

Dismantling Process Development of the Containment Building of Nuclear Power Plant

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1. Introduction

Containment Building (CB) is expected to take the longest time to dismantle power block buildings of nuclear power plant, which is the most technologically complex building. Therefore, this paper is to understand the dismantling method of the CB, the sequence of work, advantages and disadvantages of each method. And the studies of daily workload to estimate the time required for the dismantling of the CB have been followed, based on domestic and foreign references.

2. Demolition method

Two types of construction methods can be considered: demolition of the CB from top to bottom and demolition from bottom to top.

2.1. Top-down demolition method

All the equipment in the CB will be demolished including SG/RCP/Pressurizer & RV. And decontamination of the building will be followed by Cavity drainage and cleaning. The demolition of the concrete starts from the roof of the CB, sequentially from top to bottom.

[Sequence of the work]

- Concrete & Liner Plate Demolition of CB Dome & Upper Part of Exterior Wall (up to Polar Crane Rail, Top. ~ El. 135')
- CB Polar Crane and Girder Demolition
- Liner Plate Demolition of the Middle Section of CB Wall (Polar Crane Rail Location ~ El.72')
- Concrete Demolition of the Ground Part of the Surrounding Buildings including Aux. Bldg. (Roof ~ El.17' Foundation)
- Concrete Demolition of CB Exterior Wall above Ground (El.135' ~ El.20')
- CB Internal Concrete Demolition (whole)
- CB Liner Plate Lower and Bottom Part Demolition
- Concrete Demolition of Underground Part of the Surrounding Buildings & CB (El.17' or less)

The advantage of this method is a less difficulty to work and relatively short construction period because it is crushed sequentially from the top. The disadvantage is the availability of high-crushing equipment and scattering of crushed materials

- A medium-sized backhoe breaker is mounted on a dome with the large crane to crush, which can be broken except for the edge of the dome (SONGS-1 application method)
- The edge of the dome and upper part of outer wall are crushed by using the breaker and the wire saw (SONGS-1 application).
- When demolishing CB Polar Crane and Girder, these are pulled out from the outside with a large crane.

2.2. Bottom-up demolition method

The top elevation of the CB is 220' high, with a ground level 20'. Thus in case crushing from the top is inadequate, crushing the outer wall from the bottom-up might be alternatively considerable.

[Sequence of the work]

- Concrete Demolition of the Ground part of the surrounding buildings (Roof ~ El.17' foundation)
- CB Internal Concrete Demolition (down to El. 20')
- CB Polar Crane and Girder Demolition
- CB Liner Plate & Concrete Wall Demolition (Top ~ down to El.20')
- CB Liner Plate & Internal Concrete Underground Demolition (El. 20' ~ Bottom Plate)
- CB Foundation Concrete Demolition (El. 20' or less)
- Concrete Demolition of the Underground part of the surrounding buildings (El.17' or less)

The disadvantages of this method are inefficient and time consuming due to pre-dismantling of the internal concrete structure.

- In the Maine Yankee's case, many parts of the outer wall were broken with a breaker, and the remaining outer walls were demolished by blasting.
- An important precondition for this shall be established in a way that the surrounding buildings, the inside concrete structures of the CB and the Polar Crane and Liner Plate must be removed, in

advance before the crushing of the outer wall.

3. Daily workload for demolition of CB

Based on the two demolition methods, the amount of work and the required time for each detailed work will be estimated assuming the work speed. The daily workload is estimated by reference to the domestic construction standard and foreign data, and it can be adjusted according to the improvement of the equipment efficiency or the actual data of similar work process in the future as below.

[Reference for Daily Workload]

- Reference 1: Domestic Standard of Construction Estimate (Chapter 9 Mechanization Construction)
 - 9-14 : Large Breaker
 - Combination Machine: Large Breaker + Excavator 0.6 ~ 0.8 m³

	(m ³ /hr)
Item	Reinforced Structure
Average thickness of structure over 30cm	1.4 ~ 2.7

- Reference 2: DeCAT, Decommissioning Cost Analysis for the Korean pressurized Water Nuclear Power Plant
 - UCF 915, Removal of Reinforced Concrete by Diamond Wire Cutting
 - Workload : 3.3 m³/day
 - Maine Yankee Performance : 20 ton/20 hour
- Reference 3: AIF/NESP-036 Guidelines for Producing Commercial NPP Decommissioning Cost Estimates
 - Work Type : Removal of Standard Reinforced Concrete
 - ✓ Work Method : Removing with Backhoe mounted demolition hammer, and shredded concrete removed with backhoe, 8 hours work a day
 - ✓ Workload : 9.5 cubic yard / day (= 7.26 m³/day)
 - Work Type : Removal of Grade Slab Concrete
 - ✓ Work method : Removing with the Air powered tool, 8 hours work a day
 - ✓ Workload : 25 cubic yard / day (=19.11 m³/day)

[Review Result for Daily Workload]

- Domestic Standard of Construction Estimate (Civil Sector) classifies reinforced and non-reinforced structures. It suggests workloads under various

conditions taking into account working conditions, including work areas and obstacles.

- DeCAT, UCF 915 is likely to be applicable on some special parts, including RPV and SG bottom by wire cutting method.
- Therefore, it is reasonable to apply the average workload considering the use of equipment with large breaker in hydraulic backhoe and "over 30 cm thick reinforced structure" according to the Domestic Standard of Construction Estimate.
- This is similar figure to the average of the two standard values for concrete removal work proposed in AIF/NESP-036.

4. Conclusion

In order to establish the plan for demolition process of the Kori Unit 1 entire buildings, the demolition method and process of the containment shall be preferentially considered. And then it is reasonable to firstly review the demolition process of CB, secondly the surrounding buildings. The top-down demolition method is recommended to have more advantages than the bottom-up demolition, when it comes to the structure inside the CB, the Polar Crane demolition, and safety of the workers. Next step to review is that-the dismantling of the CB will be inefficient in case of the traditional crushing method due to the high-strength concrete and the complexed reinforcement bars. In addition working space and the work efficiency should be carefully regarded for the "work at height" and its equipment selection when estimating the daily workload.

REFERENCES

- [1] Domestic Standard of Construction Estimate, Construction Research Institute, 2018.
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- [3] AIF/NESP-036, "Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates", 1986.5.