Outline of the Desktop Severe Accident Graphic Simulator Module for OPR-1000

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1. Role of VMAAP in SAMEX

This paper introduce the desktop severe accident graphic simulator module (VMAAP) which is a window-based severe accident simulator using MAAP [2] as its engine. The VMAAP is one of the sub-modules in SAMEX system (Severe Accident Management Support Expert System) [2] which is a decision support system for use in a severe accident management following an incident at a nuclear power plant.

The SAMEX system consists of four major modules as sub-systems: (a) Severe accident risk data base module (SARDB): stores the data of integrated severe accident analysis code results like MAAP and MELCOR for hundreds of high frequency scenarios for the reference plant; (b) Risk-informed severe accident risk data base management module (RI-SARD): provides a platform to identify the initiating event, determine plant status and equipment availability, diagnoses the status of the reactor core, reactor vessel and containment building, and predicts the plant behaviors; (c) Severe accident management simulator module (VMAAP): runs the MAAP4 code with user friendly graphic interface for input deck and output display; (d) On-line severe accident management guidance module (On-line SAMG); provides available accident management strategies with an electronic format.

The role of VMAAP in SAMEX can be described as followings. SARDB contains the most of high frequency scenarios based on a level 2 probabilistic safety analysis. Therefore, there is good chance that a real accident sequence is similar to one of the data base cases. In such a case, RI-SARD can predict an accident progression by a scenario-base or symptom-base search depends on the available plant parameter information. Nevertheless, there still may be deviations or variations between the actual scenario and the data base scenario. The deviations can be decreased by using a real-time graphic accident simulator, VMAAP.

2. Main Features of VMAAP

VMAAP is a MAAP4-based severe accident simulation model for OPR-1000 plant. It can simulate spectrum of physical processes occurring during accident including core heatup, cladding oxidation and hydrogen generation, core melt progression, vessel failure, fission product release, transport and deposition, and containment failure.

Output results are displayed in user friendly graphical format by using text-based (numerical) output of MAAP program. Window-based simulator of VMAAP is designed to provide graphical displays of the results during the transient simulation so that the users can easily follow the plant dynamics. Figure 1 through 4 show an example of VMAAP graphic display for the reactor coolant system, reactor vessel, containment building, and plotting of important parameters.

VMAAP is able to simulate various scenarios very easily and quickly from the input deck of the scenario database of the SARDB. Since hundreds of input decks for severe core damage scenarios are available in SARDB, the simulation for a user-defined scenario can be performed very quickly by using a sub-module of VMAAP Input-editor which is a window-based MAAP-specific input deck generation program. A graphic interface of the Input-editor is shown in Figure 5.

VMAAP consists of following sub-modules:

- System menu and tool bar
- Project view
- Event summary
- Interactive control
- Parameter help view
- Input editor
- Reactor vessel view
- Reactor coolant system view
- Containment building view

The plant model used in VMAAP module is oriented to severe accident phenomena and thus it can simulate the in-vessel and ex-vessel behavior for a severe accident. Even though it may not be compatible with the desire to have a best-estimate analysis of an ongoing event, it can be a supporting or supplementary measure to understand the trends of accident progression.

REFERENCES

[1] Fauske & Associates LLC, MAAP4 Modular Accident Analysis Program for LWR Power Plants User's Manual, Project RP3131-02 (prepared for EPRI), May 1994–June 2005.

[2] S.Y.Park, K.I.Ahn, SAMEX: A severe accident management support expert, Annals of Nuclear Energy, Vol.37, Issue 8, p.1067-1075, August, 2010.

