

Physical Protection Considerations for Decommissioning Nuclear Power Plant

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1. Introduction

The six major stages in the lifetime of a nuclear power plant and of the associated licensing process are siting, design, construction, commissioning, operation, and decommissioning. And the term 'decommissioning' refers to the administrative and technical actions taken to allow the removal of some or all of the regulatory controls from the facility [1].

Kori 1 started commercial operation in 1978 and got a relicensing for a further ten years in 2007. And it was permanently shut down in 2017. The nuclear licensee will submit a decommissioning plan within 5 years and conduct decommissioning phase.

During a decommissioning phase of a nuclear power plant, simply the physical protection measures should be maintained until removing of all nuclear material. The level of physical protection measures will be down based on decommissioning steps. And other facilities such as radioactive waste storage might be needed and should be considered with regards to physical protection as well.

This paper discuss considerations for decommissioning nuclear power plant with respect to physical protection measures.

2. Decommissioning Steps for PP measures

Typically decommissioning includes planning for decommissioning, conducting decommissioning actions and terminating the authorization for decommissioning. In this paper, some decommissioning steps are identified from a physical protection perspective.

Figure 1 shows the decommissioning steps from a physical protection perspective.

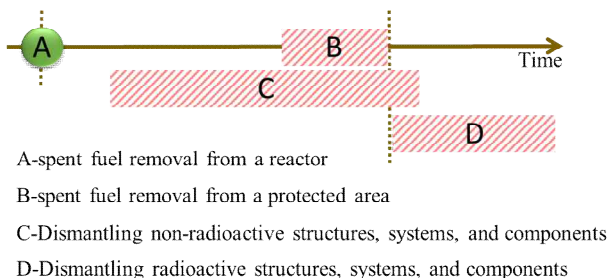


Fig. 1. The decommissioning steps from a physical protection perspective.

Security risk is affected by locations of nuclear material and facility conditions. Therefore, one of the

main decommissioning step is removing spent fuel from a reactor (step A) or a protected area (step B). The security risk is reduced with removing nuclear material. So these steps could change physical protection measures. Another steps are dismantling structures, systems or components (step C, D). Sometimes facilities of decommissioning and operation phase coexist inside of a same physical protection area. So dismantling step could affect the other operation facility. And radioactive waste management facilities are additionally needed during dismantling step. It is a debated issue that the radioactive waste management facilities are regulation targets of physical protection or not. In case of the Korea, the radioactive waste management facilities are controlled of physical protection. For example, the Korea Radioactive Waste Agency which deals with low and intermediate level radioactive waste is regulated with respect to physical protection measures.

3. PP Considerations for Each Decommissioning Steps

Removing spent fuel from a reactor (step A) changes the plant's safety conditions, and the vital area identification process should be repeated when design changes are being considered or prior to their implementation [2]. Some of systems or components which are identified as a vital equipment during operation phase are no longer needed, and less equipment has to be protected. Therefore, the vital areas should be re-identified after removing spent fuel from the reactor. Physical protection measures such as access controls, alarm systems, patrols, searches of the eliminated vital areas could be reduced. However, the act on physical protection and radiological emergency (APPRE), which is a legislative framework of the national physical protection and provides physical protection requirements, does not force to identify or re-identify of vital areas. Only a definition and some protection requirements for the vital area are mentioned. So a requirement for identification and re-identification of vital areas based on the facility conditions should be incorporated in the APPRE. And the protection requirements should be more specific.

The next decommissioning step from a security point of view is removing the whole nuclear material, i.e. spent fuel, from the protected area or the nuclear site (step B). Before implementing this step, another spent fuel pools or interim storage facility or permanent disposal facility are necessary for receiving the spent fuel. And physical protection measures to meet

protection requirements for unauthorized removal and sabotage should be applied to those. The measures could be a simple supplement of security personnel or establish a new PP system, and it is mainly affected by the location of the facilities. However, even a simple facilities increase physical protection risks, and additional physical protection measures might be a new burden to the nuclear licensee. So the licensee should consider physical protection measures of the new storages for the spent fuel before they plan and decide establishment of new storages.

Removing the whole nuclear material means spent fuel transportations, it takes a long time and happens periodically. A long-term periodic nuclear material transportations are contrary to the IAEA recommendations that refer to the minimizing the number and duration of nuclear material transfers [3]. And other physical protection requirements should be applied. For example, the nuclear licensee should develop a transportation plan to avoid the use of predictable movement schedules by varying times and routes according to the APPRE.

Another security related decommissioning step is dismantling non-radioactive structures, systems and components (step C). When dismantling starts the facility changes like a construction facility. Dismantling activities such as segmentation, cutting and milling require more workers and tools, and make vibrations which affect the other operational phase of plants. Sometimes the decommissioning and operational phase of plants coexist in a same protected area, and in this case more physical protection concerns for operational plants are needed. The workers for dismantling could access operational plant or common/shared systems. Therefore, additional physical protection measures such as dividing protected area or supplementary access point for operational plant are needed. Furthermore, the APPRE should be modified to handle this issue. It is focused on an operational phase, not the whole life cycle of facilities. There are no physical protection considerations, such as specific requirements, for operational phase of a plant with decommissioning or construction phase of plants.

Dismantling radioactive structures, systems and components (step D) needs physical protection considerations as well. Dismantling generate large amounts of fluid, dust and solid waste, and interim storage facilities of radioactive waste might be built on site. Those buildings need physical protection measures such as access control, alarm, surveillance, etc.

Physical protection related decommissioning steps and physical protection considerations of each steps are shown in table I.

Table I: PP considerations for each decommissioning steps

Step	PP Considerations
A	Re-identification of vital areas

B	PP measures of the new spent fuel storage PP measures for nuclear material transport
C	PP concerns for operation plant in the same protected area
D	PP measures of the new radioactive waste management facilities

A-spent fuel removal from a reactor

B-spent fuel removal from a protected area

C-Dismantling non-radioactive structures, systems, and components

D-Dismantling radioactive structures, systems, and components

4. Conclusions

Kori 1 has been permanently shut down since 2017, and the KHNP, nuclear licensee, should submit decommissioning plan within 5 years. After then the Korea's first decommissioning starts.

It is predictable that several physical protection related issues including insufficiency of legal system will be brought up with beginning of decommissioning. Therefore, those issues should be found and discussed. Some of those issues are discussed in this paper.

The decommissioning steps are identified with regards to physical protection, and some predictable issues are mentioned. And, appropriate solutions, such as suitable physical protection requirements for each decommissioning steps could be discussed and developed while the decommissioning plan is made.

REFERENCES

- [1] IAEA Safety Standards Series No. GSR Part 6, Decommissioning of Facilities, 2014
- [2] IAEA Nuclear Security Series No. 16, Identification of Vital Areas at Nuclear Facilities, pp.2-5, 2012.
- [3] IAEA Nuclear Security Series No. 13, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Rev.5), 2011.