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Conceptual Design of GRIG (GUI Based RETRAN Input Generator)

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1. Introduction

For the development of high performance methodology using advanced transient analysis code, it is essential to generate the basic input of transient analysis code by rigorous QA procedures. There are various types of operating NPPs (Nuclear Power Plants) in Korea such as Westinghouse plants, KSNP(Korea Standard Nuclear Power Plant), APR1400 (Advance Power Reactor), etc. So there are some difficulties to generate and manage systematically the input of transient analysis code reflecting the inherent characteristics of various types of NPPs.

To minimize the user faults and investment man power and to generate effectively and accurately the basic inputs of transient analysis code for all domestic NPPs, it is needed to develop the program that can automatically generate the basic input, which can be directly applied to the transient analysis, from the NPP design material.

ViRRE (Visual RETRAN Running Environment) developed by KEPCO (Korea Electric Power Corporation) and KAERI (Korea Atomic Energy Research Institute) provides convenient working environment for Kori Unit 1/2. ViRRE shows the calculated results through on-line display but its capability is limited on the convenient execution of RETRAN. So it can not be used as input generator.

ViSA (Visual System Analyzer) developed by KAERI is a NPA (Nuclear Plant Analyzer) using RETRAN and MARS code as thermal-hydraulic engine. ViSA contains both pre-processing and post-processing functions. In the pre-processing, only the trip data cards and boundary conditions can be changed through GUI mode based on pre-prepared text-input, so the capability of input generation is very limited.

SNAP (Symbolic Nuclear Analysis Package) developed by Applied Programming Technology, Inc. and NRC (Nuclear Regulatory Commission) provides efficient working environment for the use of nuclear safety analysis codes such as RELAP5 and TRAC-M codes. SNAP covers wide aspects of thermal-hydraulic analysis from model creation through data analysis and archival of results. But it has no capability to interconnect database of NPP design material.

RETRANUI (RETRAN User Interface) developed by Computer Simulation & Analysis, Inc. is a PC-based graphical user interface designed to assist the RETRAN analyst with execution of the RETRAN computer programs and to provide convenient automated editing and plotting features. The RETRAN calculation is monitored and controlled by the RETRANUI. Once the analysis is complete, the results can be conveniently plotted or the output file viewed by selecting the appropriate RETRANUI toolbar button. But the function is limited to post-processing.

Therefore, GRIG (Graphical User Interface based RETRAN Input Generator)[1] is being developed to generate the basic input of transient analysis code from the database of NPP design manual, to minimize the faults induced in the progress of input generation, and to enhance the user convenience. The methodology of GRIG interconnecting the input generator with the database and calculation note is new approach that has never been tried until now.

2. GRIG Features

2.1 Structure of GRIG

GRIG is the GUI based application program which provides the convenient editing tool for RETRAN input with rigorous QA procedures. It enables the user to approach more easily the code input by changing the text-type RETRAN input to GUI-type input structure. Also it enhances the searching and editing functions through card navigator having tree-type structure based on the classification of various input cards. It integrates all the works required in the input generation by accommodating together the functions of nodalization and calculation note. The data needed in the code input is synchronized with the database of NPP design material.

GIRG is composed of a Database module and an Integrated GUI module. The Database module manages the original data of NPP design material and the Integrated GUI module generates the input file and calculation note from database. The Integrated GUI module has four sub-modules such as Card Navigator, Nodalization Editor, Control System Editor, and Calculation Note Editor. The mutual relations of these modules are shown in Figure 1.

2.2 Database Module

The Database module manages the original data of NPP design material. The data contain various design material such as geometry structure, material property, pump characteristics, reactivity, valves, and thermal-hydraulic conditions, etc. There are three kinds of data,

which are numerical data, text data, and figure data. The data has various data fields to enhance the search and management functions.

