

Development of a Core Model Implementation Technology for NPP Simulators

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1. Introduction

This paper describes the methodology of connecting MASTER (Multi-purpose Analyzer for Static and Transient Effects of Reactors) to simulator system, system configuration, and previous test. The actual simulator environment for YoungKwang Unit1 has been developed. It is impossible for the simulator server to execute MASTER code by limitation of computer performance. So, environment of distributed system was developed, and it had a synchronization task. As MASTER and simulator module should be synchronized in different device, the connection of communication was tested and verified.

2. Simulation Environment Construction and Analysis

It is necessary to work at the simulator operating room for a previous test of functions of connection technology. To verify distributed system without hardware-panel, we had to establish actual simulator environment and develop software-panel. This chapter describes configuration of simulator environment and developed software-panel.

2.1 Development of Base Simulator (YoungKwang Unit1) Simulation Environment (SSP3.3)

To incorporate MASTER with a copied full scope simulator, it is necessary to construct simulation environment similar to YoungKwang Unit1 Simulator. Followings describe the configuration of YoungKwang Unit1 simulator and the modified simulator system.

Simulator Server System construction

The simulator server system consists of system modeling, P&ID and etc. The simulation environments use GSE company's SimSuitePower 3.3. It realizes real-time execution and debugging on synthesis management system.

PPC(Plant Process Computer)System construction

The PPC system has functions of simulation on safety system and supervision system.

IS(Instructor Station) System construction

This system operates simulator models. It is developed by using SEIS (SimExec IS) which has SimDaigram and SimPanel.

2.2 Development of Soft Controller

A controller is installed in Kori#2 Nuclear Education Institute. However, there is no controller in laboratory. So, soft controller has been developed for test, and it can be operated without controller in laboratory. Figure 1 shows the soft-key program for screen conversion, and figure 2 shows the output adjustment soft-panel.

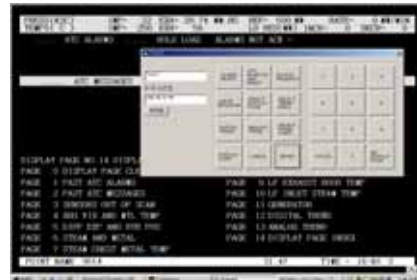


Figure 1. Soft-key program for screen conversion



Figure 2. Output adjustment soft-panel

3. Development of a Core Model Implementation Technology

3.1 Development of 3D Visualization Program for Core Model

3d visualization program has been developed to make 3d shape from the result of core model. TCP/IP communication was used to inter-link 3d visualization program with core model server (Figure 3). The reactor core design code creates much quantity of data, then, nuclear fuel temperature and neutron flux are used to visualize 3d expression (Figure 4). As much quantity of data are passed through communication, it is necessary to communicate variable essential to 3d program.

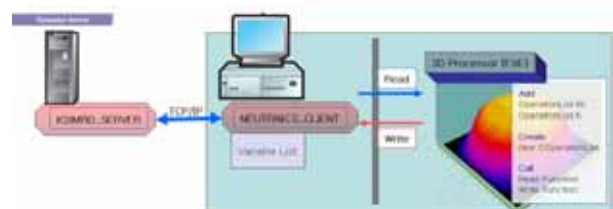


Figure 3. Linking structure of 3d program with core model

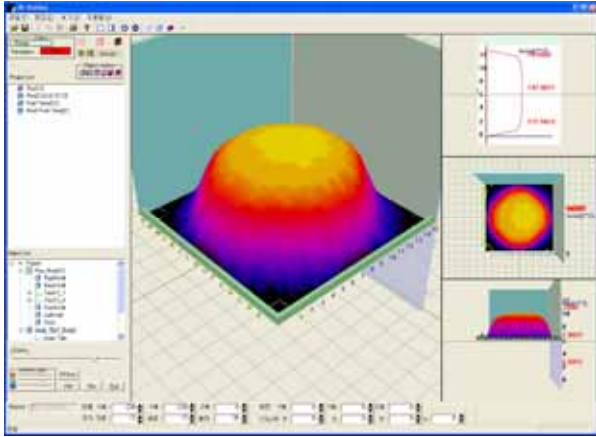


Figure 4. 3D visualization for core model

3.2 Core Model Implementation Technology

The Simulator environment of YoungKwang Unit1 is based on GSE company's SimSuitePower3.3(SSP3.3). The TH module was modified to execute distributed module (MASTER) or existent module by selecting a flag variable. The TH code was not modified, only the variable "crs:switch" was added. If variable (crs:switch) is true, distributed module is run through communication, otherwise existent module is run, which makes possible to analyze comparatively.

