

Development of the Assessment Technology for a Incident/Accident Risk Significance

Tae Young Shin, a Seok Won Hwang, b Jin Hee Park, a Moo Sung Jae, c

a Korea Atomic Energy Research Institute, 1045 Daedeokdaero, Yuseong-Gu, Daejeon, KOREA, 305-353

b Korea Hydro & Nuclear Power Co., Ltd. Jang-Dong 25-1, Yuseong-Gu, Daejeon, Korea, 305-343

c Department of Nuclear Engineering, Hanyang University, 17 Haengdang-Dong, Sungdong-Gu, Seoul 133-791, South Korea

1. Introduction

The ASP analysis is a risk evaluation program and many countries in the world have performed this analysis to assess a risk for their own operational events by using the probabilistic method. In these countries, the Accident Sequence Precursor (ASP) Program is used for the identification of operational events with conditional core damage probabilities of $\geq 1.0 \times 10^{-6}$. Other countries have tried to perform a risk evaluation program for operational events to obtain insights for precursors, an evaluation methodology and its application.

In this study, we envisage the ASP which select Precursors according to the Conditional Core Damage Probability (CCDP) by probabilistic methods. Additionally, we carry out the ASP analysis e.g. for accidents that happened in Ulchin units 3&4 on the basis of PSA models. We evaluate the effectiveness and the application method of the PSA based event analysis. Moreover the effect and the application of the PSA based event analysis is studied.

2. Methods and Results

2.1 Survey on the ASP analysis

We carried out a survey on the ASP analysis status in other countries. In U.S., the risk evaluation program for operational events started with the probabilistic method when WASH-1400 was published.[1] Up to now, about twenty ASP reports have been published annually since the first ASP report was published in 1982. In U.S.[2] and other countries according to the ASP analysis results, they established new systems or components and procedures that provided an additional protection barrier against a core damage.[3]

Table 1 States-of-the Art of ASP

Nation	Organ	Start	Measure
U. S.	NRC	1979	CCDP
Germany	GRS	1990's	Beyond Design Event Probability
Belgium	AVN	2000	CCDP
Hungary	HAEA	1995	CCDP, CDI
France	EDF	1993	CCDP
Spain	CSN	1997	CCDP

And then we find and arrange several risk acceptance criteria. Figure 1 shows risk acceptance criteria.

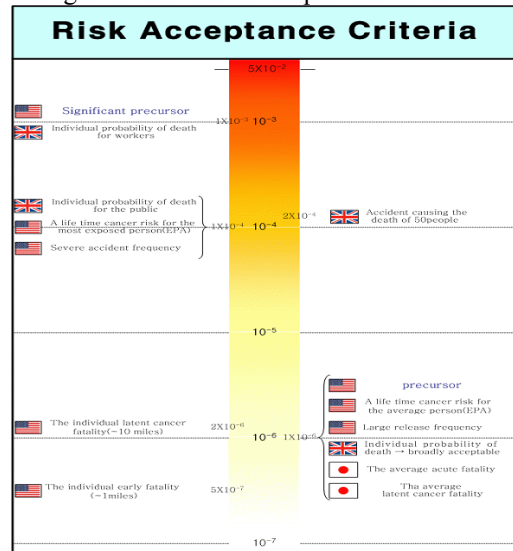


Figure 1 Risk Acceptance Criteria

2.2 The ASP application to KSNP

ASP analysis status was surveyed to apply to 6 reactor trip accidents which occurred at Ulchin units 3&4. We reviewed the feasibility of the ASP application to Korean NPPs through a Case study.

In this study, a ASP which happened in Ulchin units 3 & 4 was analyzed on the basis of the PRIME R1.0 model of Ulchin units 3 & 4 by utilizing the AIMS-PSA Manager developed by the Korea Atomic Energy Research Institute.

From 1999 to 2006, 13 reactor trip accidents occurred at Ulchin units 3&4 among which 6 accidents were analyzed as a ASP. The CCDP was evaluated using AIMS in consideration of the accident situations and system unavailability. The results are as follows.

