Estimation of On-Site Dry Storage Capacity Needed Based on Current Nuclear Policy in Korea

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1. Introduction

Most countries where the national policy for the spent fuel (SF) is "wait and see" are faced with a big problem in wet storage capacity of the nuclear power plant (NPP). One solution for those countries is constructing an on-site or off-site interim storage facility, such as a dry storage facility. Based on an assumption that one dry storage facility would be arranged at each NPP site in Korea, this work estimated the required construction time and capacity of dry storage through the dynamic simulation.

2. Korean Phase-out Scenario

Based on the present government policy on the nuclear power generation, its portion in the energy mix will fall away to zero in the future. Total 27 NPPs (23 PWRs and 4 PHWRs) are expected to be operated for about 60 years without extension of their lifetime and addition of new NPP (Fig. 1a). According to this policy, the accumulated SFs generated from NPPs are expected to reach 35,000 tHM (Fig. 2b). The annual SF generation is calculated as follows,

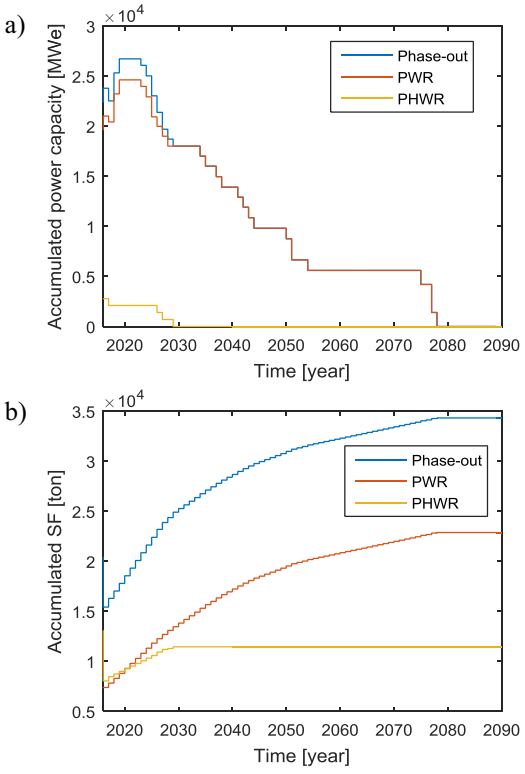

Fig. 1. Accumulated power capacity (a) and the amount of SFs generated (b) in the phase-out scenario.

$$m_{SF} = (P \times CF \times 365)/(\varepsilon \times BU) \quad (1)$$

where P is the accumulated power capacity, CF is the capacity factor, ε is the efficiency and BU is the burn up.

The government plan for decommissioning Kori#1 stopped 2017 [1] is to start work after cooling the PWR SFs in the wet storage for 7 years and releasing them from the wet storage. The released PWR SFs will be moved to the dry storage constructed until 2024 and stored temporarily for the final disposal. Like the plan for the Kori site, the required times of dry storage construction for other sites, Hanbit, Hanul and Wolsung, can be roughly estimated as 2032, 2034 and 2059, respectively.

Meanwhile, the committee for publicizing the SF management has estimated the saturation time of wet storage of all NPPs, which can be considered as the required construction time of dry storage [2]. Except for the Kori site, the estimated times based on the saturation of wet storage were earlier than the times based on the NPP decommissioning (Table 1). However, the required capacity of interim storage in the future has not been analyzed before.

Table 1. The estimated saturation times for wet storage of every NPP sites

Site	Capacity (bundle)	Current SFs (bundle)	Saturation rate (%)	Estimated saturation time (yr)
Kori	6494	5322	82.0	2028
Hanbit	9017	5413	60.0	2024
Hanul	7066	4652	65.8	2026
Wolsung	1046	64	6.1	2038

3. Dry Storage Capacity Estimation

Assumed one dry storage facility for one site, the required construction time and capacity of dry storage can be estimated based on the dynamic simulation of the PWR SF generation. Every NPPs are assumed to adopt the compact rack (at least twice) for maximizing the wet storage capacity. And also the transportation of SFs between NPPs in the same site is assumed to be allowed. The centralized interim storage and permanent disposal facilities are expected to be constructed 2035 and 2053, respectively, as announced from the government [3]. Their lifetimes are assumed to be 50 years.

As a result shown in Fig. 2, the required capacities are 2366.6 tHM for Kori, 2380.6 tHM for Hanbit and, 1204.1 tHM for Hanul. Wolsung doesn't require the dry storage. The required capacities for the interim storage facility and the disposal facility are 9258 tHM and 22875 tHM, respectively.

