Development of Safety Significance Evaluation Program for Accidents and Events in NPPs

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1. Introduction

To evaluate the significance in terms of safety for the accidents and events occurred in nuclear power plants using probabilistic safety assessment techniques can provide useful insights to the regulator. Based on the quantified risk information of accident or event occurred, regulators can decide which regulatory areas should be focused than the others. To support these regulatory analysis activities, KINS-ASP program was developed. KINS-ASP program can supports the risk increase due to the occurred accidents or events by providing the graphic interfaces and linked quantification engines for the PSA experts and non-PSA acquainted regulators both.

2. Accidents and Events Safety Significance Evaluation Program (KINS-ASP)

Accidents and events safety significance evaluation program, KINS-ASP methodology was developed to provide the methods and tools for regulators who should analyze the risk impacts of occurred accidents or events in nuclear power plants.

For years, USNRC has been analyzing the safety significance of all events occurred in nuclear power plants in US by the Accident Sequence Precursor (ASP) program. Based on the risk analysis using PSA techniques and models, USNRC selected ASP's among the various events based on the calculated Conditional Core Damage Probability (CCDP).

ASP methodology adopted by USNRC consists of three process of event selection. The first selection process is performed by Sequence Coding and Searching System (SCSS). Selected events would be process in the second selection process by USNRC, ORNL and utilities. After the final selection from the second process, selected events would be processed by the risk analyzers.

However KINS-ASP methodology referred USNRC's ASP methodology, it was modified for the effective implementation in Korean regulatory environment. Numbers of nuclear power plants and events occurred are relatively small in Korea, pre-selection process was skipped. For every event will be analyzed in terms of risk impact and safety significance using regulatory PSA model, MPAS.

2.1 KINS-ASP Process

In Fig. 1, overall KINS-ASP process was illustrated. KINS-ASP consists of following processes.

- Accidents and events identification
- 1st (primary) screening analysis
- Expert review
- 2nd (detailed) screening analysis including sensitivity studies
- Evaluation
- ASP determination

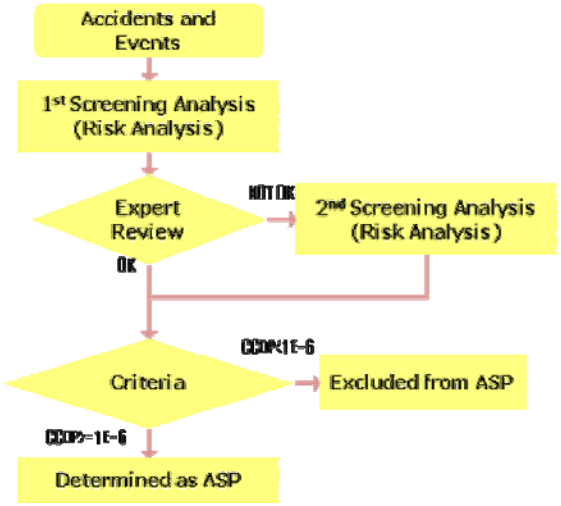

Fig. 1 Overall Process of KINS-ASP

2.2 Accidents and Events Identification

In this process, information of events is required. Required information is as following;

- Title and unit
- Occurrence date and time
- Clearance date and time
- Event summary

These information will be entered database using UI in Fig.2.

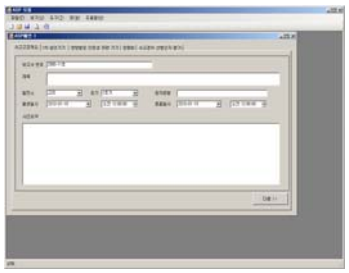

Fig.2 Accidents and events identification

2.3 SSC Identification

After identifying the accident and event information, SSC's influenced by this event should be identified. By suggesting table of systems and, analyst can search systems and components easily.

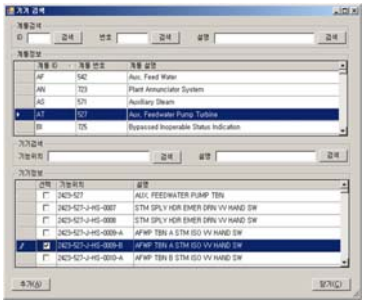

Fig. 3 SSC Identification

2.4 PSA Event Mapping

After identifying the related SSC's, these SSC's will be mapped into the events in PSA model. Using built-in mapping table, analyst can relate SSC's with PSA events easily. Depending on the types of the PSA events such and initiating events, basic events, HRA events, CCF events, various failure rate or frequency modification methods are provided.

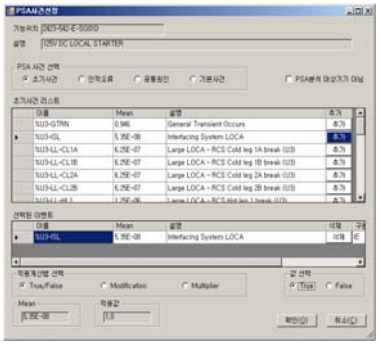

Fig.4 PSA event mapping

2.5 Quantification and Evaluation

When proper PSA events were mapped and their values were modified, core damage frequency can be quantified. FTREX developed by KAERI is the default quantification engine for KINS-ASP. Using the event occurrence and clearance date, CCDP can be calculated automatically. If the calculated CCDP were larger than or equal to 1.0E-6, the analyzed event will be classified as accident sequence precursor.

3. Conclusions

KINS-ASP process and program were developed to support the safety significance evaluation activities by regulators. By providing the embedded methodology and graphic user interfaces, analyst can easily calculated the risk impact of events. This methodology and software can contribute to the area where the risk-informed insights are needed.

REFERENCES

[1] USNRC, "Precursors to Potential Severe Core Damage Accidents: 1998," NUREG/CR-4674, 2000
[2] USNRC, "Status Report on Accident Sequence Precursor Program and Related Initiatives", SECY-01-0034, 2001
[3] USNRC, "Status Report on Accident Sequence Precursor Program and Related Initiatives", SECY-02-0041, 2002
[4] USNRC, "Status Report on Accident Sequence Precursor Program and Related Initiatives", SECY-03-0049, 2003
[5] USNRC, "Status Report on Accident Sequence Precursor Program and Related Initiatives", SECY-04-0210, 2004
[6] USNRC, "Status Report on Accident Sequence Precursor Program and Related Initiatives", SECY-05-0192, 2005
[7] USNRC, "Status Report on Accident Sequence Precursor Program and Related Initiatives", SECY-06-0208, 2006
[8] USNRC, "Status Report on Accident Sequence Precursor Program and Related Initiatives", SECY-07-0063, 2007