Application Method of Anthropometric Data for Operator Console of Exportable Research Reactor

Goo-Hyun Ryu [a*], Jun-Hun Lee [a], Ja-Won Jeng [a], Youn-Sang Lee [a], Min-Gyu Kim [a]
[a*, a] *PONUTech, KAERI, Daedeok-daero 989-111, Yuseong-gu, Daejeon, 305-353, Korea*
[*] *Corresponding author: gerrard.ryu@ponu-tech.com*

1. Introduction

Nuclear-related domestic technology has been exported overseas, starting with the JRTR (Jordan Research & Training Reactor) which is currently on its development scheduled to operate in March 2015. It means that Korean nuclear technology has reached the global level already. Therefore, design standards of Human Factors Engineering (HFE) are needed for good products to make more comfortable and suitable for export products.

In addition, U.S. Nuclear Regulatory Commission (NRC) reported that the Three Mile Island (TMI) accident in 1979 has been caused by inappropriate design of control panel, human errors, and incorrect procedures. Accordingly, the importance of HFE was raised.

In this paper, we studied the application of anthropometric data for operator console and large display of exportable research reactor.

2. Control Room of the Research Reactor

Recently, advanced nuclear countries have developed improved control rooms with digital information processing technology. The distinctive feature of the improved power plant control room is that it uses computer-based equipment in digital network environment to process all of the information, and displays the process data on Visual Display Unit (VDU)s. Also, it has the advantages of early fault diagnosis, automatic operation and operation supporting using the computer-based equipment.

As nuclear power plants are improved, control rooms of the research reactors have been also improved by applying digital technology. Major feature of the control rooms that most of the monitoring and control are implemented using computers, and that large display is used to monitor high-level information and primary parameters. Operators' missions are controlling the reactor effectively using the computers which are installed in the consoles, maintaining the system safe all the time, and restoring the system quickly to the normal status in case of accidental events. The large display is helpful for them to grasp operation status easily and to take emergency measures for every abnormal event quickly without any confusion.

2. Application of Anthropometric Data

The design of the control equipment which are tightly related to operators' usability should be based on HFE. Therefore, the products which will be exported to other countries should be redesigned for their own people since all the products which are manufactured and designed for the domestic usage are now appropriate to Korean. To satisfy the usability of the actual operators, we need to refer to the anthropometric data of the relevant country's people. Consequently, the design of the control room, consoles, equipment, large display, and so on are based on the average people's sizes living in the country.

3.1 Targets for Application of Anthropometric Data

This paper studied the application method of anthropometric data for operator console and large display as following.

3.1.1 Operator Console

Operators monitor and control the process during normal and abnormal operations on the operator console. Therefore, operator console is where the operators stay most of the time.

3.1.2 Large Display

A large display shall be equipped in the place where the operators can easily access and see. It is because the purpose of the large display is monitoring the overall condition and status of the reactor.

3.2 Method for Application of Anthropometric Data

This paper proposes to apply the anthropometric data to the space as shown in Figure 1. The chair which becomes application criteria of the anthropometric data should be readily purchasable in the local, and also the height of the chair should be adjustable. It is because the chair has considered a body shape of local people and it is easy to maintain in the future.

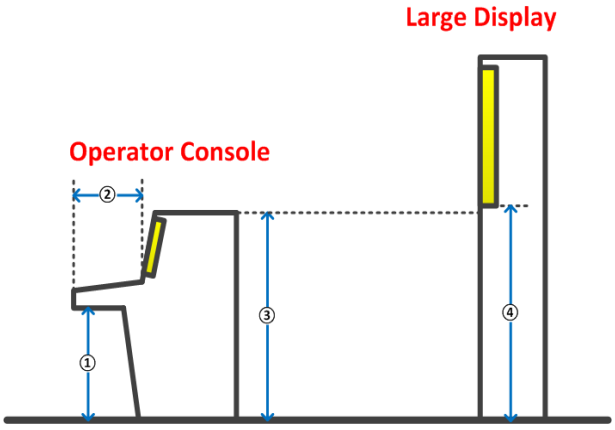

Fig 1 Space for Application of Anthropometric Data

3.2.1 Knee Space of the Console

In order to provide a comfortable operating environment of operators at the operator console, the knee space of the console should be set as following.

(1) Minimum knee space = Thigh diameter of 95% adult men + Minimum height of the chair

In addition, if the anthropometric data does not include the diameter of thigh, the diameter could be calculated approximately by using following method.

Thigh diameter of 95% adult men ≒ Thigh circumference of 95% adult men / 3.14

Using the equation (1), the console could satisfy the knee space for the 95% of adult men. Therefore, it could satisfy all adult men and women except for less than 5% adult men.

3.2.2 Control Space of the Console

In order to provide a comfortable control space for monitoring and control of power plants on the operator console, the control space of the console should be set as following.

(2) Maximum length of the control space = Length from shoulder to hand of 5% adult women

Using the equation (2), the console could satisfy control space for more than 5% of adult women. Therefore, it could satisfy all adult men and women except for less than 5% of adult women.

3.2.3 Height of the Console

In order to provide a comfortable view of easy monitoring of the large display sitting on the operator console, the height of the console should be set as following.

(3) Maximum height of the console = Sitting eye height of 5% women + Maximum height of the chair

Using the equation (3), the console could satisfy console height for more than 5% of adult women. Therefore, it could satisfy all adult men and women except for less than 5% of adult women.

3.2.4 Display Height of the Large Display

In order to provide a easy view for overall mimic, critical parameters, alarms and so on at the operator console, the display height of the large display should be set as following.

(4) Minimum display height of the large display = Maximum height of the console

Using the equation (4), the large display could satisfy the display height for more than 5% of adult women. Therefore, it could satisfy all adult men and women except for less than 5% of adult women.

3. Conclusions

Research for nuclear power has been active around the world with environment friendly image. Therefore, it is also very important to study the HFE as a big part in the field of nuclear safety.
This paper studied the method to apply the anthropometric data to operator console and large display that used to control room of the exportable research reactor. It is difficult to provide an appropriate operation environment personally to all operators. Therefore, this paper studied method to provide comfortable operation space common to most operators. In the future, it will be possible to enhance the completeness through conformity assessment of the design based on this paper. Therefore, the results of this paper will be an important basic data to design suitable for body size of the user for exportable products such as large display and operator console.

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