

Spent Nuclear Fuel Safety Evaluation Methodology (SSEM) for Storage and Transportation

Y.K. Kim^{1*}, J. S. Noh^{2**}, S.K. Lee¹ and T.W. Kim³

¹ KEPCO Nuclear Fuel Co., 242, Daedeok-daero 989beon-gil, Yuseong-gu, Daejeon, Korea

² ACT Co., Ltd., Techno 9 Ro-35, Yuseong-Gu, Daejeon, Korea

³ Hanyang University, 222, Wangsimni-ro, Seongdong-gu, Seoul, Korea

*ykkim@knfc.co.kr, **jsnoh@actbest.com

1. Introduction

When the nuclear fuel is removed from the reactor after around 5 years of irradiation, it is initially stored under water in the nuclear power plant (NPP) pools (Spent Fuel Pool(SFP)) for at least 5 years through 40 years maximum. During the storage in the SFP, the decay heat of SNF shall be decreased enough to be shifted and stored to the dry storage facility.

To transport the SNF from the SFP to the dry storage facility, loading the SNF into the dry storage system should be practiced in SFP followed by drying process with inert gas afterwards. Then the SNF loaded in dry cask would be transported to the dry storage facility and remained until the further process.

Throughout the overall processes, the most important thing is the safety of the system and SNF itself as well to protect public health. In this paper, the new approach to obtain the goal of SNF safety is proposed, so called SSEM.

2. Regulations regarding to Transportation and Storage of SNF

In order to safely transport and store the high level of waste materials, like SNF, it is necessary to comply with the safety regulations strictly. For the regulations, there are a few of nuclear acts in Korea and USNRC Codes & Standards for specific technical details.

The legal requirements and regulations for the designs and operations of the transportation system and storage system/facility are stipulated in USNRC 10CFR71(Transportation), 10CFR72(Storage), and the specific technical guidance are in NUREG-1617(Transportation), NUREG-1536(Storage System), NUREG-1567(Storage Facility).

Detailed requirements on Structural, Thermal, Confinement, Shielding, Criticality, Material(Corrosion, Cladding Integrity/Fuel), Operating Procedure, Acceptance Test & Maintenance, Radiation Protection, Accident Analysis, Technical Specifications and Operating Controls and Limits, Quality Assurance are described in these regulations and guidance.

For the containment review of the transportation

system, fractions of rods that develop cladding breaches were assumed 3 % for normal condition of transport, 100 % for hypothetical accident conditions, respectively. [NUREG 1617]

For the design of dry storage system, it is described in NUREG-1536 that the system shall be evaluated assuming rupture of 1 percent, 10 percent, and 100 percent of the fuel rods for normal, off-normal, and accident-level conditions, respectively. [NUREG 1536 Rev.1]

Technical Specifications for the operations of the Transportation/Storage system/facility designed and manufactured considering these assumptions are required to establish Acceptance Criteria for Functional/Operating Limit, Monitoring Instruments, Limiting Control Setting and Limiting Conditions to protect the safety of the system and the integrity of SNF and to protect the operators from radiation. Also, Acceptance Criteria for the inspection schedule and scope of the structures, systems and components, which are Important To Safety are required. [NUREG 1536 Rev.1]

The licensing processes according to these legal requirements and regulations are presented in Fig. 1, 2. [USNRC Draft Regulatory Issue Summary 2015-XX Considerations in Licensing High Burnup Spent Fuel in Dry Storage and Transportation, XX, 2015]

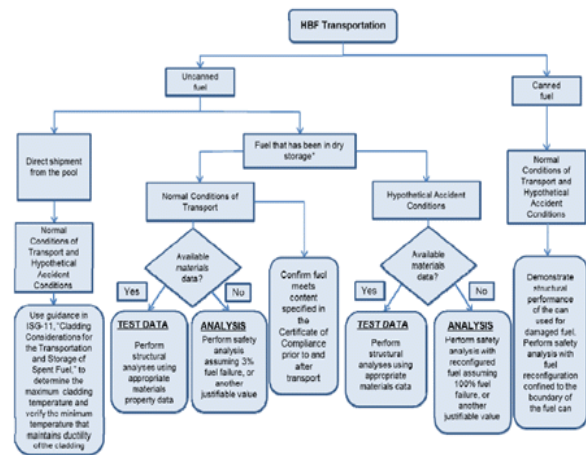


Fig. 1. Transportation Licensing Approach.

In order to transport and dry store the SNF safely, not only the requirements for licensing the system

and facility, but also the requirements for the integrity of SNF should be reviewed.

