

## Development of a Review Guide for a Level-3 PSA of Nuclear Power Plants

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### 1. Introduction

A probabilistic safety assessment (PSA) provides a systematic analysis to identify and quantify all the risks that a plant imposes to the operators, general public and the environment. The main benefits of a PSA is to provide insights into the safety aspects of a plant design, performance, and the potential environmental impacts of postulated accidents, including the identification of dominant risk contributors, and a comparison of the options for reducing a risk. Among the three levels of a PSA, a Level-3 PSA provides insights into the relative importance of an accident prevention and mitigative measures expressed in terms of the adverse consequences for the health of the public, and the contamination of land, air, water, and foodstuffs. Finally, a Level-3 PSA provides insights into the relative effectiveness of emergency response planning aspects of an off-site accident management, and into the economic impacts[1].

Regulatory bodies are generally responsible for the specification of safety criteria which can be related to PSAs at Level-1, -2, and -3. Examples of these criteria are the frequency of a severe core damage for a Level-1, and the frequency of large releases of radionuclides for a Level-2 PSA. The most commonly used Level-3 related safety criteria are early and cancer fatality risks.

The regulatory body in Korea has developed the review guides for the Level-1 and -2 PSA. And the current regulatory structure for the licensing of nuclear power plants is established for an LWR-oriented structure. However, the accomplishment of a Level-3 PSA as well as Level-1 and -2 PSA is necessary in order to establish the risk-informed and performance-based regulatory structure for the licensing of future nuclear power plants. In such a situation, the need for the accomplishment of a Level-3 PSA is increasing. Therefore, the main goal of this study is to develop a review guide for the Level-3 PSA.

### 2. Methods and Results

Level-3 PSA is defined as a set of realistic calculations of the ranges (probabilities of occurrence and magnitudes) of the adverse impacts that would follow from an accidental release of radionuclides. These adverse impacts, commonly referred to as "public risks," include (1) early and long-term deaths; (2) early and long-term injuries; (3) genetic damage; (4) the contamination of property, land, and water; (5)

economic impacts[1]. The general procedure of a Level-3 PSA is shown in Figure 1.

The review guide is composed of 3 parts; introduction, detailed review guides, and appendices. In the introduction of the guide, the background, purpose, scope, application area, and organization of the review team is suggested.

In the detailed review guides, we developed the basic contents of the review guides based on the general procedure of the Level-3 PSA, which is the format and contents of the Level-3 PSA report. The standard format of the Level-3 PSA report is shown in Table 1.

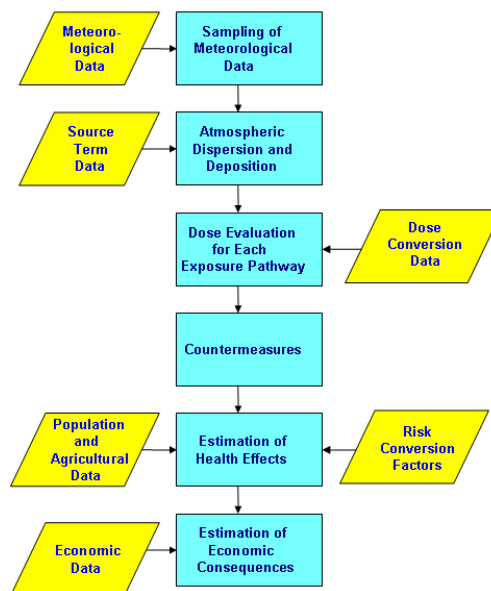


Fig. 1. A The general procedure of a Level-3 PSA.

Table 1. Standard format of a Level-3 PSA report

Subject	Content
1. Executive Summary	
2. Introduction	- Background and purpose - Scope - Application area
3. Methodology	- Overview of consequence analysis code - Atmospheric dispersion - Exposure pathway and dose and dose assessment - Health effects and risk assessment
4. Input data	- Source term - Meteorological data - Population and site data

	- Dose conversion data - Risk conversion data
5. Results and discussions	- Results - Use of results
6. Peer Review	- Results of peer review
7. Summary and conclusions	- Summary and conclusions
Appendices	

The technical items for the detailed review process are as follows;

- Source term
- Consequence analysis code
- Meteorological data
- Site data
- Emergency planning and countermeasures
- Health effects
- Results
- Sensitivity and uncertainty analysis

The radiological source terms and frequencies used in Level-3 PSAs are identified in Level-2 PSAs. Therefore, the basic characteristics of the source terms which the reviewers need to be satisfied with are described. The basic elements of the consequence analysis code which the reviewers are satisfied with are also described. The input data that are required to carry out a consequence analysis are described and the basic requirements of the data are also described[2].

For the review of the emergency planning and countermeasures, the requirements, countermeasure data, and criteria for an emergency planning and the countermeasures are described. The basic requirements and the relevant data for the estimation of the health effects and risks are described for the review of the final results of Level-s PSAs. The items and presentation method of the results such as the early fatality risk and the cancer fatality are described and the use of the results such as a check on a satisfaction of the safety goals is also described. Finally, the requirements and use of the sensitivity and uncertainty analyses are described[3,4].

In the appendices, the references, the concept and the definition of terminologies for a Level-3 PSA are described.

### 3. Conclusions

We developed a review guide for a Level-3 PSA for the reviewers of a regulatory body. This guide will be used to review the format, the contents, and the detailed technical steps of a Level-3 PSA report which will be submitted by the utilities. This guide will also be used for the review of a Level-3 PSA report of the research reactor, SMART, and future reactors in order to check on the achievement of the safety goals.

This review guide for Level-3 PSAs can be integrated with review guides for PSAs in Korea along with the review guides for the Level-1 and -2 PSAs which are already developed.

### Acknowledgement

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### REFERENCES

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