Risk Assessment on Hazards for Safety of Nuclear Power Plant Decommissioning

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1. Introduction

All facilities using radioactive materials should be proved to be safe over their lifetime, so safety assessment should be carried out in decommissioing plan and performing work according to national laws and internationally agreed recommendations.

Probabilistic risk assessment methods are applied in the design and operation of nuclear facilities. However, this is an approach that can be used when a certain amount of analytical data is accumulated, and thus is not suitable for applications such as disassembly processes.

Decomposing process risk assessment is basically using methods such as judging the level of risk by experience because of the lack of reliable empirical data. For this reason, the nuclear facility sector has traditionally relied on data from previous researchers or on engineering judgment based on expert experience.

In this study, we analyze several safety evaluation techniques and try to find a way to supplement risk assessment on hazards for safety related modules in the currently developing Decommissioning process simulation system.

2. Safety Assessment for Decommissioning

2.1 Safety assessment methodology

Nuclear facility decommissioning requires the dismantling of equipment and structures. Radiological or non-radiological hazards occur during nuclear facility decommissioning activities. The safety assessment methodology of nuclear facility decommissioning plan is applied to identify the potential radiological or non-radiological hazards and risks. Safety assessments are required to support the decommissioning plan and, therefore, need to be incorporated into the decommissioning plan or be contained in supporting documents. For larger projects consisting of a number of phases, it is usual practice for the detailed safety assessments to be separated from, but complementary to, the decommissioning plan. The decommissioning plan for such projects may, however, contain an overall or preliminary safety assessment.

2.2 Radiological characterization

In cases where activation is significant, calculation methods for its assessment may be necessary. Methods for estimating neutron induced activity in a reactor core, its components and its surrounding structures involve the use of computer codes. For large power reactors, a full range of calculations may be needed, whereas for actual calculation of activation, simplified, regional and separate models would be used, with the results confirmed by sampling and local measurements, and by comparison with similar reactors.

We used MCNP6.1 modeling, which is a three -

dimensional Monte Carlo code, to evaluate the distribution of neutron species in the Kori unit 1 reactor. Monte Carlo calculations were used to obtain the distribution of neutron fluxes within and outside of the core, and the neutron flux distribution was calculated using the ORIGENS code. Nuclear internal structure, reactor pressure vessel, outer concrete area, etc.

Radiological and non-radiological working environments are defined first, and processes and scenarios are selected according to radiative assessment and air dose assessment, but it could be difficult to put workers into containment building without protective measures.

After the results of the radiological characterization have been obtained, the safety assessment can be planned. To first identify the hazards and then to perform a screening assessment in order to identify the relevant scenarios and to omit those with low consequences. Existing analyses, for example, from the operational phase, may be of help, and should be reviewed in this process.

2.3 Graded Approach

A graded approach can be used in all of the phases of the planning and implementation of the radiological characterization of a facility in order to ensure adequate characterization without performing unnecessary work.

The decommissioning technology can classify equipment and structures to be disassembled into concrete and metal by materials, and classify them according to each applied technology. This is because the main equipment used in nuclear power plant is metal, buildings are mainly made of concrete, and their material properties are different.

Therefore, considering different materials as well as different shapes, the dismantling technology applied is very different.

And, depending on the level of contamination, workers may be exposed to radiation in contaminated equipment and structure dismantling work. In addition, worker exposure can also occur in preparation and waste treatment operations.

Owing to the complexity and variety of the activities during the decommissioning process, a graded approach is applied to the evaluation of safety during decommissioning, with technical resources being allocated in proportion to the risks presented by the planned decommissioning activities.

3. Conclusion

Decommissioning process simulation system is able to select the optimal dismantling process by quantitatively comparing the dismantling process with the decommissioning cost and the work safety. It can be used effectively as a dismantling engineering tool after completion of technology development.

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