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SPADE: SPent Fuel Assessment solution for Dry storage Engineering

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SPADE is an assessment technical solution that can evaluate SF mechanical integrity during the transportation and handling under the dry storage condition. In particular, This technology is a dry storage transport evaluation technical system reflecting the SF degradation characteristics of long-term dry storage and can reliably evaluate the requirements of relevant laws and regulations. SPADE has been developed through verification · validation(V&V) procedures such as various tests, analyzes and evaluations to enhance the its reliable performance.

management technology will be continuously increased in the near future from the managerial and technical points of view.

● Purpose and Necessity

- For dry storage of SF management, SF integrity specified in the related laws and licensing regulatory requirements abroad(IAEA, US etc.) and domestic(Nuclear Safety Acts) should be evaluated · approved. In order to perform the evaluation required by these related laws and regulations, it is necessary to develop a system reflecting domestic SF characteristics credibly.

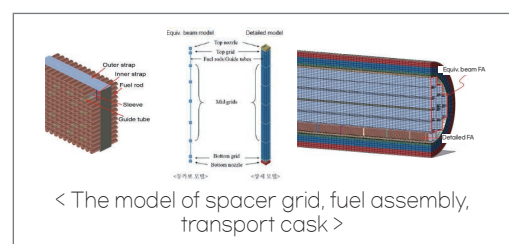
● Principle

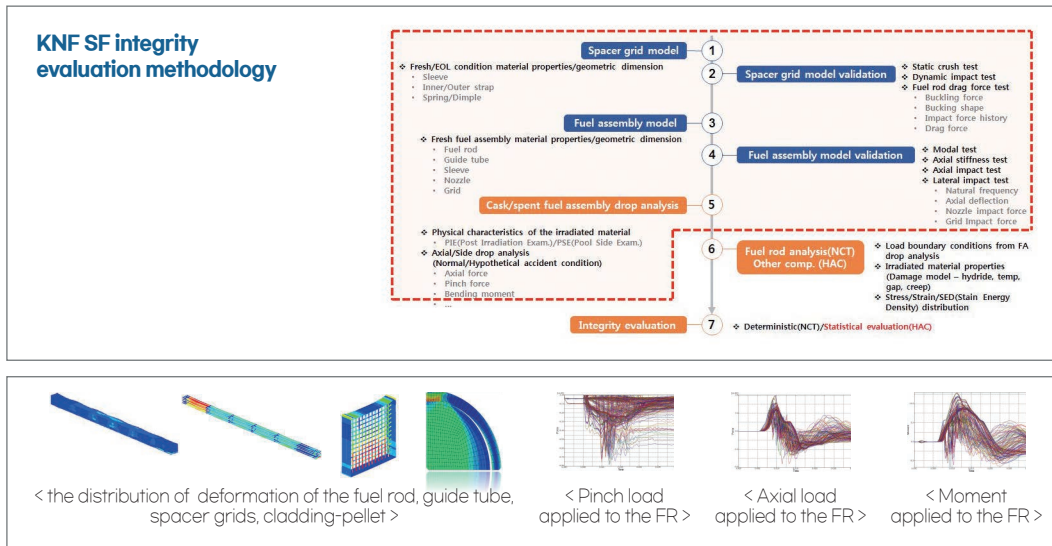
- For SF evaluation, a mathematical model based on data base with destructive inspection(hot cell) and non-destructive inspection[simulated and accelerated test, pool side examination(PSE)] is required, and an analytical model that can define geometry and physical properties of SF is required.
- In particular, the verification&validation (V&V) for each stage of modeling was conducted to enhance the reliability.

Description

● Background

- SF stored temporarily in the wet storage of domestic nuclear power plants is gradually reaching the storage saturation point. This status is one of the most important problems to be solved urgently for the sustainable development of nuclear industry field. Interim dry storage of SF is a promising measure for SF management.
- SF integrity evaluation technology is the key item for the interim dry storage, and it is expected that the demand for this SF





Technology Readiness Level (TRL)

Actual system proven through operation

Business Model

Technology Transfer

Licensing

Joint Search

Service Execution

Others

● System of SPADE

- SPADE consists of several models such as a transport cask, an equivalent beam and a detailed SF of fuel assembly, a detailed fuel rod damage evaluation built by the commercial finite element code, ABAQUS.
- The evaluation is performed in two steps. Firstly, the boundary conditions such as the stresses of the SF parts are derived by performing the SF-cask global evaluation. In the second step analysis, the boundary condition derived from the first step is applied to the fuel rod considering the dry storage degradation characteristics, and the detailed analysis is performed to perform the quantitative damage rate evaluation.

● Result

- SF mechanical integrity such as vibration, impact and abnormality can be assessed under normal and hypothetical accidental environments, which are the most critical damage modes during dry storage transport · handling of SF.

- Identifying the worst cell location boundary conditions in the transport cask
- Applying SF characteristics(deformation, irradiation behavior, oxidation corrosion thickness reduction, etc) to SPADE model

● Benefits

- Leading the domestic technology in SF evaluation field
- Fresh nuclear fuel-SF total solution service
- Applicable to other fields(Failed SF evaluation, HWR SF etc.) and new SF such as HIPER, ATF etc.

Experience

- Government projects(1)
- National Lab project(1)
- Utility project(1)
- Future plan: high burn-up SF, HWR SF, and new nuclear fuel(HIPER, ATF etc.)

Distinctiveness

● Characteristic

- Enhancing the reliability of analysis through various verification · validation procedure

Deliverables

- Engineering service related to SF integrity
- Spent Fuel integrity evaluation licensing support