Essential Factors of Decommissioning Strategies for Korean Nuclear Industry

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1. INTRODUCTION

Kori-1 unit came into shutdown on June 18 2017 which is the first commercial nuclear power plant being decommissioned in Korea in accordance with the Korean government's decision in June 2015. Kori-1 has generated 576 MWe electricity capacities since 1978, plus a refurbishment for 10-year extension. This article is prepared to factor out decommissioning strategies mostly appropriate to the decommissioning Kori-1 nuclear power plant.

Terms used to delineate the lifetime of an authorized facility and of the associated licensing process consists of six core stages such as siting, design, construction, commissioning, operation and decommissioning. The term decommissioning implies the administrative and technical actions taken to allow the removal of some or all of the regulatory controls from a facility except for the part of a disposal facility in which the radioactive waste is emplaced [1]. Whole range of each process of decommissioning should be considered throughout the other five stages. The decommissioning process is typically composed of its planning, conducting actions and terminating the authorization.

2. GLOBAL DECOMMISSIONING INDUSTY

The prospects of the global decommissioning industry could be demonstrated in the Figure 1 assuming the time for immediate and deferred dismantling is 10 and 50 years respectively. At the stage of the introduction, from 1960s to 1980s, the industry was led by the USA whose scale of the market is $353 million on the yearly basis reached to the accumulation of $8,109 million. The growth stage after the Chernobyl accident whose scale of the market is $1,219 million on the yearly basis reached to the accumulation of $30,485 million. In the matured stage after the Fukushima accident, the scale of the market is $4,016 million on the yearly basis reached to the accumulation of $201,186 million.

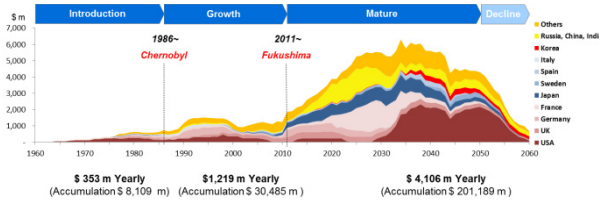

Fig. 1. Global Decommissioning Industry.

It is expected the decommissioning industry would be into the stage of decline after 2020 in nations such as UK, France, and Italy. Korea, however, is supposed to be into the growth stage from 2030s in the case of one time extension, or 2050s in the case of twice extensions each.

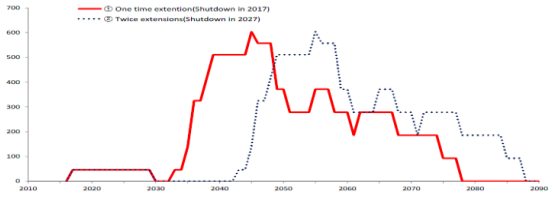

Fig. 2. Scale of Decommissioning in Korea.

Since new government declared the nuclear energy free strategy, more efforts of not only physical and financial source should be prepared from the early stage in a scrutinized manner.

3. DECOMMISSIONING STRATEGY

In order to accomplish successful decommissioning, strategies for decommissioning adopted should be the essential element. Normally, immediate dismantling and deferred dismantling are suggested as the principle consideration for the decommissioning applicable for all nuclear related facilities [1, 2].

Immediate dismantling could be apt to the case that decommissioning actions begin shortly after the permanent shutdown. Equipment and structures, systems and components (SSCs) of a facility containing radioactive material are removed and/or decontaminated to a level that permits the facility to be released from regulatory control for unrestricted /restricted use on its future use. On the other hand, deferred dismantling is an alternative to apply to the case that after removal of the nuclear fuel from the facility, all or part of a facility containing radioactive material is either processed or placed in a safe storage and the facility maintained until it is subsequently decontaminated and/or dismantled. A combination of these two strategies may be considered practicable under the circumstance not to violate safety and environmental requirements, technical availability, local conditions. Entombment is not an option in the case of planned permanent shutdown. It might be considered only under exceptional circumstances such as the Fukushima event [3].