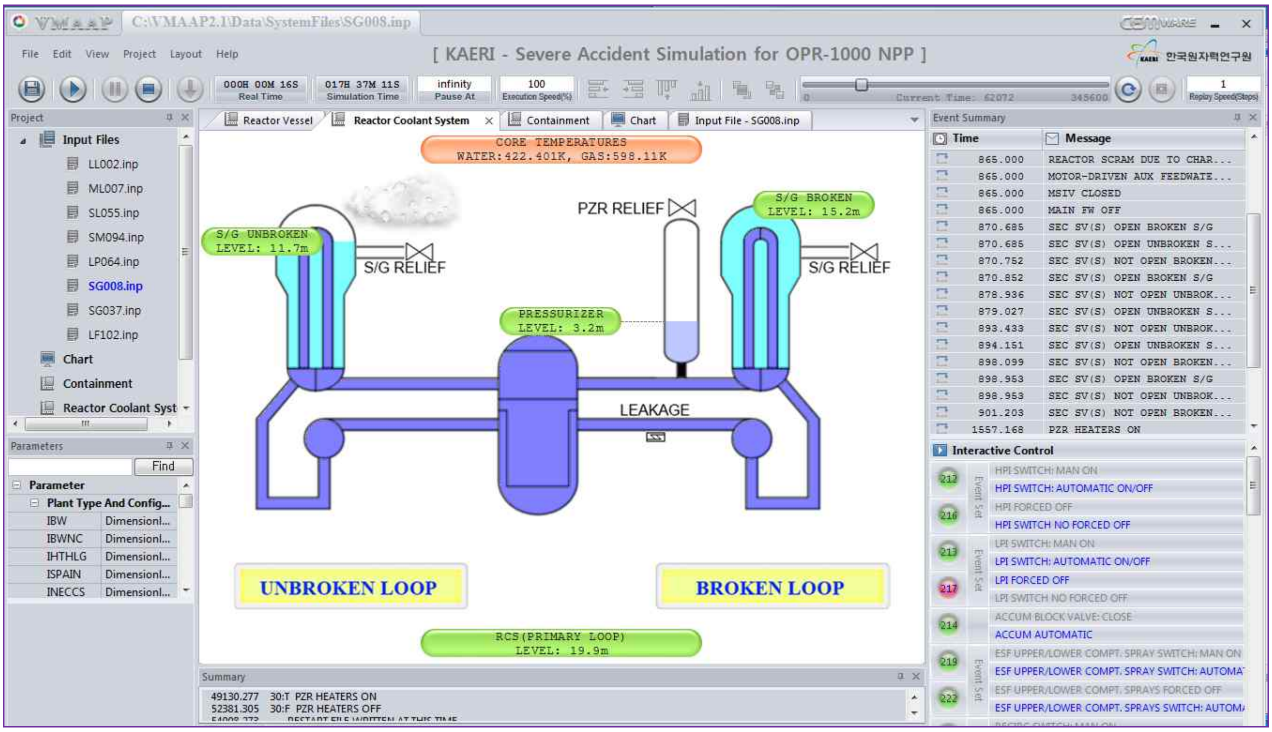

Figure 1. A Sample Display of VMAAP Graphic Module – Reactor Coolant System Sub-module

