Design of a Control Room for Jordan Research & Training Reactor (JRTR)

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1. Introduction

Since the main role of JRTR(Jordan Research & Training Reactor) operating personnel is safe and reliable operation of the reactor, MCR(Main Control Room) and SCR(Supplementary Control Room) must provide them with sufficient information and controls needed to optimize their performance.

Before the TMI accident, control room were generally designed just with intuitive common sense, without using any proper HFE(human factors engineering) practices. Many results derived from the analysis of TMI accident showed that a more comprehensive and systematic approaches to develop MCR design requirements were needed. Moreover changes of operators' role as a decision maker from a physical controller in rapid improvement of control system which resulted in higher automation clearly needed more featured regulatory requirements and guidelines. So many regulatory and industrial guidance for control room design have been developed by relevant institution and regulatory bodies.

In this paper, a conceptual design of the JRTR control room in the effort of satisfying current regulatory requirements and guidelines are presented. And some information display design is also presented.

2. Main Control Room (layout)

The main control room of JRTR is a kind of nerve centre necessary for controlling and monitoring the plant. The design principles of MCR layout are as in the followings:

1) The MCR is continuously manned, at least two persons (a reactor operator and a supervisor), and is a protected enclosure in which actions are normally taken to operate the reactor under normal and abnormal conditions.
2) The MCR consists of an LDP (Large Display Panel), OWSs (Operator Workstations), cabinets for RPS(reactor protection system) and PAMS(post-accident monitoring system), and other miscellaneous equipments.
3) All equipment and system facilities installed in the MCR shall satisfy seismic category II at least except safety grade equipments which shall meet requirements of seismic category I.
4) The MCR is a space which is always manned, so that it shall have adequate habitability to provide a comfortable living condition and environment.
5) Etc…

Also, a pray room was installed considering the religious characteristics of Jordan people.

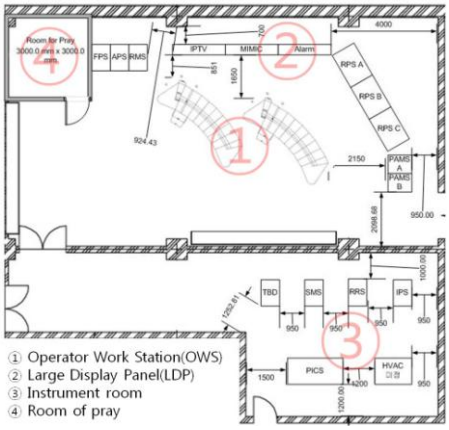

Fig 1. JRTR MCR Layout

3. Information display design

The human-system interface(HSI) in control room has been rapidly changed as automation and computerization have been increased. Manual switches, push button and knobs used to initiate actions have been replaced by their soft-controls in display screen. Also, computer displays are being added to existing control rooms to supplement the information already available from the instruments on the panel.

JRTR have two kinds of information displays, and they are Large Display Panel(LDP) and OWS displays. For the purpose of monitoring the overall condition and status of the reactor, display pages of LDP and OWS are designed considering the human factors principles for easy and accurate information acquisition and awareness. Basic principles designing information displays are as in the followings:

1) Consistency of symbols, characters' font(type)/size and colors…
2) Task focused design : the displayed information directly supports the task.
3) Easy navigation : It should be easy to move between information display pages.

3.1 Information displays of LDP

LDP consists of three digital displays. One which is installed at the left side of LDP is for Reactor Surveillance System(RASS). The middle one is to display the overall process mimics. And the last one is used for the process variables and alarm windows.

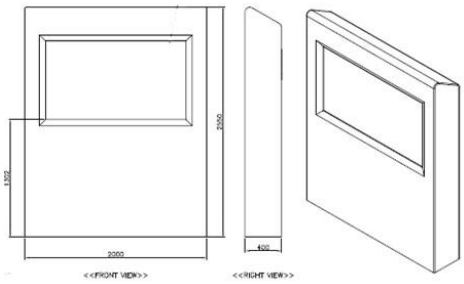

Fig 2. LDP Panel

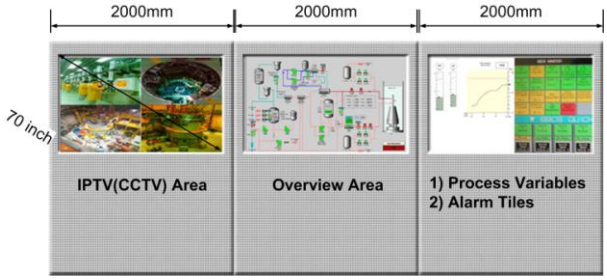

Fig 3. Form of LDP

3.2 Information displays of OWS

All variables which require monitoring and control of the process during normal and abnormal plant conditions are displayed on the information display of OWS. The types of display pages presented on the LCDs are system-based displays, function-based displays, alarm displays, and other displays for navigation and operation support.

Four LCDs are used for the control and monitoring of the reactor. All information on those LCDs are designed in consideration of human factors.

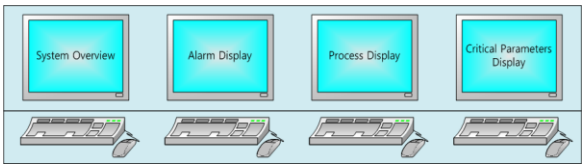

Fig 4. Composition of OWS display

Three LCDs are assigned to the system overview display, the alarm display, and process display, respectively.

1) System overview display : It is used to present the overall status of the reactor based on a mimic with representative variables of main systems.
2) Alarm display : It is used to show an alarm list and grouped alarm tiles for each system and has basic functions such as silence, acknowledgement, reset, and test.
3) Process display : It is used to monitor the process in detail and control the process.

The other one can be used for the display of the critical parameters. When required, it can be used for the process display.

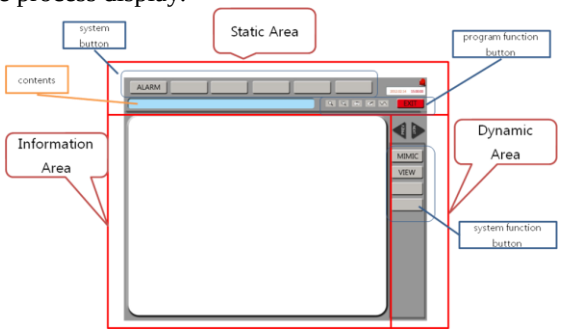

Fig 5. OWS display

A display shall consist of three major areas : a static area, a dynamic area and an information area. The static and the dynamic area of the display frame shall be not disappeared and not overlapped by any pop-up window and display pages so that all the common information is shown always.

4. Conclusions

A HFE program plan was developed for systematic design efforts in designing control room and HSIs. According to this, operators' functions and tasks are analyzed, and the results of the analyses are used for HSI design. In addition to this effort, design guidelines for displays were developed.

A systematic HFE procedures take into account anthropometric considerations as well as human cognitive strengths and limitations. They are applied to control room design and to development of operating procedures which reduce the potential for human errors.

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