

Development of a User Interface of LogACTS(Logic Alarm Cause Tracking System)

Jung-Woon Lee^{a*}, Jung-Taek Kim^a, Jae-Chang Park^a, In-Koo Hwang^a, Hyun-Chul Lee^a, Seong-Hwan Hwang^a, Jaekyu Park^a, Yonghee Lee^a, Yeon-Ki Lee^b, Seong-Taek Chon^b, Byoung-Joo Kim^b, Ki-Tae Kim^c, and Sang-Ho Lee^c

^aKorea Atomic Energy Research Institute, I&C/HF Research Division, 1045 Daedeokdaero, Yuseong-gu, Daejeon

^bKorea Hydro & Nuclear Power Co. Ltd., Wolsong Nuclear Power Generation., 260 Naa-ri Yangnam-myeon, Gyeongju Si, Gyeongsangbuk-Do

^cBNF Technology Inc., 556 Yongsan-dong, Yuseong-gu, Daejeon

*Corresponding author: leejw@kaeri.re.kr

1. Introduction

An alarm processing and presentation system LogACTS(Logic Alarm Cause Tracking System) has been developed and installed into the main control room(MCR) of the Wolsong nuclear power plant(NPP) unit 3.

KAERI research team has developed an alarm root cause tracking system (ACTs), an alarm and diagnosis-integrated operator support system (ADIOS), and a dynamic alarm system (DAS) [1, 2, 3]. Many features of the KAERI team's researches have been acknowledged to be helpful for an improvement to the Wolsong alarm systems. For this reason, LogACTS has been developed to have an alarm reduction and a cause tracking as key functions.

For the development of the LogACTS user interface, the functions to be performed by LogACTS were analyzed and the structure of windows for the information display and controls were designed. A prototype of the user interface was implemented and evaluated by Wolsong NPP operators.

2. Development of LogACTS user interface

2.1 Functions of LogACTS

In the process of the development of LogACTS, the following functions are defined and implemented;

- 1) Alarm compression – by applying various alarm processing techniques [4], to reduce the number of alarms during plant transients and display a list of causal and important alarms,
- 2) Presentation of a full list of alarm messages,
- 3) Presentation of the alarm messages sorted by the priorities or the system groups as used on the current alarm CRT displays of the Wolsong NPP,
- 4) Separation of status and program alarms from other alarm messages,
- 5) Presentation of alarm information for a selected alarm messages,
- 6) Tracking causes of the important alarms and the power reduction signals,
- 7) Computerization and presentation of alarm logic diagrams,

- 8) Presentation of overview mimic diagrams for the primary and secondary systems for monitoring the plant status,
- 9) Checking the entry conditions of the abnormal operation procedures (AOPs),
- 10) Presentation of process mimic diagrams for monitoring the plant status during AOP operation,
- 11) Checking the entry conditions of the emergency operation procedures (EOPs),
- 12) Presentation of trend graphs for monitoring the status of safety parameters during EOP operation
- 13) Retrieval of the history of alarm messages.

2.2 Design of Windows

Many windows are devised for displaying information being generated when LogACTS carries out the functions listed above. Windows matching with the functions are listed as follows; a compressed alarm message window for 1) alarm compression, a whole alarm message window for 2) a full list of alarm messages (also for 3) alarm messages sorted by the priorities or the system groups, and 4) status or program alarms, depending on user selection), an alarm information window for 5) an alarm message selected from the windows displaying alarm messages, an alarm cause window for 6) the causes of alarms in a compressed alarm message window, a cause-tracking logic diagram window for 7) computerized logic diagrams showing causes tracked through the alarm logic diagrams, two overview mimic diagram windows for 8) overview plant status, one for the primary systems and another for the secondary systems, an AOP entry condition window for 9) AOP entry condition checks, an AOP mimic diagram window for 10) monitoring plant status during AOP execution, an EOP entry condition window for 11) EOP entry condition checks, a safety parameter trend graph window for 12) trend graphs for monitoring safety parameters during EOP operations, and an alarm history window for 13) retrieval and presentation of alarm message history.

Together with these windows, several buttons and pull-down menus are composed as controls that lead users to desired information on the LogACTS display.

A 22" LCD monitor is assigned to each LogACTS client by considering the space on the operator workstations in the MCR. Hence, all the windows and controls should be displayed on a single display screen.

A group of information to be provided by LogACTS can be different depending on the operation modes. For example, during normal to pre-AOP operation, a compressed alarm message, a whole alarm message window, and overview mimic diagram windows can be candidate windows to be displayed, while an AOP entry condition display window and an AOP mimic diagram window are for an AOP operation mode, an EOP entry condition display window and a safety parameter trend display window for an EOP operation mode. Some windows for displaying supplementary information can be presented when operators want to see them. Considering this relationship to the operation modes and possible operation strategy with the LogACTS display, LogACTS windows are classified into main windows or pop-up windows as shown in Figure 1.