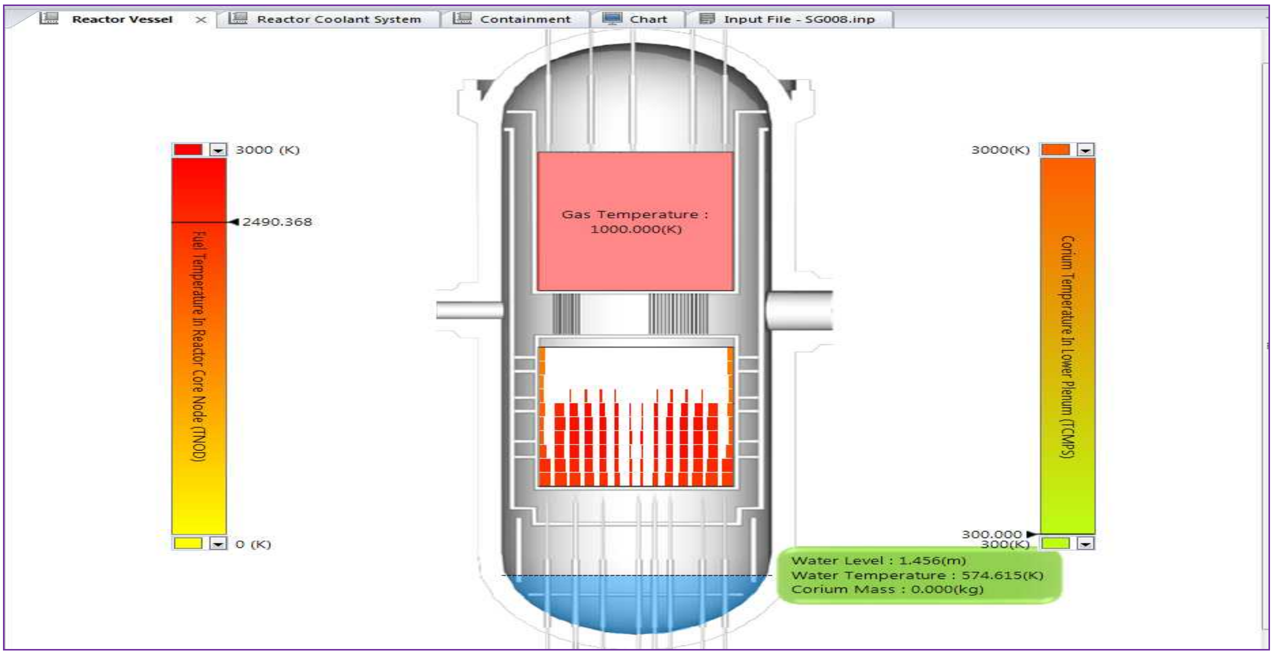

Figure 2. A Sample Display of VMAAP Graphic Module – Reactor Vessel Sub-module

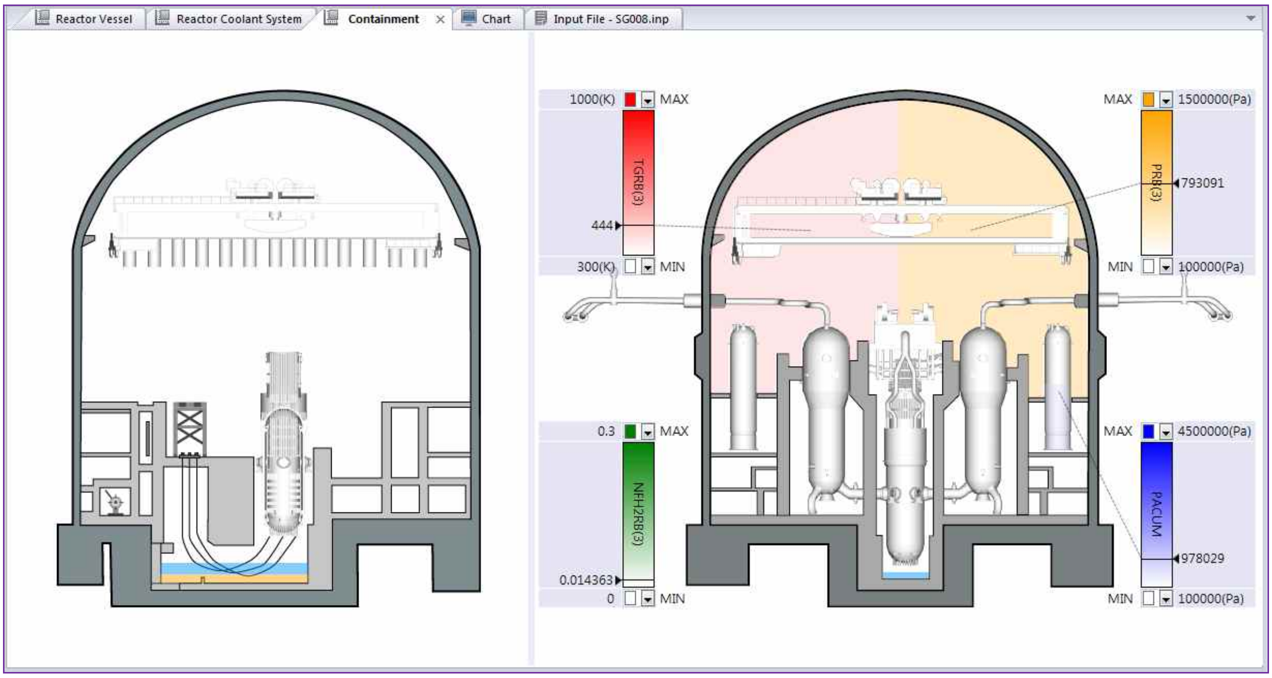

Figure 3. A Sample Display of VMAAP Graphic Module – Containment Building Sub-module

