Transactions of the Korean Nuclear Society Spring Meeting
Jeju, Korea, May 22, 2009

Design of the Database and Simulator Supported Severe Accident Management System

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1. Introduction

To prevent and mitigate core damage accidents effectively, the following elements are regarded as very important : an immediate detection and quick recognition of an accident, a correct diagnosis based on the given information, a prediction of an expected accident progression, and an implementation of the mitigative actions by controlling or recovering the safety systems.

Severe accident management guidance which all of the Korea light water reactors have developed and implemented are aimed at a mitigation of core damage accidents. The guidance includes various mitigative actions by using safety systems. For example, the cooling water can be injected into the reactor cavity to prevent a molten corium-concrete interaction, or spray systems can be operated in the case of a high containment pressure. However, they do not provide a fully meaningful diagnosis for a current accident scenario or a prediction for an expected accident progression. Under severe accident situations, operator’s actions, which should be executed with in a high stress condition, may be very complex and difficult if the diagnostic information or the tentative accident progression information is not provided. To improve this situation, a database and simulator supported accident management system has been designed. The purpose of this paper is to describe a decision support system which is under development to aid in a severe accident management guidance by providing immediate and various diagnostic tools based on the given information and a prediction of an expected accident progression.

2. System and Module Design

The severe accident management (SAM) support system consists of several modules as sub-systems: Severe accident risk data base module (SARDB), Risk-informed severe accident risk data base management module (RI-SARD), Severe accident management simulator module(SAMS), and On-line severe accident management guidance module (On-line SAMG). The framework of the SAM support system is represented in Figure 1 and the information flow among the modules is depicted in Figure 2.

The SARDB consists of thousands of calculation results by using integrated severe accident analysis codes. It includes most of the high frequency accident sequences which are selected from the plant damage state event tree of a level 2 probabilistic safety analysis as base scenarios. The base scenarios are expanded to sensitivity cases to consider a variety of system operations or initial accident conditions. Furthermore, they can also be expanded to uncertainty cases to consider a phenomenological modeling uncertainty.

The RI-SARD provides diagnostic or tentative accident progression information through a symptom based or scenario based search function by using the SARDB module. This module also provides diagnosis information (for example, an accident type, safety system status, pipe rupture size or location) by using a diagnosis logic or a diagnosis template based on plant specific safety parameters.

Nevertheless, there still may be deviations or variations between the actual scenario and the data base scenario. These deviations can be decreased by using a graphic accident management simulator named SAMS. SAMS is able to simulate various scenarios very easily and quickly from the input deck of the scenario database of the SARDB with the minimum required change.

The on-line SAMG can be accomplished by an automation and computerization of an existing off-line SAMG. It provides the most appropriate SAM strategy or the system availability automatically via an electronic search.

This SAM support system is expected to be used at the technical support center (TSC) of a plant emergency organization or at the radiation protection technical support center of a national regulatory body for the purpose of an optimized decision-making under a severe accident situation.

Acknowledgements

This study has been carried out under the nuclear R&D program planned by the Korean Ministry of Education, Science and Technology (MEST).