4. IMPACT FACTORS ON STRATEGY [2]

4.1 Legislative and regulatory requirements

Each countries having nuclear power plants under construction or in operation or in consideration of

decommissioning has different regulations governing decommissioning strategies. For instance, the US Nuclear Regulatory Commission (NRC) limits the safe enclosure period up to 60 years, UK, however, allows dismantling to be delayed for Magnox reactors and for them to be kept in a safe enclosure mode for more than 100 years. Such a long period allows levels of radioactive decay so that workers could work on a Magnox reactor without limitation, and also allows the accumulation of decommissioning funds. However, this policy is being reconsidered.

From the perspective of responsibility, a facility's operator has the primary responsibility for all technical and financial measures except for the disposal of radioactive waste which is under the supervision of national regulatory bodies or national agencies.

4.2 National waste management strategies

The most crucial regulatory requirements are related to clearance criteria. International recommendations for exemption and clearance have been issued by IAEA and European commission. These specify radiological concentrations below which material can be considered to be non-radioactive and released from regulatory control. Such protocols are now established in many countries such as Germany, UK, USA, South Korea etc.

4.3 Future use of site

An alternative of decommissioning strategy would rely on the planned future use of the site. In case of lacking of sites for new plant construction, the owner may choose to reuse a site for a new plant. In this case, immediate dismantling may be the good choice. If the plant to be decommissioned is in the multi-plant site, safe enclosure may be the preferred choice. In this case, the necessary security, surveillance and maintenance for the shutdown facility could be provided by the remaining operating facilities. The examples of reuse of the sites decommissioned are such that the turbine building of a decommissioned plant was reused for a fossil fired plant (Fort, St. Vrain, USA), the chinon-1 nuclear power plant in France was converted into a museum, Part of the Greifswald nuclear power plant in Germany is being converted into a biodiesel production facility.

4.4 Radiological factors

While the remaining residual radioactive will present smaller risks compared to that of an operating reactor, it should be taken good care for the workers, the public and the environment during decommissioning. Currently technological breakthroughs in electronics, robotics and remote handling have considerably reduced the hands-on works to highly contaminated area. Hence, it has set aside the importance of radiological factors in selecting a decommissioning strategy.

4.5 Availability of technology and other resources

In general, decommissioning technology is more available in countries with much experience. Such countries have both expertise and experience related to their nuclear technologies and resources In this sense, technology setting is also one of the important factor to perform a decommissioning.

4.6 Stakeholder considerations

Due to widespread heightened public sensitivity to environmental protection, any waste management or decommissioning decision will typically require thorough public examination and the involvement of many stakeholders. The diversity of relevant social, political, economic, and cultural environments makes it difficult to develop universally applicable guidance. However, we have to find in the experience of other good practices that can be adapted to our own project.

4.7 Decommissioning cost and funding

Whatever choice and decisions are made, it is the responsibility of the plant owner to make financial provisions sufficient to cover the cost of all stages of decommissioning in accordance with pertinent national legislation and funding requirements. Korea has established legal provisions to decommission Kori-1 and accumulate appropriate liability for the reaming facilities.

4.8 Knowledge management

The decommissioning of a nuclear facility should be considered from the earliest stage of its life cycle, and emphasis should be given to eh acquisition and maintenance of all relevant records.

5. CONCLUSION

Technically, decommissioning is a mature industry; many steps and processes are similar to maintenance, storage, and transport procedures experienced during the operation. However, to minimize hazardous and radioactive materials as much as possible produced in process of decommissioning should be the focused issue for the protection of workers, the public and the environment. In order to achieve the successful decommissioning, the impact factor on the strategy should be analyzed and evaluated to optimally apply to Kori-1 project. From my perspective, among eight factor, stakeholder's consideration and spent fuel management are considered the key elements we have to concentrate on to smoothly go ahead for successful decommissioning of Kori-1.

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