Table 2 Events analyzed as the ASP

	UNIT	DATA	EVENT
1	U3	05.12.20	Fail to Reed Switch Position Transmitter
2	U4	04.07.26	Fail to CEAC Power feeder
3	U4	02.12.29	Fail to CEDM MG set
4	U4	02.05.26	SGTR(Operating)
5	U4	02.04.05	SGTR(LP/SD)
6	U3	00.04.03	Fail to Feedwater system

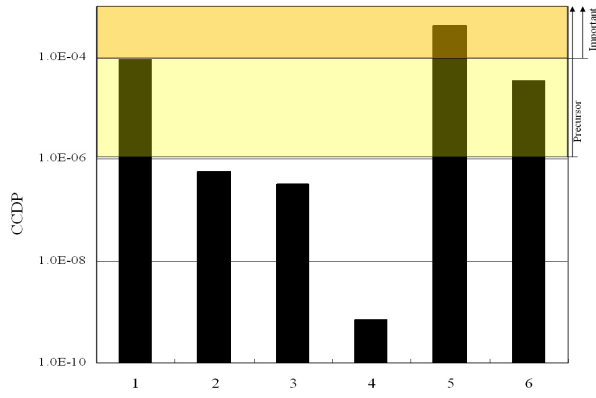


Figure 2 ASP result at Ulchin units 3&4

These potential precursors are analyzed, and a CCDP is calculated by mapping the failure observed during the event onto accident sequences in the risk models. An event with a CCDP greater than or equal to 1.0×10^{-6} is considered as a precursor in the ASP program. And an event with a CCDP greater than or equal to 1.0×10^{-4} is considered as an important precursor in the ASP program. The Status of the ASP analysis was reviewed to apply it to 6 reactor trip accidents which occurred at Ulchin units 3&4. 3 of these events are considered as precursors. And the SGTR (LP/SD) accident is considered as an important precursor.

2.2 Development of the Korean ASP methodology

The Status of the ASP analysis and methodology in other countries was reviewed.[5] The feasibility of the ASP analysis also was reviewed to apply it to Korean NPPs. The ASP flow diagram developed for this purpose is as follows.

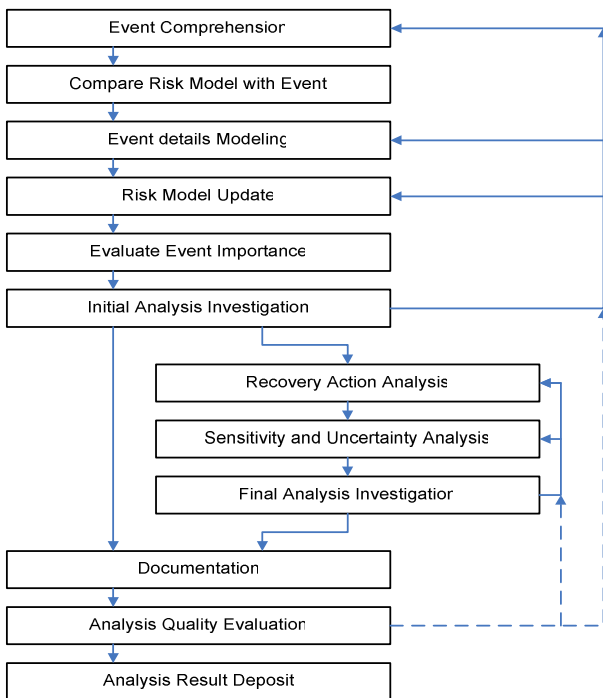


Figure 3 ASP Flow diagram

3. Conclusion

The Object of this study is to evaluate the effectiveness and the application method of the PSA based Event Analysis. We surveyed the ASP analysis status and methodology in other countries. We re-evaluated the risk for our domestic operational events using a PSA method. The Status of the ASP analysis was reviewed to apply it to 6 reactor trip accidents which occurred at Ulchin units 3&4. 3 of these events were considered precursors. And the SGTR (LP/SD) accident was considered as an important precursor. Thus, the feasibility of the ASP application to a KSNP through a case study was studied and applied. As a result, an assessment technology for a Incident/Accident Risk Significance was suggested.

REFERENCES

- [1] WASH-1400 "Reactor Safety Study": An Assessment of Anticipated Risks in U.S. Commercial Nuclear Power Plants, 1975.
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- [5] U.S. NRC RASP Handbook (SDP Phase 3, ASP, MD8.3).