

## Development of a Regulatory PSA Model of Kori Units 2 for a Risk Informed Regulation

Jin Hee Park, Ho-Gon Lim, Sang Hoon Han, Dae Il Kang  
Integrated Safety Assessment Division, Korea Atomic Energy Research Institute, Daejeon, Korea  
jhpark6@kaeri.re.kr

Chang-Ju Lee, Namchul Cho  
Korea Institute of Nuclear Safety

### 1. Introduction

The regulatory Level-1 internal probabilistic safety assessment (PSA) model (MPAS, multi purpose analysis safety) is developed to apply to risk informed regulation. This MPAS model could be applied to develop the index for a graded regulation and to perform the independent risk analysis of Kori units 2 in KINS (Korea Institute of Nuclear Safety).

### 2. Development Kori Units 2 MPAS Model

This study was composed of three steps. The first step was a review of the utility PSA Model, design and operation document and operating experiences. The second was the identification of the items to be modified from the first step processing. The last is the development the PSA model for Kori unit 2.

#### 2.1 Utility PSA Model Review

From the review the utility PSA model, we have derived what items are to be improved based on ASME PSA standard. The design change items that could be impacted the PSA, were also investigated. The in-depth interview with a MCR (Main Control Room) shift operation team was performed. From this process, various items to be modified were evaluated as follows.

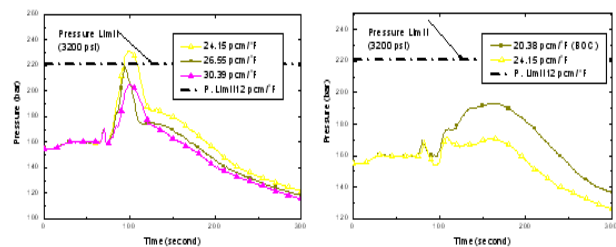
- Event Tree (ET) modification based on as built & as operated conditions are to be considered.
- The AAA DG is installed in Kori site is to be added into MPAS model
- Duplication of motive power of main steam & feed water isolation valves was added
- T/H analysis using best estimate program for success criteria is needed.
- New HRA(human error analysis) methodology is to be applied
- Domestic operation experiences are to be applied
- ATWS(Anticipated Transient Without Scram) ET is to be re-evaluated

#### 2.1 MPAS PSA Model Development

The MPAS PSA model for Kori unit 2 is developed based on the review results in the former section.

The success criteria of the utility's PSA model was determined based on the MAAP code. In the MPAS model, various T/H analyses for using a best estimate program (MARS) was performed for the success criteria.

In the ATWS ET of utility PSA model, the conservative assumption without the UET (Unfavorable Exposure Time) calculation was applied. In MPAS model for Kori units 2, the UET calculation based on as operated condition was performed and the ATWS ET was modified based on this result. The UET due to turbine trip or non turbine trip is as follows.



(1) Turbine Trip (2) Non Turbine

Figure 1 UET Calculation

To determine the operability of a component following a loss of a HVAC (heating, ventilation and air conditioning) in a pump room, the room temperature heat-up test for RHR Pump Room was performed in Kori unit 2. The test result is as follows.

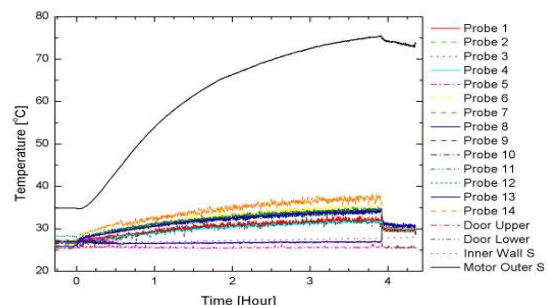


Figure 2 Room Temperature Heat-up Test

All of HRA data were examined using K-HRA methodology and the results are also applied in to MPAS model.

Various FT(fault tree) models were reviewed and modified based on design and operation condition as follows.

- 1) Safety Injection System
  - Charging line isolation valve model was added
  - The manual valve in recirculation line are added.
- 2) Auxiliary Feed Water System
  - The CCF (common cause failure) event between MDP (motor driven pump) & TDP (turbine driven pump) was deleted
- 3) Electrical Power System
  - AAC D/G was added

Several ET are modified such as small LOCA (Loss of Coolant Accident), SGRT(Steam Generator Tube Rupture), LOOP(Loss of Offsite Power), SBO(Station Black Out) and ATWS. Two ET(Loss of NSCW, Loss of Vital Bus) are added. Two transients (General Transient and SBO) induced LOCA ETs are added also for the convenience of analysis.

Through a modification of the PSA model, MPAS model for Kori units 3 has been developed..

### **3. Conclusion**

The regulatory Level-1 probabilistic safety assessment (PSA) model (MPAS, multi purpose analysis safety) was developed to apply to risk informed regulation. To develop the MPAS model for Kori unit 2, various T/H analyses for using a best estimate analysis program and the HRA analysis using K-HRA methodology were performed for the success criteria determination. This MPAS model could be applied to develop the index for a graded regulation and to perform an independent risk analysis of Kori unit 2 in KINS (Korea Institute of Nuclear Safety).

### **ACKNOWLEDGEMENT**

This research was supported by the Mid- and Long-Term Nuclear Research & Development Program of the Ministry of Education, Science and Technology, Korea.

### **REFERENCES**

- [1] Kori Units 2 PSA Report, KHNP, 2007.
- [2] Review of UCN 3,4 PSA Model based on ASME PRA Standard, KAERI/TR-2509/2003, KAERI.
- [3] The regulatory Level-1 internal PSA Model Development Report (Draft), KAERI.