Case Study on Large Component Removal in Decommissioning of Commercial NPPs in USA

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1. Introduction

For the safe and effective decommissioning of nuclear power plants (NPPs), technological basis for regulatory control on decommissioning of current and future NPP facilities should be established, inclusive of regulatory policy for NPP decommissioning and regulatory technology for NPP site decontamination and remediation. For establishment of safety regulatory policy, it is important that the scheme for decommission of NPP facilities should be prepared, which can be referred to the decommissioning experiences conducted in the United States. In this paper, therefore, the decommissioning of five commercial NPPs with PWR type in the United States is reviewed and investigated, especially for the decommissioning of large components in the primary system including reactor vessel, steam generator, and pressurizer.

2. NPPs Decommissioned in USA

2.1 Generals

For five NPP facilities decommissioned in the United States, Table 1 summarizes general information about reactor capacity, commercial operation time, and decommissioning period. All NPP facilities investigated in this paper have a PWR type; Maine Yankee NPP and San Onofre NPP consist of three loops in the primary loop while Connecticut Yankee NPP and Trojan NPP consist of four loops in the primary loop.

Table 1: General Information of Five Decommissioned Nuclear Power Plants Considered in this Study

	Reactor Capacity (MWe)	Commercial Operation	De-commission
Trojan	1,130	1976~1993	1996~1999
Maine Yankee	860	1972~1996	1997~2004
Connecticut Yankee	619	1968~1996	1996~2006
Rancho Seco	913	1975~1989	1989~2007
San Onofre	450	1968~1992	1999~2008

2.2 Dismantling of Reactor Vessel

One of the important issues on decommissioning of NPP facilities is dismantling of reactor vessel which is one of the most radioactive components in NPP facilities. The procedures to remove a reactor vessel can be divided into two methods; 1) reactor vessel and internals are separated before removing, and 2) reactor vessel including internals is removed together without segmentation and separation. In the case of the first option, after separation of internals from a reactor vessel, reactor vessel can be removed after segmentation or can be removed as one piece without segmentation. The second option has been chosen for decommissioning of Trojan NPP while the first option has been chosen for the other four NPPs.

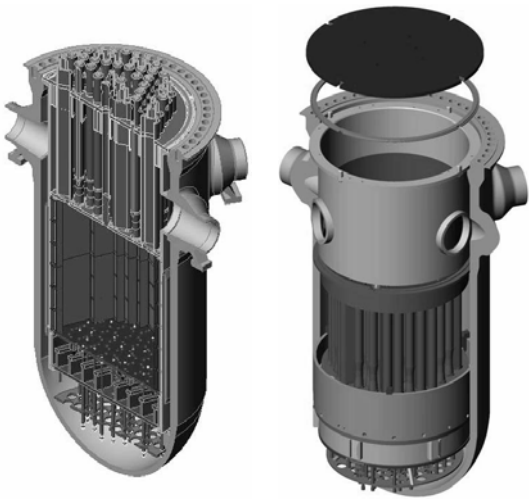

Fig. 1. Maine Yankee RPV and Internals Prior to Segmentation.

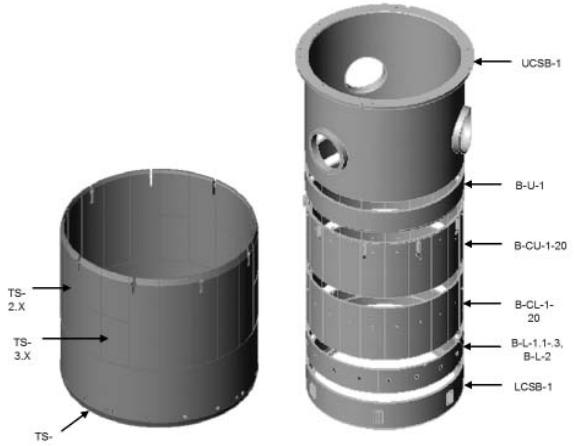

Fig. 2. Maine Yankee Projected Cuts on Thermal Shield and Core Support Barrel.

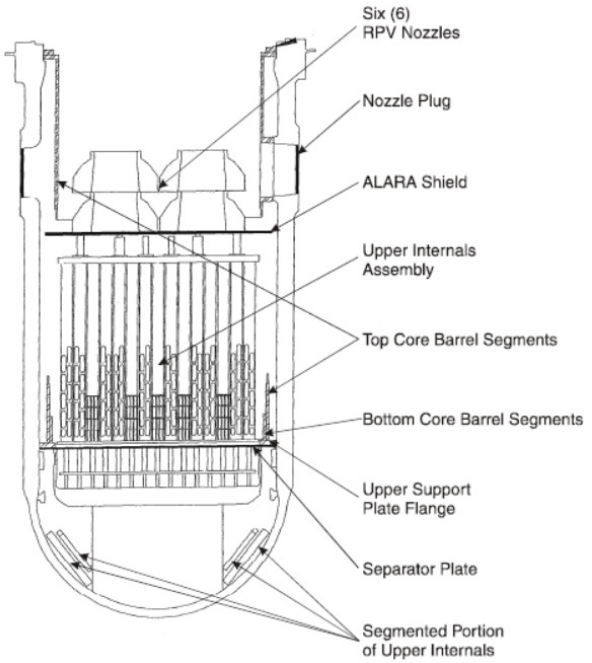

Fig. 3. Final RPV Configuration at the Time of Shipment, Connecticut Yankee.

Fig. 4. Reactor Package, Trojan.

