

## Evaluation on Waste Volume and Weight from Decommissioning of Kori Unit 1 Reactor Vessel

Yujeong Choi <sup>a\*</sup>, Seong-Cheol Lee <sup>a</sup>, Chang-Lak Kim <sup>a</sup>

<sup>a</sup>KEPCO International Nuclear Graduate School, 658-91 Heamaji-ro, Seosaeng-myeon, Ulju-gun, Ulsan 689-882, Korea

\*Corresponding author: supern3@naver.com

### 1. Introduction

Recently, life extension of the nuclear power plants has been issued in South Korea. There is a plan that Korean government will decide by the end of June in 2015, whether operation life of KORI unit 1 can be extended or terminated.

As a part of continuing efforts to prepare shut down of nuclear power plant, several researches have been conducted to establish plans to dispose decommissioning waste from nuclear power plants. When decommissioning nuclear power plant, most of radioactive waste is generated from primary side including a reactor vessel. Radioactive waste amounts generated from decommissioning is significantly affected by several factors, such as dismantling method, waste classification, reactor lifetime, disposal method and etc.

In this paper, radioactive waste amount from decommissioning of KORI unit 1 reactor vessel is evaluated with the consideration of disposal containers.

### 2. Disposal containers for decommissioning of reactor vessels

This section reviewed preferable containers for waste disposal which were used for decommissioning of reactor vessels in other countries.

#### 2.1 Disposal containers

In South Korea, radioactive waste disposal containers used in the site are described in **Table I**. In general, most of disposal containers are designated for radioactive waste generated during operation of nuclear power plant. However, radioactive waste generated from decommissioning of nuclear facilities is generally much heavier in the weight and much larger in the volume, compared to radioactive waste from operation. Therefore, it might be not suitable to use the disposal containers listed in the table, for disposal of radioactive waste generated from decommissioning of large components including reactor vessels.

Table I: Waste type and size of containers

Drum	Nuclear power plant	KEARI	KPS	
200l drum Ø 615*h884 mm	Concentrated liquid	HLW	Compounds	
	Metal scrap	Metal scrap	Metal scrap	
	Spent resin	Spent resin	Sediment of lime	
	Spent filter	Solidified waste	Metal	
			Concrete	
			Wood	
Glass				
Repacking drum (320l) Ø 713*h955mm	Concentrated liquid	-	-	
	Metal scrap			
	Spent resin			
Circular drum(1200l) Ø 1100*h1300 mm	Spent resin	-	-	
	Spent filter			
Circular drum (2000l) Ø 1400*h1300 mm	Concentrated liquid	-	-	
	Spent resin			
	Spent filter			
Square drum (2500l, 4-pack) L1460 *W1460*H1180mm	Concentrated liquid	-	-	
HIC (1200l) EL-50 : Ø 1190 *h1290mm EA-50 : Ø 1181 *h1289mm	Spent resin	-	-	

## 2.2 Case study on decommissioning of reactor vessels

In order for decommissioning of the reactor vessel in Kori unit 1 nuclear power plant, it might be a good idea to review disposal containers used for disposal of large component in other countries.

In Spain, three options were considered for disposal of large components in discussing stage. Consequently, CE-2b was chosen for LILW container in the case of disposal of José-Cabrera NPP (CNJC) large components. Details of containers are described as below.

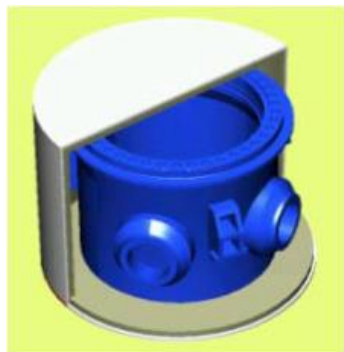


Fig. 1. Option A: 4.52 m in diameter by 2.28 m in height

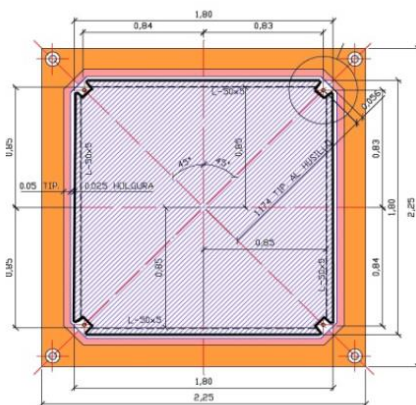


Fig. 2. Option B: CE-2a size (external dimensions: 2.25 m square by 2.2 m high)