The data fields are classified into Group, Point ID, Variable Name, Parameter, System, Value, Unit, Reference, Figure, Description, and 1- or 2-Dimensional Values. Point ID and Variable Name fields must be unique. Point ID field has a predetermined fixed-format but Variable Name field has a free-format. Point ID field distinguishes the data when loading the data into calculation note. Group field is composed of volume, junction, heat conductor, pump, valve, kinetics, control, trip, initial condition, etc. based on the RETRAN input card structure. System field consists of reactor vessel, reactor coolant system, pressurizer, SG primary side, SG secondary side, main steam system, feedwater system, ECCS (Emergency Core Cooling System), CVCS (Chemical Volume and control System), core, pump, etc. 1- or 2-Dimensional Values field is used only when the type of data is table. Description field provides the detailed summary of the data.

The Database module has three sub-modules such as DB Search, DB Viewer, and DB Configurator. DB Search has a search function by keyword and/or field classification. DB Viewer provides a detailed view function but it doesn't have editing capability. The inputting process of NPP design material into DB is provided by DB Configurator. Only the licensed user can access to the DB Configurator. The feature of DB Configurator is shown in Figure 2.

2.3 Integrated GUI Module

The Integrated GUI module has four sub-modules such as Card Navigator, Nodalization Editor, Control System Editor, and Calculation Note Editor. Also it can show the text input.

Card Navigator classifies all the RETRAN input data cards into several categories and briefs them with tab and tree structure. It provides the detailed information of the input data card. The addition or deletion of new or previous model, component, and data are performed in Card Navigator. Also it enables the user to approach the specified data card more easily and quickly.

Nodalization Editor shows the RETRAN nodalization model and enables the user to edit the addition or change of RETRAN input component through GUI mode. The user can easily design the nodalization model by drag-and-dropping the preset Nodalization Editor tools like as volume, junction, valve, pump, and fill. It can interconnect the selected component with Card Navigator.

Control System Editor enables the user to design or investigate the trip and control logic model through GUI mode. The addition or deletion of control system and editing of parameters or setpoints in control logic are performed in Control System Editor. The user can easily design the control model by drag-and-dropping the preset Control System Editor tools like as trip, control input, control block, and table. It can interconnect the selected component with Card Navigator.

Calculation Note Editor constructs the calculation note required in the generation of RETRAN code input by calling the data from Database module. It has some numerical computation capabilities such as addition, subtraction, multiplication, division, etc. Also it contains mathematical functions such as square, square root, logarithmic function, trigonometrical function, etc. Calculation Note Editor is interconnected with Card Navigator and Nodalization Editor.

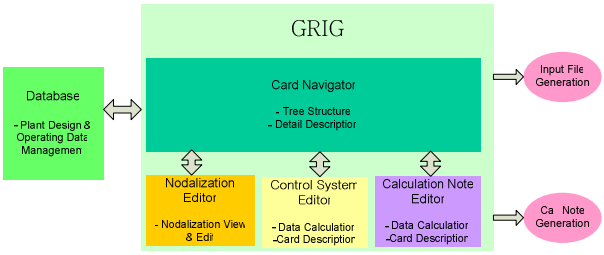

Figure 1. Constitution of GRIG

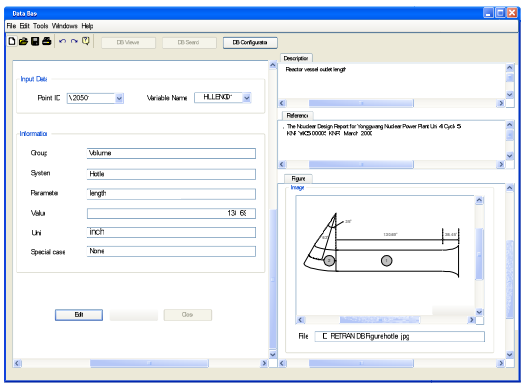

Figure 2. Example of DB Configurator

3. Conclusion

The development of GRIG will be completed by the end of 2007 year. Then it will be verified and qualified through various run tests for the domestic operating NPPs. The database developed to generate RETRAN input in this study can be applied to the input generation of other best-estimate analysis codes. It will be helpful to establish DB standardization for the input generation of best-estimate analysis codes. Also GRIG can be expanded to the input generator of other best-estimate analysis codes.

REFERENCES

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