Design of a MAAP Specific Scenario Input Generation Module for a Systematic Analysis of Severe Accident Progression

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1. Introduction

During a severe accident, a fast prediction of accident progression might play an important role, especially when implementing a particular severe accident management (SAM) action, and/or analyzing the SAM-specific positive and negative impacts required for a successful implementation of the severe accident mitigation. But such kinds of activities are very difficult without a prior knowledge of accident progressions. The purpose of this paper is to describe a design of the systematic accident progression analysis frame work and the current development status of a MAAP specific scenario input generation module helpful for a fast simulation of an accident progression.

2. Methods and Results

The severe accident progression prediction system consists of several subsystems: a severe accident simulation database, a MAAP input generation module (ModIn), and a MAAP based severe accident analyzer (SAMS). The framework for an accident progression prediction is depicted in Fig. 1.

2.1 Severe Accident Progression Prediction System Using MAAP Code

Normally the system monitors plant safety parameters characterizing a severe accident. And when a core exit temperature exceeds 650°K, signaling a severe accident, the system tries to identify an accident type or initiating event which is necessary to predict the accident progression. In this step, an effective accident identification process developed by using a symptom-based severe accident simulation data searching method can be used for the purpose [1].

Once the relevant accident type is recognized, the next step is to find the accident-specific scenario simulation data in the database or to find an input file among sample scenario files for a further simulation. In this step, the input generation module (ModIn) is used to retrieve the corresponding scenario file and the system user can edit it if necessary with the relevant plant damage status information.

Finally an accident analyzer (SAMS) is useful when the accident scenario is not included in the database. In that case the SAMS begins a further simulation using the input file generated by ModIn in the previous step. Since the SAMS provides several control equipments which could be operated interactively, it makes it easy to understand the impacts of several kinds of SAM activities to be taken.

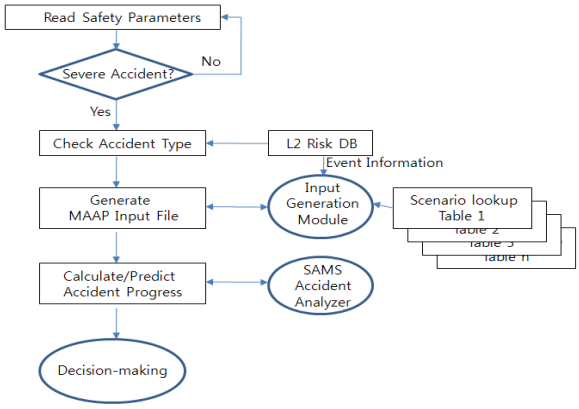

Fig. 1. Severe accident progression prediction flow

2.2 Description of Functions of the ModIn module

Fig. 2 shows the screen design of the ModIn module. Its main function is to generate the accident specific scenario input files. For convenience, the graphic user interface (GUI) function of ModIn includes: selection of template scenario file, selection of plant specific parametric input files, scenario file edition GUI, plant status information display and so on. Depending on user's selections, ModIn will change or add necessary input lines to the corresponding template scenario file selected.

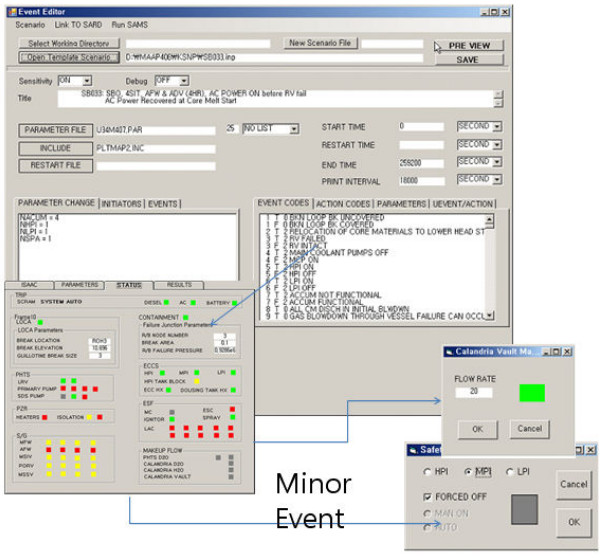

Fig. 2. MAAP Scenario Input Generation Module (ModIn)

Currently ModIn provides GUI interface to generate several initiating condition input lines and parameter setting input lines according to user's choice. Moreover if a system user designates special control conditions for particular systems, it can generate several conditional input lines using event codes which are defined in the selected parametric input file. However GUI for generating control input lines using user defined functions is still under construction now. The lower part of the Fig. 2 shows the conceptual screen design of ModIn's GUI windows which are currently under development. Those GUI's will be developed in the near future to treat several minor operational condition parameters which could not be edited automatically. These kinds of parameters are particular valve and pump operating conditions, related system status, and so on.

Table I: SLOCA Lookup Table to generate SLOCA scenario Input files

Sequence	HPSI Operation	2ry Heat Removal	LPSI Injection	LPSI Recirc	CSS Operation	Comment
SLOCA-11	Injection	AFW+ ADV	N/A	Aggressive Cool + No Rec	Inj & Rec	
SLOCA-12	Injection	AFW+ ADV	N/A	Aggressive Cool + No Rec	Injection	
SLOCA-13	Injection	AFW+ ADV	N/A	No Aggressive Cool + Rec	Inj & Rec	
SLOCA-21	Inj & Rec	AFW+ MSSV(No Long Term)	N/A	N/A	Inj & Rec	
SLOCA-26	Injection	AFW+ MSSV	N/A	N/A	Injection	
SLOCA-45	Injection	No AFW	Injection	Rec	Inj & Rec	
SLOCA-55	No Injection	AFW+ ADV	Aggressive Cool + No Inj	N/A	Inj & Rec	
SLOCA-57	No Injection	AFW+ ADV	Aggressive Cool + No Inj	N/A	No Injection	same as SLOCA-58 (w/ CFS)
SLOCA-58	No Injection	AFW+ ADV	Aggressive Cool + No Inj	N/A	No Injection	
SLOCA-59	No Injection	AFW+ MSSV	No Aggressive Cool + Inj	Rec	Inj & Rec	
SLOCA-70	No Injection	No AFW	No Injection	No Rec	No Injection	

2.3 Example Application

Table I shows a SLOCA look-up table used to find a specific SLOCA input file. We constructed top head of this table by removing several PDS-ET top-events, so as to cover at least 99.5% of SLOCA according to PSA results. [2]

Now suppose a severe accident occurs and the accident type was identified as a small loss of coolant accident (SLOCA) with additional information so that the ModIn module determines that the most likely scenario is SLOCA-12 in the above table. Then the ModIn gets the SLOCA-12 scenario file from the SLOCA scenario file database to be edited on the GUI windows of the ModIn for a new scenario file generation.

3. Conclusions

Current severe accident management guidance (SAMG)[3] has several guidelines requiring experts' decision-makings, such as the estimation of positive/negative impacts of particular SAM activities to accident progress etc. Since such kinds of decision-makings certainly require an accident progress prediction based on current plant condition, a practical accident prediction tool is strongly required. In this paper, we outlined an accident progression prediction scheme using the MAAP code and presented current development status of the interactive MAAP input generation module ModIn.

REFERENCES

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