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A study on the Electronic SAMG Framework

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1. Introduction

As a part of the Ministry of Science, Ict & future Planning (MSIP) Project, we at KAERI are developing electronic SAMG (e-SAMG, severe accident mitigation guideline) for a general SAMG for nuclear power plants. The computerized methods can be applied in nuclear fields due to the accuracy and rapid processing. Since the Fukushima accident, unexpected accidents or extreme damages have become a concern. Therefore, a rapid and exact confrontation such as a computerized attempt in SAMG has been tried [1].

To contribute to a rapid and accurate processing for a severe accident, based on the study of SAMG functional modules, the e-SAMG framework has been studied and developed [2,3]. This paper describes a study on the e-SAMG framework.

2. Methods and Results

The five guidelines among the SAMG are selected as a representative guidance to develop the e-SAMG framework. These are emergency-01, control-01, mitigation-05, monitor-01, and finish-01. In this section the development of the e-SAMG framework and related matters are described.

2.1 Standard Framework Development

The standard framework was developed to utilize the database (SQLite) for application to various guidelines according to the characteristics of the reactor building. In consideration of the utilization of the operator's training, e-SAMG was divided into training mode and actual mode.

The design was developed to make possible the structural processing around the control-01 guideline in consideration of a later expansion or complement, as well as for template development.

The software developing environments are as follows.

- OS: Windows -XP or higher
- OS for users: Windows -XP or higher (desktop PC and Notebook)
- Development tool: Windows Visual Studio
- GUI tool: dot-Net framework 4.0
- Development language: Windows Visual Basic
- Graphic interface: WPF (Windows Presentation Foundation)
- DBMS: SQLite

2.2 Functional module

Most of the functions were modularized centering around the control-01 to control the procedures. The common technical functions and the major functions were modularized for efficiency, such as keyword data manipulation, input manipulation of confirmation table, and common data manipulation.

The function of the screen control is modularized: the review function of pictures and tables (enlargement for the convenient checkup of operators), active adjustment of the program interface according the monitor resolution, and the size.

The additional functions are implemented along with the existing functions: an automatic expression of the satisfaction of special conditions, and a display of the output value according to the operator's input related to the formula for special tables.

2.3 DB construction

The DBMS was implemented for the contents of the guidelines such as calculation tables, confirmation tables, figures, items of concern, long-term items of concern, and the reference data. The contents are categorized into four tables in DBMS: USER information, MEDIA information, LOG information, and the LINK information. The USER information includes the username, unique number, password, log session code, login-time, log-out time, and user mode (training or actual). The MEDIA information includes a unique number, related guidelines, media type, saving location of the information, media size, media file size, media saving date, and media file register date. The LOG information includes the log session code, user ID, guideline type (emergency, control, mitigation, monitor, and finish), current step code, log saving time, step starting time, step ending time, total time, and user mode (training or actual). The LINK information includes information about the key word link within the guideline contents.

2.4 GUI Design

The eSAMG screen design consisted of WPF(Windows Presentation Foundation) technology, which was added from the v 3.0 of dot-Net framework. This technology can implement a more advanced UI using XAML language compared with the existing UI method. The design of most stages is as shown in fig 1.

Based on this design, most of the GUI such as the login stage, guideline contents stage, confirmation table, and attachment data are constructed. The samples of the GUI design are shown in figs. 2 through 4.

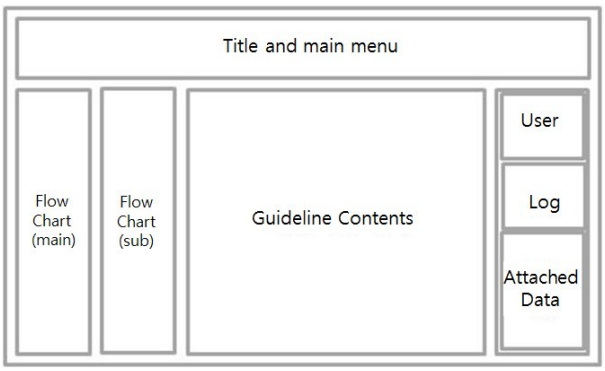

Fig. 1. GUI frame.

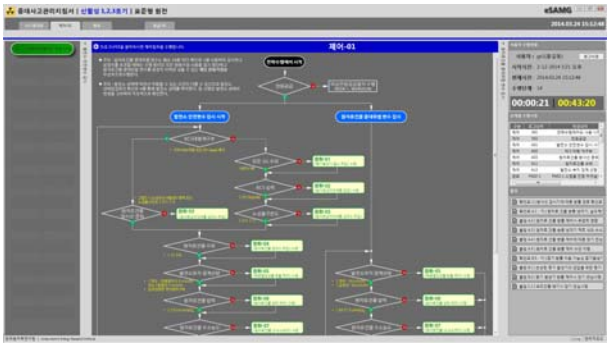

Fig. 2. GUI frame for Control-01 guideline.

Fig. 3. GUI frame for Control-01 guideline (switch type of confirmation).

Fig. 4. GUI frame for Control-01 guideline (text type of confirmation).

2.5 Results of development

The contents of the guidelines such as emergency-01, control-01, mitigation-05, monitor-01, and finish-01 are computerized as a DB. From the start stage to the finish stage, through the input of the user, the essential and referred contents are shown to the user according to the user selection.

The eSAMG checks the user information, selects the contents of the guidelines, and shows the only needed contents. Thus it makes the user choose the right decision according to the current stage without fallacy. If it needs to be saved in the middle of the process, it can be saved and the saved information invoked later.

The eSAMG can also be used for training. The accumulated training data can be used later as an analysis. The analysis results can be used to make a more advanced and refined SAMG.

3. Conclusions

Through the eSAMG development, a rapid and accurate decision can be expected, and the burden of operator during a severe accident can also be reduced.

In a qualitative view, eSAMG can be used to promote work skills in the field, and manage rapid work. It can also secure the efficiency and safety through an assistant system compared with severe accidents at all times. In addition, it can maximize the operator's ability through training using the eSAMG system. In a quantitative view, eSAMG can reduce the following damage through an improvement of accuracy and processing speed for a severe accident. It can also secure the PR (public relation) effect of safety and improvement of NPP perception. Moreover, it can execute systematic training against a severe accident and reduce the training cost. This system will be implemented extendedly into the entire SAMG for perfection of the complete eSAMG.

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