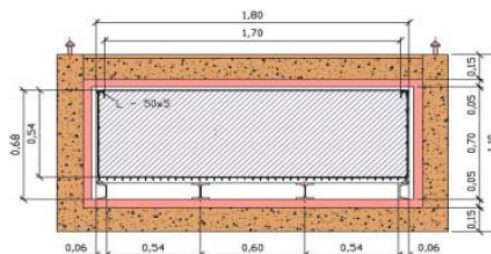


Fig. 3. Option C: CE-2b size (external dimensions: 2.25 m square by 1.1 m high)

## 3. Evaluation of decommissioning waste

In order to evaluate the amount of radioactive waste generated from decommissioning of Kori unit 1 reactor vessel, two options (option a, and b) considered in Spain was employed in this paper. Fundamental assumptions and

evaluated radioactive waste amounts are described in the following section.

### 3.1 Assumption

- Dismantled reactor pressure vessel is classified as low level radioactive waste.
- Body part of reactor pressure vessel is considered cylinder. (do not consider pipes etc.)
- Upper and bottom heads are assumed as hemi sphere. (do not consider pipes etc.)
- The reactor vessel is made of steel.
- Disposal container is filled with cement mortar after placing dismantled reactor vessel pieces.

### 3.2 Radioactive waste amount

The amount of radioactive waste is mainly depending on cutting methods, packing, and disposal container. In this section, therefore, it is evaluated with 3 different cases which consider dimensions of dismantled reactor vessel pieces and containers.

#### 3.2.1 Option A: circular drum

- Dimension of disposal drum: 4.52 m in diameter by 2.72 m in height
- Upper head and bottom head are not cut.
- Height of reactor vessel body part: 2.42m

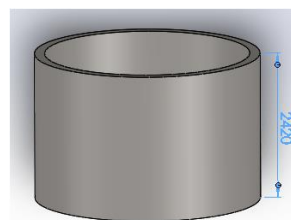


Fig. 3. Piece size (reactor vessel body part)

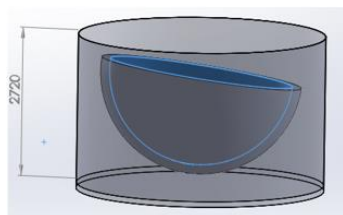


Fig. 4. Packaged piece: reactor vessel head part

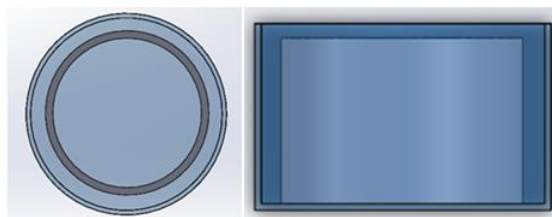


Fig. 5. Packaged piece: reactor vessel body part

3.2.1 Case 1) Option B: square drum with 8 pieces cutting of reactor vessel

- Size of drum: CE-2a size (external dimensions: 2.25 m square by 2.2 m height)
- Upper and bottom heads are cut into 6 pieces.
- Dimension of body part: 1.8 m in height, cut into 8 pieces.

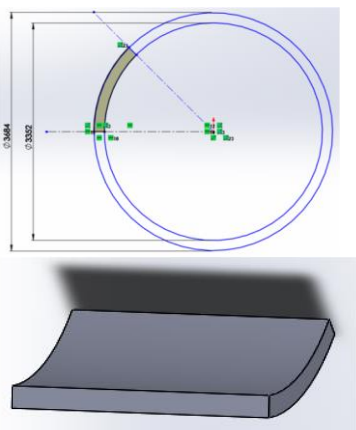


Fig. 6. Piece size (body part)

