

# Application of Likelihood Evaluation Method for an Integrated Safety Analysis

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## 1. Introduction

One of the most significant issues in South Korea is management of spent fuels (SFs) due to relatively narrow territory and low public acceptance on safe and reliable controls on radioactive wastes. Currently, a low- and intermediate-level radioactive waste (LILW) disposal facility in Gyeongju province has been operated since 2015. However, high-level radioactive wastes such as PWR SFs have been temporarily stored in SF pools with active cooling systems in nuclear power plant (NPP) sites. In addition, a shortage of the temporary storage capacity is anticipated by 2024 for Hanbit and Kori NPPs. In order to recycle the valuable materials in SFs and to reduce the amount of wastes, Korea Atomic Energy Research Institute (KAERI) has been developing a pyroprocess technology as a dry process compared to a wet process.

In a pyroprocess, it is essential to ensure safety of operations due to the high radiological consequences of radioactive materials on facility workers as well as public and the environment. U.S. Nuclear Regulatory Commission (NRC) requests conducting integrated safety analysis (ISA) for fuel cycle facilities to identify potential accident sequences and to designate items relied on for safety (IROFS) for prevention and mitigation of the accidents[1]. In a risk matrix of 3 by 3, three types of consequences and likelihoods, respectively, are divided based on 10 CFR 70.61. In this study, a likelihood evaluation method is applied

by distinguishing failure frequency index numbers and failure probability index numbers according to f-type and p-type events, respectively.

## 2. Methodology

### 2.1 Consequence category, likelihood category, and risk index matrix[1]

Table 1. Consequence Category

	Workers	Offsite Public
Category 3: High Consequence	RD > 1Sv CD > AEGL-3, ERPG-3	RD > 0.25Sv 30 mg sol U intake CD > AEGL-2, ERPG-2
Category 2: Intermediate Consequence	0.25 Sv (25 rem) < RD < 1 Sv AEGL-2, ERPG-2 < CD < AEGL-3, ERPG-3	0.05 Sv (5rem) < RD < 0.25Sv AEGL-1, ERPG-1 < CD < AEGL-2, ERPG-2
Category 1: Low Consequence	Accidents with lower radiological and chemical exposures than those above in this column	Accidents with lower radiological and chemical exposures than those above in this column

Table 2. Likelihood Category

	Likelihood	Range
3	Not Unlikely	More than 10 <sup>-4</sup> /yr
2	Unlikely	10 <sup>-4</sup> /yr ~ 10 <sup>-5</sup> /yr
1	Highly Unlikely	Less than 10 <sup>-6</sup> /yr

Table 3. 4x4 Risk Index Matrix

		Likelihood of Occurrence		
		Highly Unlikely	Unlikely	Not Unlikely
		[1]	[2]	[3]
Consequence	High [3]	Acceptable 3	Not Acceptable 6	Not Acceptable 9
	Intermediate [2]	Acceptable 2	Acceptable 4	Not Acceptable 6
	Low [1]	Acceptable 1	Acceptable 2	Acceptable 3

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### REFERENCES

- [1] NUREG-1520, Standard Review Plan for Fuel Cycle Facilities License Applications, U.S. Nuclear Regulatory Commission (2015).