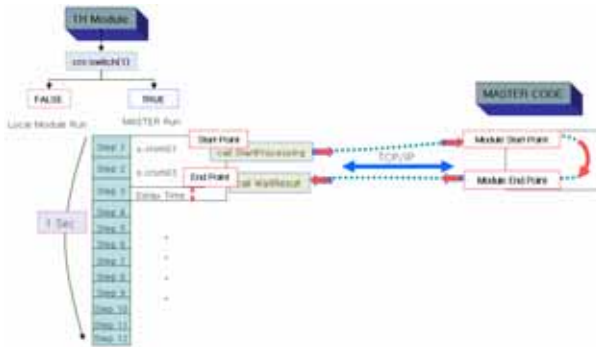


Figure 5. Process to connect Master code

To realize real-time distributed system, MASTER model and simulator server model should be synchronized. To do this, StartProcessing and WaitResult Module are inserted. If StartProcessing module is achieved, MASTER code receives boundary conditions that are required from simulator server, and server system becomes stand-by status until return result in MASTER. The boundary conditions gained from MASTER code are given as inputs for calculation. If Master code is achieved, sever system becomes stand-by status by WaitResult module until sever system receives result of MASTER code. Figure 5 shows such process.

3.3 Operation Test

The server side executes simulator, and client side executes MASTER code. The computing time through

communication between server side and client side is confirmed. Also, server side tests Run, Freeze, Snap shot and Reset command using ISD. The synchronization between server side and client side is confirmed being correctly executed by command. The variables at 100% stable state were checked and compared with each output (100%, 75%, 50%, 25%). Figure 6 shows the initial condition and heat efficiency tests as an example.

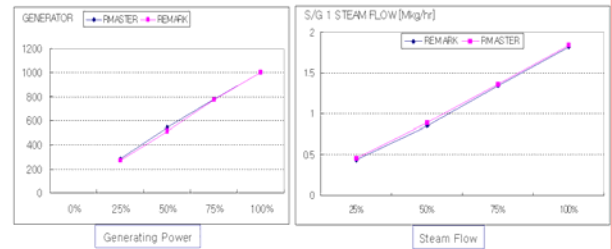


Figure 6. Initial condition and heat efficiency tests

4. Conclusion

The distributed system was developed using MASTER code offered by another project, and connected to simulator environment (SSP3.3). The control functions (Run, Freeze, Snap shot, Reset etc.) are correctly operated as a result of previous test. Functional reinforcement of simulation software (SEIS) is required for the user convenience. And, 3D visualization program is required additionally for reactor core analysis and verification. A simple test was executed using distributed system, and the results were satisfied to the goals. Also, the methodology for core model implementation technology was verified to be useful.

REFERENCES

- [1] Song Jae Seung, Joo Han Gyu, Zee Sung-Quun, Noh Jae Man, "MASTER-2.0 : Multi-purpose Analyzer for Static and Transient Effects of Reactors", Korea Atomic Energy Research Institute, January, 1999.
- [2] Jin-hyuk Hong, Myeong-soo Lee, Yong-kwan Lee, In-yong Seo, "Development of the Core-Model Implementation Technology for YGN1 Simulator", Korean Nuclear Society, 2004.
- [3] "GSE Modeling Technical Manual", GSE, 2002.
- [4] KAERI, "Improvement of Cycle Dependent Core Model for NPP Simulator", Final Report, 2002.
- [5] Myeong-soo Lee etc., "The New Research Activities of KEPRI for KNPEC-2 Simulator Upgrade Project", ASTC-Advanced Simulation Technologies Conference-2001 SCS, 2001.