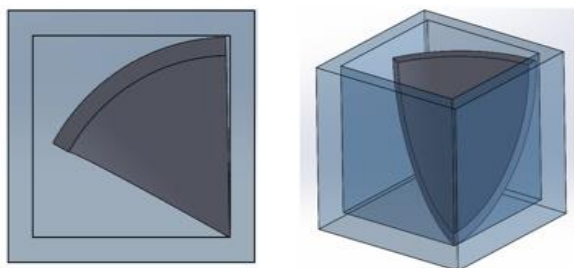


Fig. 7. Packaged piece from the reactor vessel head

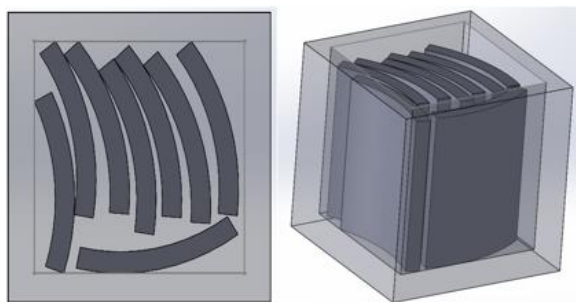


Fig. 8. Packaged piece from the reactor vessel body

3.2.1 Case2) Option B: square drum with 16 pieces cutting of reactor vessel

- Dimension of disposal drum: CE-2a size (external dimensions: 2.25 m square by 2.2 m high)
- Upper and bottom heads are cut into 12 pieces with half the height of the case 1) in the section 3.2.1.
- Dimension of body part: 0.9 m in height, cut 16ths.

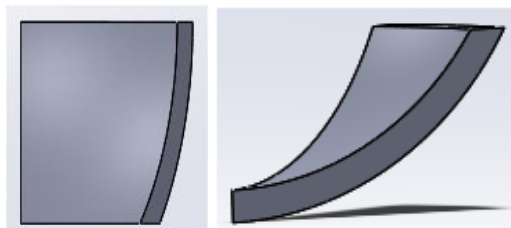


Fig 9. Piece size (head part)

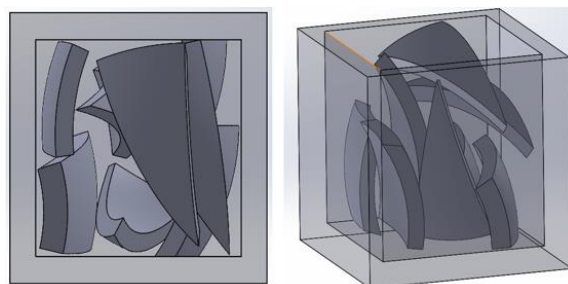


Fig. 10. Packaged piece from the reactor vessel head

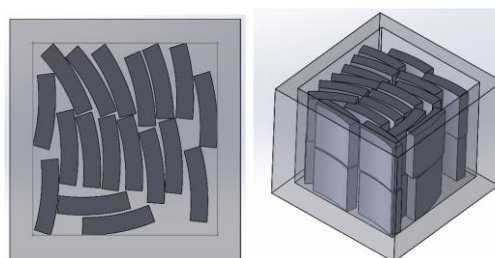


Fig. 11. Packaged piece from the reactor vessel body

Table II: Amount of radioactive waste from the reactor vessel in Kori unit 1

		No. of cut	Pieces (packaged /drum)	No. of Drum	Weight per drum	Total volume
Circular container	Upper and bottom	2	1	2	126	226
	Body	3	1	3	133	
Square container	Upper and bottom	12	1	12	29	178
	Body	32	8	4	45	
	Upper and bottom	48	8	6	32	111
	Body	128	36	4	45	

The weight per drum of circular container with minimum cutting pieces is more than 100 tonf. It is too heavy to lift by a crane in the radioactive waste repository.

In case of square container with the reactor vessel upper and bottom heads, if the head part is cut smaller, then total disposal volume decreases with increasing weight per drum. When a piece of head part is quarter of the case 1), the weight per drum increases about 10% and the total disposal volume decreases about 38%. Since the reduction on the total disposal volume of the packaged waste is larger compared to the weight increase per drum, it can be concluded that cutting the head and bottom heads of Kori unit 1 reactor vessel into smaller pieces under criteria of weight limit is more desirable.

### **3. Conclusions**

In this paper, the concept of cutting reactor vessel and container for decommissioning Kori unit 1 has been investigated. As a result of the investigation, it is found that cutting the reactor vessel into small pieces, especially for upper and bottom heads of the reactor vessel, is more effective to reduce total disposal volume generated from decommissioning.

### **4. Acknowledgement**

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### **REFERENCES**

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