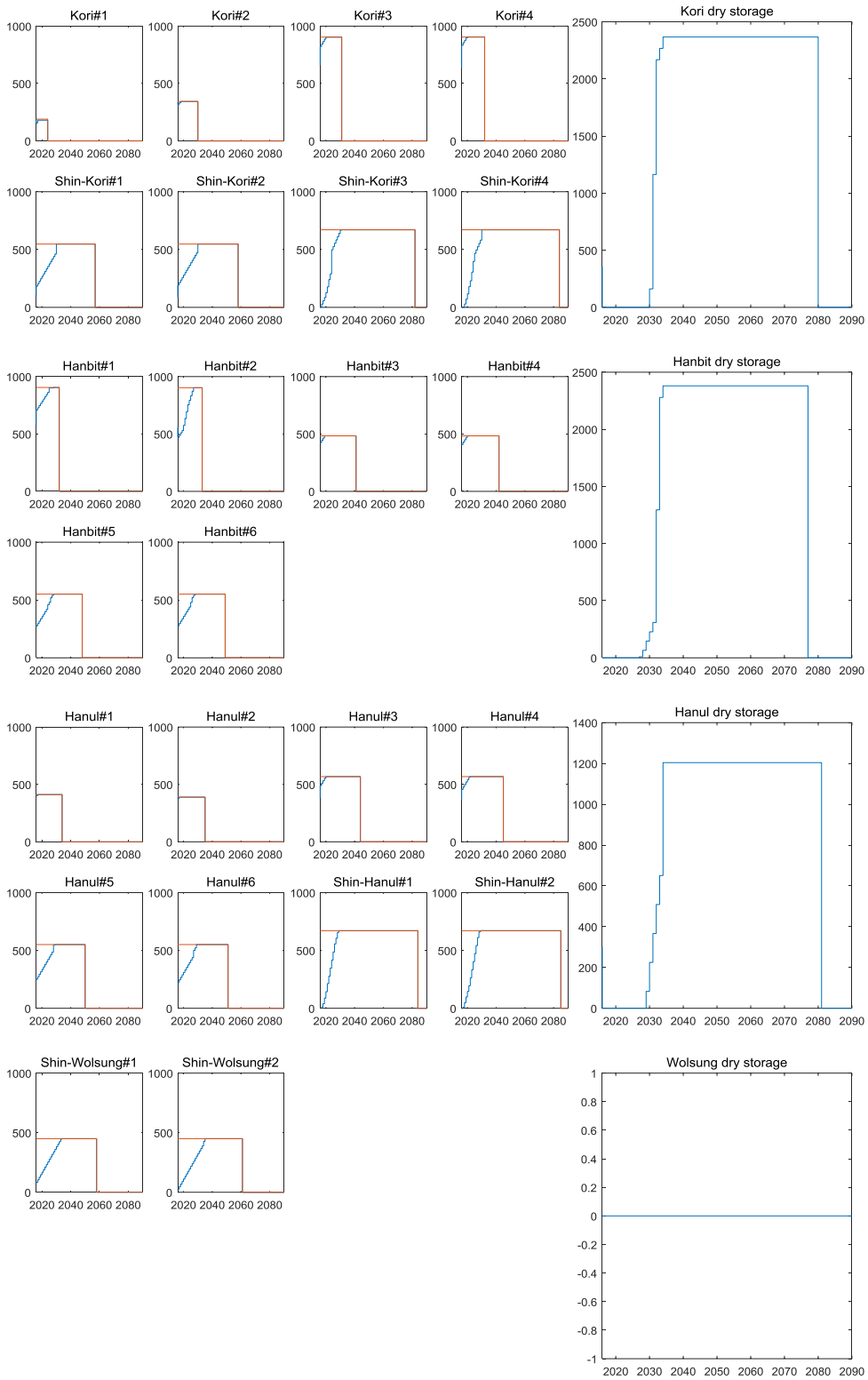

Fig. 2. The required time and capacity of on-site dry storage facility (y axis: accumulated SF [tHM], x axis: time [year]).

4. Conclusion

Based on the government policy for the nuclear power, we could estimate the required construction time and capacity of on-site dry storage for PWR SFs. As a future work, the constraint for the PWR SF transportation will be considered in the estimation.

REFERENCES

[1] MOTIE, Permanent shutdown of Kori No.1, 2017.
[2] PECOS, Proposal of recommendation for spent fuel management, 2015.
[3] MOTIE, Proposal of basic plan for high-level radioactive waste management, 2016.