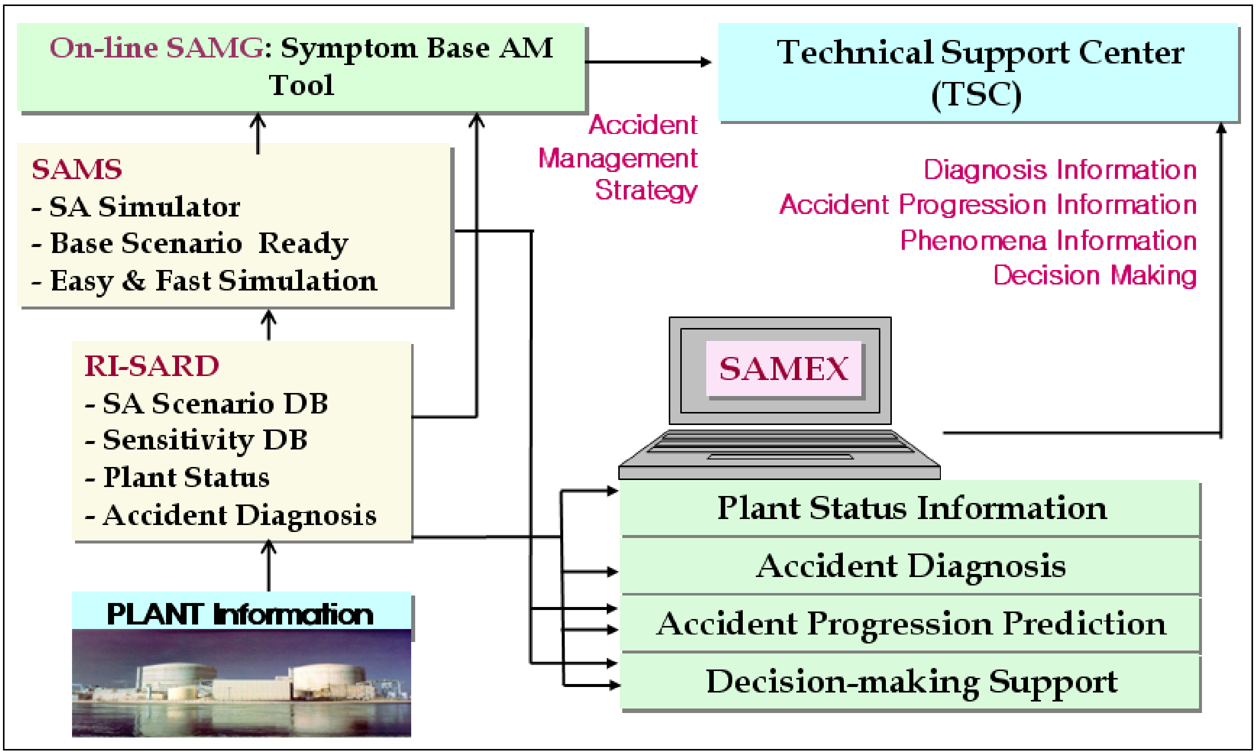

Figure 1. **Framework of the Database and Simulator Supported SAM System**

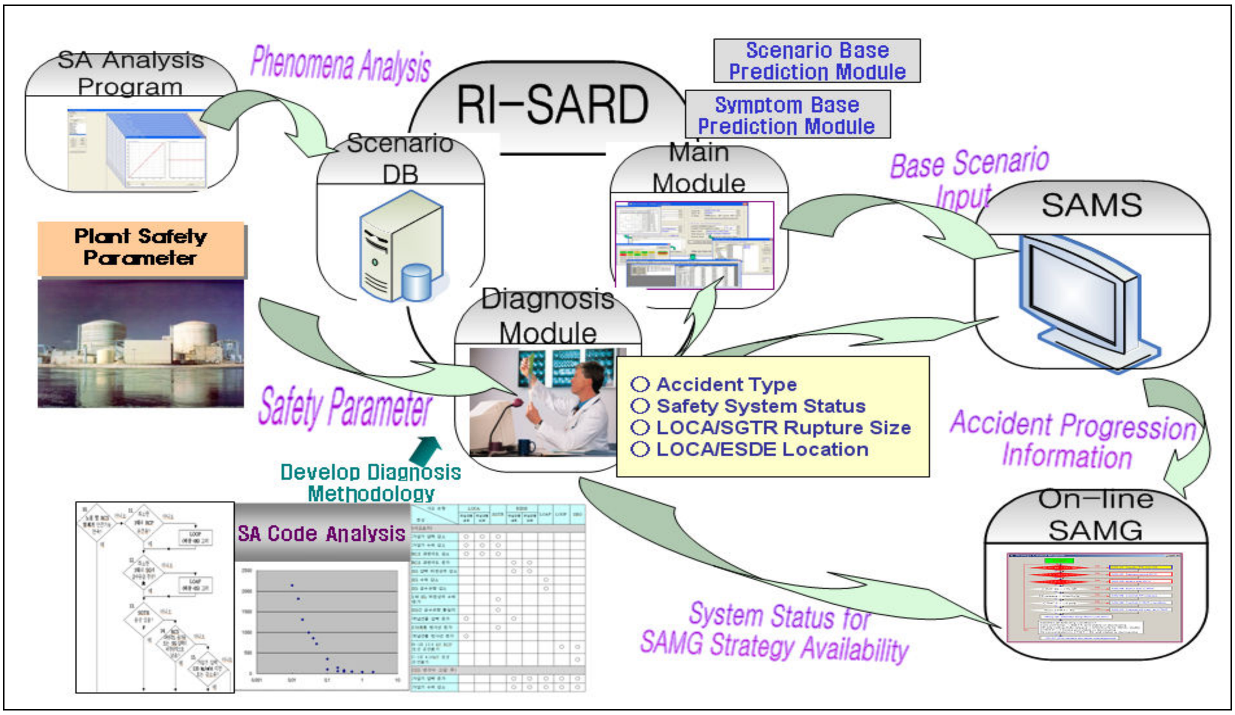

Figure 2. **Information Flow in the Database and Simulator Supported SAM System**