3. SSEM

In order to meet those regulation requirements and guidance, the vendor and utility shall prepare a plan implementable for the safe management of SNF and need to set up an action plan and methodology.

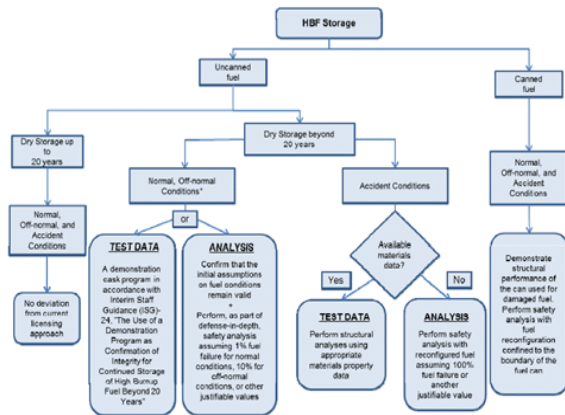


Fig. 2. Storage Licensing Approach.

Without this kind of methodology which could facilitate the reviewing processes with simple and outlined fashion, there could be some kind of confusion in determination of scope of reviewing processes between the licensees and regulatory body. It will help the licensees and regulatory body prepare and review the transportation or storage of SNF in consistency without missing important check points, resulting in a good safety management of SNF.

The main concept of the methodology would be a simplified form of reviewing processes for the transportation or storage of SNF.

In addition to the requirements for licensing the system and facility, limiting conditions for the actual operations of system and facility shall be reviewed.

Limiting conditions for operations to maintain the integrity of the system/facility and fuel itself shall be established before implementing actual storage and transportation works. (NUREG-1536, 1567)

Based on these foundation, there is a need to develop a new methodology (SSEM: Spent Nuclear Fuel Safety Evaluation Methodology), which enables to facilitate the licensing process for the transportation/ Dry Storage of SNF being systematic.

The frame of this methodology mainly relies on the safety check for each campaign of dry storage/ transportation based on the reference SAR, which was prepared using conservative bounding values for key parameters.

This methodology could verify and evaluate whether the each transportation and dry storage campaign meets the regulatory requirements with standard format and processes.

By using this methodology, the licensee can get permission for the transportation and dry storage campaign from the regulatory body by submitting the Spent Fuel Safety Evaluation Report(SSER). The outline of this methodology is illustrated in Fig. 3.

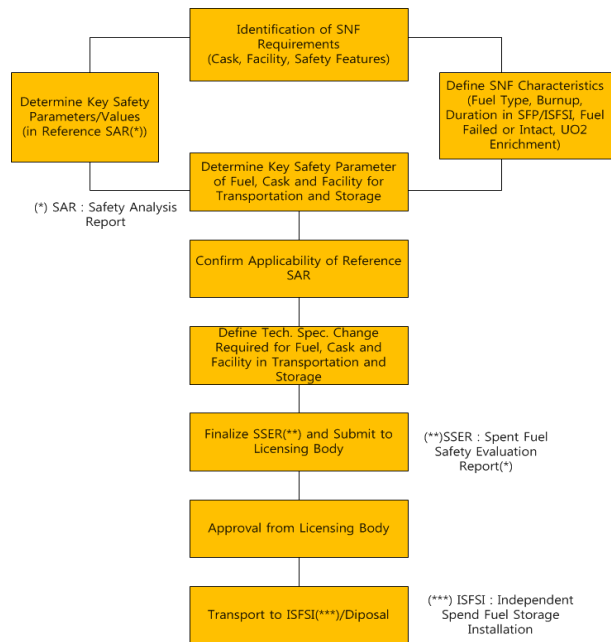


Fig. 3. Spent Fuel Safety Evaluation Methodology (SSEM) Outline.

The SSEM could be a technical foundation in transportation and storage of the SNF with safe and efficiency and regulatory requirements could be met with it too. It seems to be an essential methodology and public reliability on SNF management could be enhanced with it.

4. Summary

New approach to achieve the safety goals in transportation and dry storage of SNF, so called SSEM has been proposed. The main concept of the SSEM is that it simplifies the reviewing processes of each campaign of the transportation or storage of SNF with standard format.

This SSEM could be considered as a model case for assuring public that the SNF be managed safely.

REFERENCES

- [1] NUREG 1536r1 Standard Review Plan for SNF Dry storage systems at a general license facility.
- [2] NUREG 1567 Standard Review Plan for SNF Dry Storage Facilities.
- [3] NUREG 1617 Standard review plan for Transportation for SNF.
- [4] NRC RIS 2015-XX, 'Considerations in licensing HBF in dry storage and transportation'.