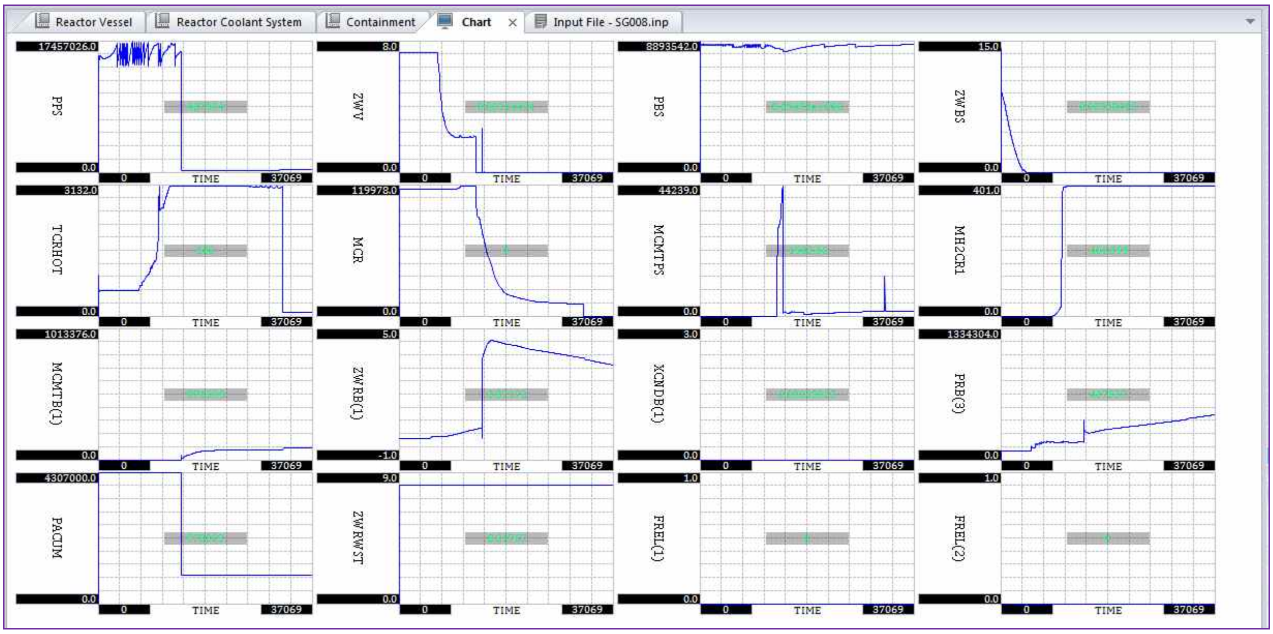

Figure 4. A Sample Display of VMAAP Graphic Module – Parameters Plotting Sub-module

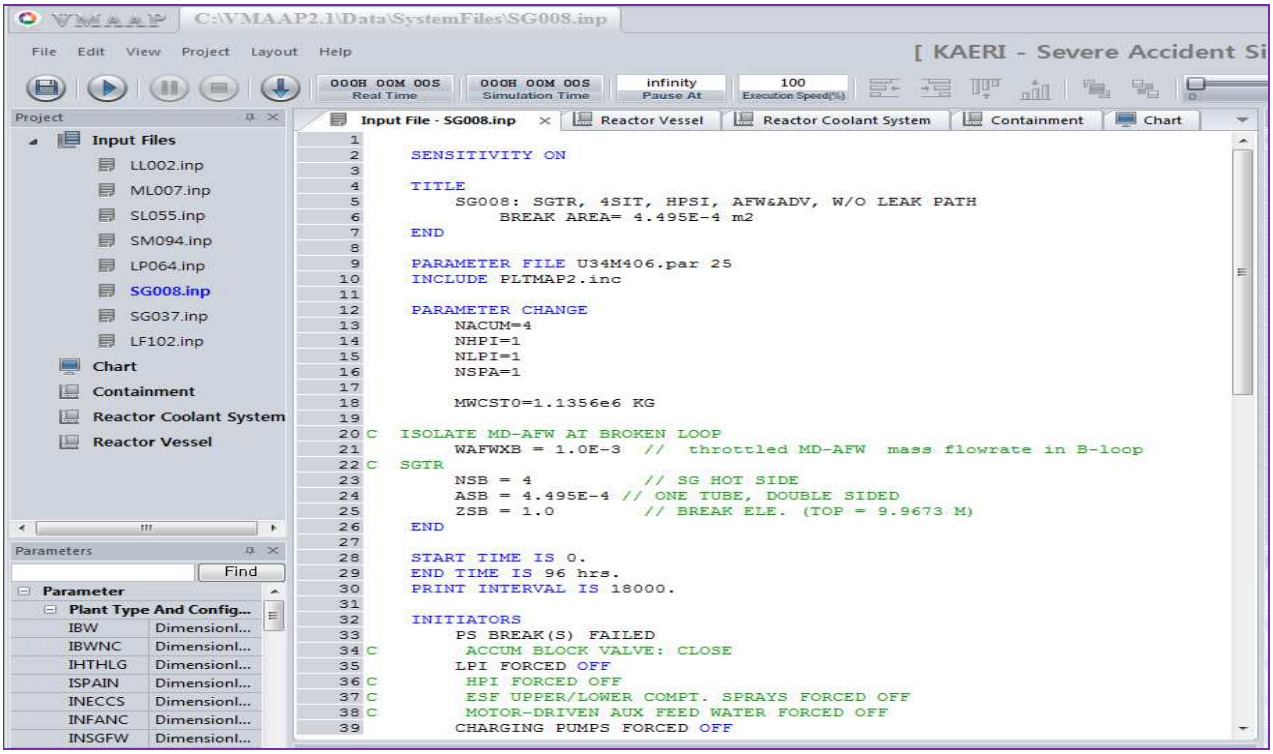

Figure 5. A Sample Display of VMAAP Graphic Module- Input Editor Sub-module