants. Spent fuels from the reactors are stored temporarily in the storages of each power plant site, wet type or dry type.

Korea launched a long-term R&D program for the spent fuel direct disposal technology development in 1997 and the Korean Reference spent fuel deep geological disposal System (KRS-V) has been developed.

Now, in our country, as one of the management alternatives which is more effective and non-proliferation, pyro-processing method is being developed actively to retrieve reusable uranium and TRU, and to reduce the volume of high level waste from a Nuclear power plant. This is a new dry recycling process. So, the disposal system for high level waste from this process should be developed.

In this study, the characteristics of the metal wastes from this recycling process are analyzed and their amount is estimated. And based on the waste information from these analyses and the technologies from the KRS-V system, the geological disposal concept for the metal wastes are developed. Namely, according to the amount and the characteristics of waste, the concepts of waste packages, the disposal containers and disposal tunnel are developed.

The proposed metal waste disposal concept in this paper can be used as input data for design of the deep geological disposal system.

2. WASTE CHARACTERISTICS

This study may guide us what should be needed for developing a disposal system for totally different sources compared with spent fuels.

Table 1 represents the brief summary of the characteristics of the waste from the pyro-processing of PWR spent fuels. The reference PWR spent fuel is 10 MTHM of oxide fuel with 4.5 wt% U-235, 45,000 MWD/MTU burn up and 5 years cooling time.

The metal waste is produced mainly from chopping/ decladding process in the pyro-processing. It is most massive but its radioactivity is too weak to be high level waste. The estimated amount of metal wastes is around 3.16 tons from 10 MTU of PWR spent fuels. Two different conditioning methods, compaction and ingot, can be proposed. But in this paper, the focus is on the compacted metal waste. The ingot method is proposed in order to recycle some part of metal waste. Due to negligible heat generation, the waste can be disposed of at the shallow level. Figure 1 shows a metal waste package concept which contains 5 disks of compacted metal waste.

Table 1. Characteristics of the wastes from the pyro-process of PWR spent fuels

	Long-Lived Waste			Interim decay Waste	
	Metal	Ceramic	Vitrified	Ceramic	Vitrified
		LiCl+KCl	LiCl+KCl	off-gas+LiCl	LiCl
Major nuclide	NM+U+TRU+RE	Cs+α	Sr+TRU+RE	Cs	Sr
Weight (kg)	3,158.53	0.65	936.21	600.94	67.99
Volume (L)	470.7	0.3	419.8	231.8	30.5
Heat (W)	-	0.9	4,200 (49.3 after 100 yrs)	12,500 (6.72 after 300 yrs)	6,000 (4.23 after 300 yrs)
Container	❶	❷	❸	❹	❺
Disposal Depth	200	500	500	200	200
Disposal Methods	Silo or Tunnel	With waste ❸	KRS or Cavern	Tunnel Storage and then final disposal	Tunnel Storage and then final disposal

➔ 10MTHM of oxide fuel with 4.5 wt% U-235. 45,000 MWD/MTU, 5 yrs cooling

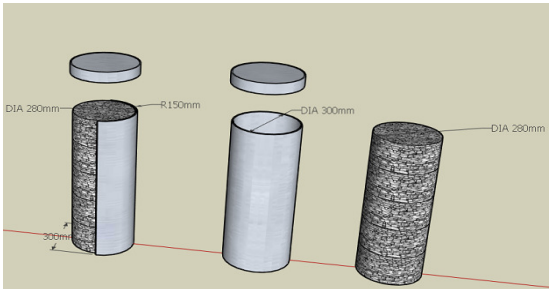

Fig. 1. Concept of a metal waste package

3. DISPOSAL CONCEPT FOR METAL WASTE

3.1 Concept of Disposal Container for Metal Waste

The compacted metal waste will be disposed of in a MDP(compact Metal Disposal Package). A MDP will contain nine cans of compacted metal wastes. This container is made of polymer concrete and the weight of MDP with wastes is around 6.03 tons. Thickness of MDP will be determined through radiation shielding calculation. Total numbers is 3,250 MDPs from 22,500 tU spent fuels by 24 PWR reactors. They can be disposed of in two tunnels. Large amount of metal wastes is expected from the NPP decommissioning. These wastes can be disposed of together with metal wastes.

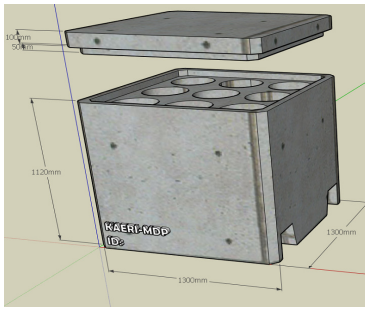

Fig. 2. Disposal package concept

3.2 Concept of Disposal Tunnel for Metal Waste

The dimension of disposal tunnel is determined by the size and the numbers of the disposal container and the handling equipment. The disposal container is handled by forklift truck.

The wall and the roof are prepared after the disposal is excavated in the disposal tunnel for the metal waste. This structure is made of the polymer concrete. After the disposal container is emplaced in the disposal tunnel the void between disposal container and the wall structure will be filled with bentonite block as a buffer material. And also, the void between the structure and the tunnel will be backfilled with the mixture of the bentonite and the cruched rock.

The section area of these disposal tunnels is about 25 m^2 and the width is 5.1 m and the height is 4.8 m. Also, the length of the disposal tunnel is 500 m. There need two disposal tunnels for the total numbers of 3,250 MDPs from 22,500 tU spent fuels by 24 PWR reactors.

The concept of the disposal tunnel for the metal waste can be shown in the Fig. 3.

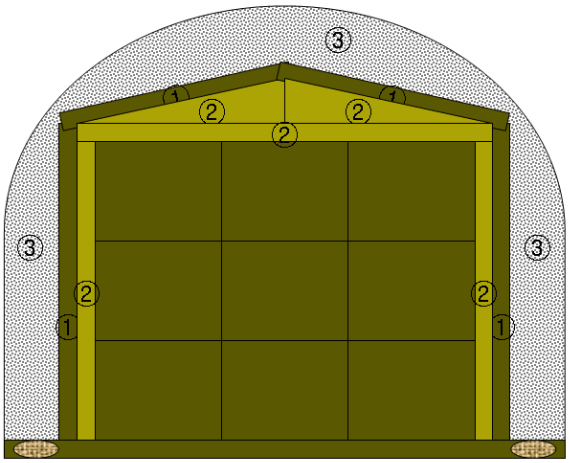

Fig. 3. The concept of the metal waste disposal tunnel.

4. CONCLUSION

In this study, the characteristics of the metal wastes from the spent fuels recycling process are analyzed and their amount is estimated. And based on the waste information from these analyses and the technologies from the KRS-V system, the disposal concept for the metal wastes are developed. Namely, according to the amount and the characteristics of each waste, the concepts of waste packages, the disposal containers and the disposal tunnels are developed.

The disposal concept proposed in this paper can be used as an input data for design of the deep geological disposal system for the various wastes from the recycling process. And they will be improved through the application of the real site data and safety assessment in the future. After then, the final disposal concept will be selected with various assessments and the optimization will be carried out.

5. REFERENCES

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