2.3 Removal and Shipping of Large Components

Removal and shipping of large components is depending on the size of a hatch: whether large components can be moved outside through a hatch or not. In most reactor containment buildings recently constructed, a hatch has been prepared to move-in and move-out a reactor vessel, steam generator, and so on, so that it makes removal and shipping of large components easier. On the other hand, if there is no hatch or hatch size is not enough, opening through wall or roof of a reactor containment building should be prepared for removal of large components from the containment building.

In San Onofre NPP, the bridge crane inside the containment sphere was not capable of handling large components. The reactor containment building consisted of two-layers of structures; the containment sphere made of steel and the Doghouse constructed of reinforced concrete. Therefore, it was decided that openings should be cut into the top of the containment sphere directly above each of the large components, after removing the entire roof of the Doghouse. Then, the steam generators and the pressurizer can be lifted and removed by a Lampson Transi-lift LT1200 crane approached to the containment building.

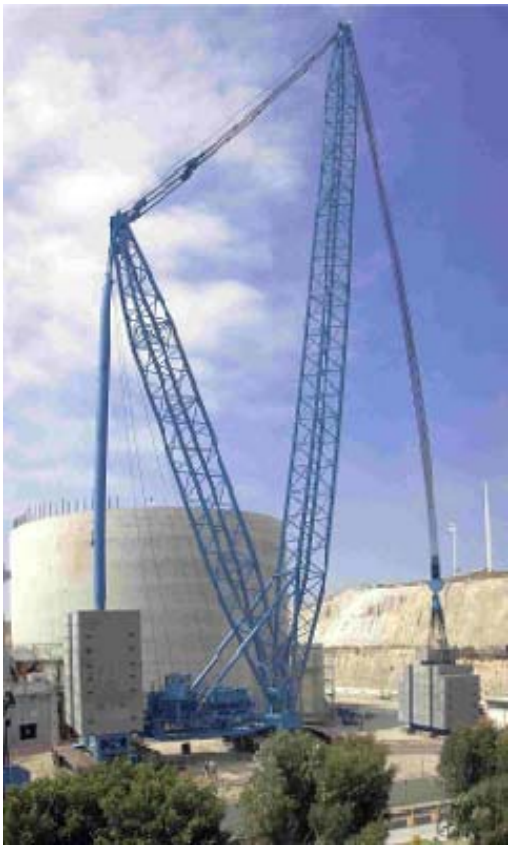

Fig. 5. Lampson Transi-Lift 1200 Crane.

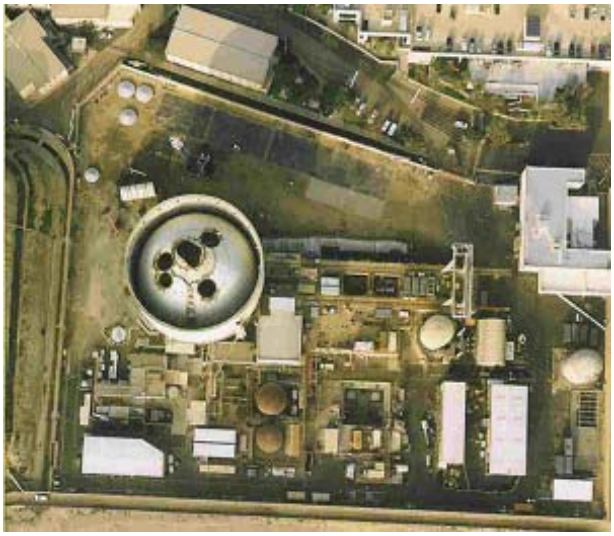

Fig. 6. Aerial View of Containment Sphere, San Onofre.

In Trojan NPP, it was decided to dismantle the reactor vessel and internals together without segmentation, so an opening big enough to pass the reactor had to be prepared. Since the reactor containment building was unbonded post-tensioned, detensioning had been completed for all of the tendons. After detensioning and removal of the all tendons, concrete and reinforcement bars were cut in order to make an opening at the containment building wall in the path of the reactor vessel being removed.

Fig. 7. Opening into Containment, Trojan.

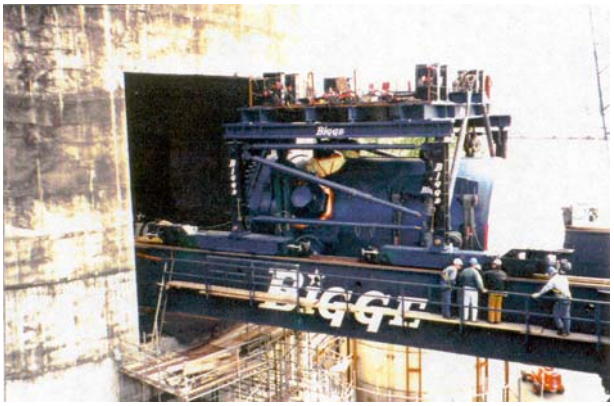

Fig. 8. Reactor Moved Outside, Trojan.

3. Conclusions

In this paper, five PWR nuclear power plant facilities decommissioned in the United States have been reviewed and investigated. As results of the investigation, it was found that various procedures can be considered for dismantling and removal of large and heavy components such as a reactor vessel, steam generator, pressurizer, and so on. For safe and effective decommissioning, an appropriate dismantling procedure has been chosen with considerations of site characteristics. The results summarized in this paper can be useful on decision for decommissioning of the nuclear power plants in this country.

4. Acknowledgement

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