

## Lessons Learned for Decommissioning Planning

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### 1. Introduction

After the decision to place Kori unit 1 in a permanent shutdown state in June 2017 has made recently, the Kori unit 1 entered into a decommissioning planning period where the ultimate goal is to be fully ready for its decommissioning. Since the readiness for the decommissioning can be achieved through a well-made decommissioning planning, the decommissioning planning for the Kori unit 1 should be performed with as much information as possible.

For Korea having little decommissioning experiences for commercial nuclear power plants, it is imperative to make an in-depth review of lessons learned which most nuclearized countries have learned from their decommissioning experiences including those for the decommissioning planning.

The purpose of this paper is to introduce the U.S. nuclear industrial's some key lessons learned especially for decommissioning planning based on which well-informed decommissioning planning can be carried out.

### 2. Factors to be decided during Decommissioning Planning Period

The U.S. industry experiences indicate that, during the decommissioning planning period, the following factors should be decided or given due consideration.

#### 2.1 End State of a Site

The end state of a site means the availability of a site for other uses after decommissioning with the residual radioactivity level of a site meeting the requirements of the site release criteria. Usually, the site release criteria are represented by Derived Concentration Guideline Levels (DCGLs), measurable concentrations for radionuclides present at a site, at which the presence of the radionuclides results in a dose equivalent to the site release criteria. Since the whole decommissioning processes can be planned only after the end state of a site is decided, the decision should be made at the earliest stage of decommissioning planning.

In most nuclearized countries, the decision for the end state of a site can be made between unrestricted and restricted releases: the former requires a lower level of residual radioactivity (that is, lower DCGL) present at a site than does the latter. As a result, a decommissioning project which aims at the unrestricted release costs more than that for the restricted release, as the former requires a lower level of site cleanliness thereby producing more radwaste than does the latter. Besides, the decision

gives guidance for most of decommissioning technologies needed for achieving the end state of a site, thereby affecting the whole decommissioning project. If a site will be still owned by the operating company after decommissioning, the decision for the restricted release can be made because the constitutional controls for some exposure pathways can be implemented by the company.

#### 2.2 Overall Decommissioning Strategy

The overall decommissioning strategy means how to decommission a plant. Although there are three kinds of options such as DECON (immediate decommissioning), SAFSTOR (deferred decommissioning) and ENTOM (burial of a reactor without decommissioning), a recent trend is to choose DECON, mostly because decommissioning can be performed with the involvement of personnel who have information and knowledge on the plant are available, and that the public concerns can be minimized. On the other hand, SAFSTOR is generally employed when the fund for decommissioning is not sufficient so that it is needed to await the accumulation of the fund. The one of merits of SAFSTOR is that, because the decommissioning occurs after some time period, the radiation level at that time will be lower than that of DECON. ENTOM option is seldom employed because it leaves the plant behind forever without decommissioning as in the Chernobyl site. In practice, choice between DECON and SAFSTOR is determined according to the logic given in Fig. 1.

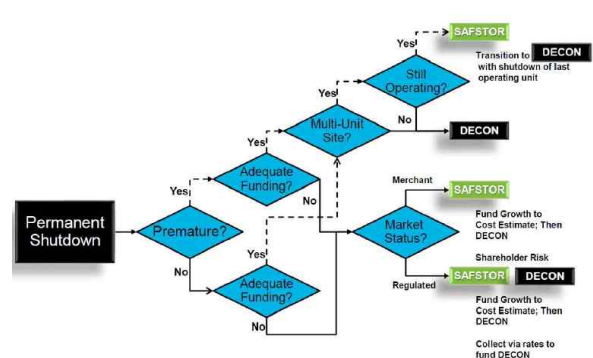


Fig. 1. Logic for choice of overall decommissioning strategy.

#### 2.3 Management of Spent Fuel

One of the critical paths affecting the decommissioning project is a path for how to manage the spent fuel removed from a reactor after permanent shutdown of a plant. Ideally, the defueled spent fuel is transferred to disposal site after 5-7 year cooling period in spent fuel

pool to remove decay heat. However, when such a final disposal facility is not available, options for interim storage of the spent fuel should be considered. There are two options, wet and dry interim storages: the former stores the fuel in the spent fuel pool designed for a long term operation and the latter stores the fuels in a dedicated facility such as an Interim Spent Fuel Storage Installation (ISFSI). Although initial investment for the former is smaller because it modifies the previous spent fuel, its higher operation and maintenance costs render the former as an uneconomic option relative to the latter. So, most U.S. utilities are storing their defueled spent fuels in the ISFSIs near the sites.

#### 2.4 Spent Fuel Pool Island

Before the spent fuels are transferred to the ISFSIs, U.S. industry is employing a unique approach for storing the fuels, so called 'Spent Fuel Pool Island Project', which isolates the operation of the spent fuel pool from other systems by modifying the existing cooling system for the spent fuel pool. There are two reasons for this approach. First, it is much cost saving to retire CCW and ESW systems whose original capacities are designed to remove the heat produced during normal operation, mainly from fuels in a reactor which are defueled in an initial phase of the permanent shutdown. To retire these systems, the cooling system for the spent fuel pool, the sole remaining heat source, should be replaced by a much simplified (e.g., skid-type) one. Fig. 2 shows an example of the SFPI at San Onofre Nuclear Generation Station (SONGS).

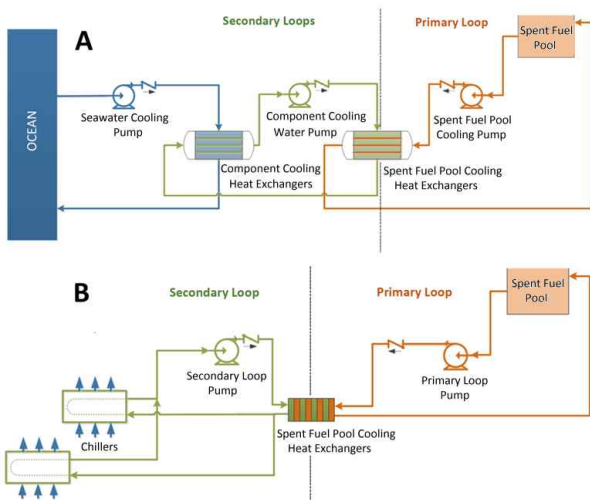


Fig. 2. Spent Fuel Pool Cooling System (A) before SFPI and (B) after SFPI at SONGS.

Second, this strategy is very advantageous to utilities because the isolation of operation of the spent fuel from other parts of a plant allows decommissioning activities to occur in the remaining part even before the spent fuels' transfer to the ISFSI is completed. That is, delay in transfer of the spent fuel does not affect the original

schedule of decommissioning at the remaining areas. Therefore, this strategy should be sought in Kori unit 1.

### 3. Conclusions

For a successful decommissioning, it is crucial to carry out a well-organized decommissioning planning before the decommissioning starts. This paper discussed four key factors which should be decided or considered carefully during the decommissioning planning period with introduction of related decommissioning lessons learned of U.S. nuclear industry.

Those factors which have been discussed in this paper include the end state of a site, the overall decommissioning strategy, the management of the spent fuels, and the spent fuel pool island. Among them, the end state of a site should be decided first as it directs the whole decommissioning processes. Then, decisions on the overall decommissioning strategy (DECON vs. SAFSTOR) and the management of the spent fuels (wet vs. dry) should follow. Finally, the spent fuel pool island should be given due consideration because its implementation will result in much cost saving.

Hopefully, the results of this paper would provide useful inputs to performing the decommissioning planning for the Kori unit 1.

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