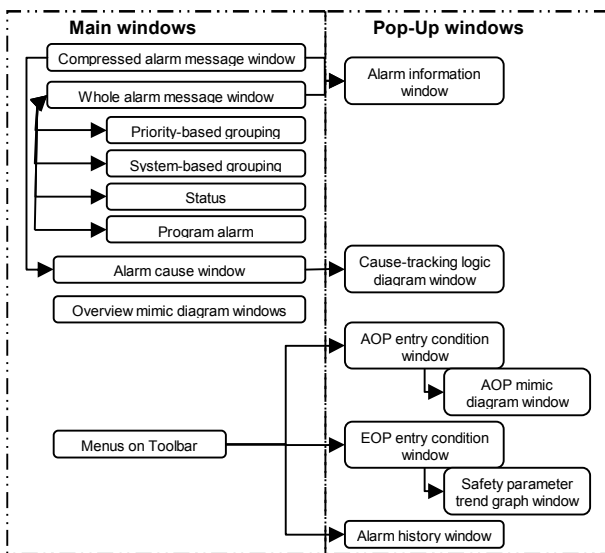


Fig. 1. LogACTS display structure

Figure 2 shows the main display showing main windows. A pop-up window has a size about one fourth of the whole display screen and will appear at a right side and in the middle of the screen. A compressed alarm message window contains causal and important alarm messages resulting from LogACTS alarm processing [4]. By using selection buttons on the top of the whole alarm message window, alarm messages, grouped with respect to their priorities or relevant plant systems, or only status or program alarms can be displayed in the whole alarm message window. If an alarm is selected from a compressed alarm message window, an alarm cause window displays automatically the causes of the selected alarm. Further by selecting a cause from the alarm cause window, users can view a logic diagram pop-up window demonstrating the logic links from the alarm to the cause. Overview mimic

diagram windows show process mimics for the primary systems and the secondary systems. LogACTS continually checks to see if AOP or EOP entry conditions are met. If a set of entry conditions is met, a window displaying the corresponding AOP or EOP title together with the marked entry conditions pops-up automatically. Operators can also view this entry condition check window by selecting an AOP or EOP from pull-down menus on a toolbar at the top of the main display.

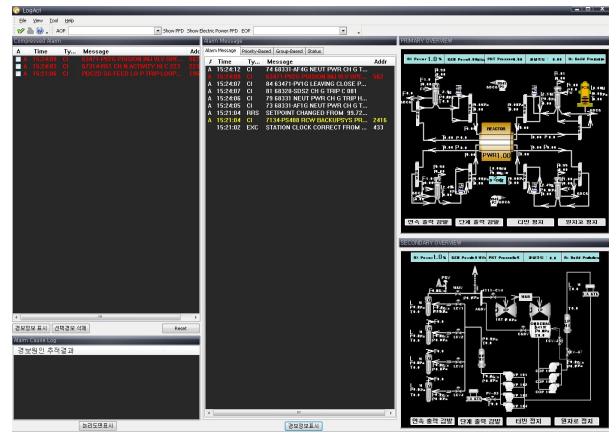


Fig. 2. LogACTS main display

3. Conclusions

An alarm support system LogACTS has been developed to help operators identify the causes of plant transients and mitigate them. Although some limitations, i.e. to maintain the same display colors as existing alarm CRT displays, affect our display design, we develop a user interface for LogACTS in consideration of the human factors engineering principles to ensure the efficient use of LogACTS.

REFERENCES

- [1] Sung P. Lyu, An Identification of Alarm Cause by Tracking Logic Diagram, 2002 Spring Conference, Korea Nuclear Society, 2002.
- [2] Jung-Taek Kim, Kee-Choon Kwon, In-Koo Hwang, Dong-Young Lee, Won-Man Park, Jung-Soo Kim, and Sang-Jeong Lee, Development of advanced I&C in nuclear power plants: ADIOS and ASICS, Nuclear Engineering and Design, Vol. 207, pp.105-119, 2001.
- [3] Jung Taek Kim, et. al, An Evaluation Approach for Alarm Processing Improvement, IAEA Specialists Meeting (IWGNPPCI) on Experience and Improvements in Advanced Alarm Annunciation Systems in Nuclear Power Plants, Chalk River, Ontario, Canada, 1996.
- [4] Jung-Woon Lee, et. al, LOGACTS(Logic Alarm Cause Tracking System) for a nuclear power plant operation, NPIC&HMIT 2009, Knoxville, Tennessee, April 5-9, 2009.