

Requirements for Direct Radiation From SNF Dry Storage Casks

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1. Introduction

Dry storage casks for spent nuclear fuel(SNF) must be designed to meet the regulatory requirements in Korea Nuclear Safety Act[1] and US 10CFR72[2]. Shielding features for SNF dry storage casks must restrict direct radiation dose so that total dose due to radiation from the casks is within the regulatory limits. And dose rates for dry storage casks must be consistent with ALARA principles, which are incorporated into storage cask design to the extent practical. But dose rate limits for protection against direct radiation from SNF dry storage casks are not explicitly specified in any domestic and foreign regulation. Radiation dose rate limits for SNF dry storage cask based on US and Korea regulatory requirements were examined.

2. Regulatory requirements

Regulations in US 10CFR72 require that SNF dry storage casks are designed to provide sufficient radiation protection during normal operations, off-normal conditions, accidents and natural phenomenon events, all of which are referred as design-basis conditions, and that shielding design descriptions of storage casks to be in compliance with regulatory limits. Radiation limits rely on a variety of factors of cask array geometry of storage facilities, working time in storage facilities such as monitoring or remote operations, proximity to work areas or public access areas and other limitations for cask operations.

US 10CFR72 establishes radiation dose limits for SNF dry storage facilities(Fig.1) including dry storage buildings(Fig.2) : annual normal operations dose limit is 0.25mSv (10CFR72. 104(a)) and accident exposure limit 50mSv(10CFR72. 106(b)), for individual on or beyond controlled area boundary of storage facilities.

But specific dose rate limits on individual dry storage casks is not imposed. In SRP of USNRC NUREG-1536[3], NRC has accepted surface dose rates on SNF dry storage casks from 0.2 to 4mSv/h in shielding

assessment of canister-based storage cask designs(Fig.3). Radiation dose rate limits of transport casks under normal conditions of transportation in accordance with IAEA SSR-6[4] and US 10CFR71[5] is 2mSv/h on cask surfaces and 0.1mSv/h at 1m distance from casks for non-exclusive use or 10mSv/h on cask surfaces for exclusive use. These radiations dose rate limits are the same as those of Korea's regulatory requirements. Transportable dry storage casks(Fig.4) must be designed to meet these radiation dose rate limits for transport casks.

SNF dry storage facilities will be designated as a radiation control area. Radiation dose rate limits for the radiation control area shall be applied to the design of dry storage facilities in accordance with Korea's relevant regulations such as regulations on technical standards for radiation safety control[6]. In Article 3 of Regulation on technical standards, radiation dose rate limit outside the radiation control area is limited to 0.4mSv per week, which is based on annual worker exposure dose limit of 20mSv. And in Article 5 of regulation on technical standards, external radiation dose rate limits to maintain shielding capacity of maximum nuclear fuel materials storable at storage facilities is 1mSv per week, which is based on annual exposure dose limit of 50mSv. These limits are the same as design criteria on shielding structure of Korea NSSC notice for radiation protection[7].



Fig. 1. SNF dry storage facility.



Fig. 2. SNF dry storage building.



Fig. 3. Canister-based dry storage casks.



Fig. 4. Transportable dry storage casks.

3. Conclusion

Radiation shielding features of SNF dry storage casks must be sufficient for the design to fulfill the radiation dose requirements in the related regulations. US 10CFR72 establishes radiation limits of annual doses for normal operations and total dose from accidents, which are applied for individuals on or beyond controlled area boundary of SNF dry storage facilities. The regulations don't specify radiation limits for dry storage cask surfaces nor at distance from cask surfaces, unlike transport casks. Radiation

dose rates on dry storage cask surfaces to comply with the radiation requirements of 10CFR72 depends on radiation dose limits of storage facilities including cask arrangement. Since SNF dry storage facilities including storage buildings will be designated as a radiation control area, the storage facilities shall be designed to meet radiation dose limits for the radiation control area in accordance with Korea regulations on technical standards for radiation safety control. Radiation dose rate limits outside SNF dry storage facilities shall not exceed 0.4mSv/week.

Radiation dose rate limits on dry storage cask surfaces are not specified in any domestic or foreign regulation. Although it is possible to refer to US regulatory guidance, it may be desirable to apply radiation dose limits for shielding structure design requirements of domestic regulations. Radiation dose rate limits for SNF dry storage casks shall not exceed 1mSv/week in accordance with Korea regulations on technical standards for radiation safety control. And transportable dry storage casks must be designed to meet radiation dose rate limits for transport casks in accordance with the related regulations.

However, radiation dose rate limits of the canister-based dry storage casks and the transportable dry storage casks differ from each other. Radiation dose rate limits of dry storage casks shall be set so that radiation dose rate limits of storage facilities are within radiation limits of the radiation control area, regardless of which storage casks are stored.

REFERENCES

- [1] Korea Act No.14839, Nuclear Safety Act
- [2] US 10 CFR Part 72, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel
- [3] USNRC NUREG-1536, Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility
- [4] IAEA Safety Standards Series No.SSR-6(2012 Edition), Regulations for the Safe Transport of Radioactive Material
- [5] US 10 CFR Part 71, Packaging and Transportation of Radioactive Material
- [6] Korea NSSC Regulation No.19, Regulations on Technical standards for Radiation Safety Control
- [7] Korea NSSC Notice 2014-34, Radiation Protection