Development of the scenario-based training system to reduce hazards and prevent accidents during decommissioning of nuclear facilities

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1. Introduction

Decommissioning is under the hazardous environments with high radioactivity and high difficulty. Decommissioning of nuclear facilities has to be accomplished by assuring the safety of workers. Decommissioning workers need familiarization with working environments because working environment is under high radioactivity and work difficulty during decommissioning of nuclear facilities. On-the-job training of decommissioning works could effectively train decommissioning workers but this training approach could consume much costs and poor modifications of scenarios. The efficiency of virtual training system could be much better than that of physical training system.

This paper was intended to develop the training system to prevent accidents for decommissioning of nuclear facilities. The requirements for the training system were drawn. The data management modules for the training system were designed. The training system of decommissioning workers was developed on the basis of virtual reality which is flexibly modified.

2. Methodology

2.1 Development of the training system

The training system for decommissioning worker was developed as shown in Fig. 1. When worker puts the head-mounted display (HMD) on his head, the graphic server of virtual training system is being operated. The graphic server receives data of worker's direction changing. The graphic server exchanges data management unit with the detected numerical data. The graphic server provides the HMD with pictures of direction response and the monitoring device with pictures of worker's location and behavior. In this situation, worker is in first person mode and recognizes decommissioning scenarios with HMD as ones of working in place. On the other hand, Manager is in third person mode and could keep up with location of worker and situation of working.

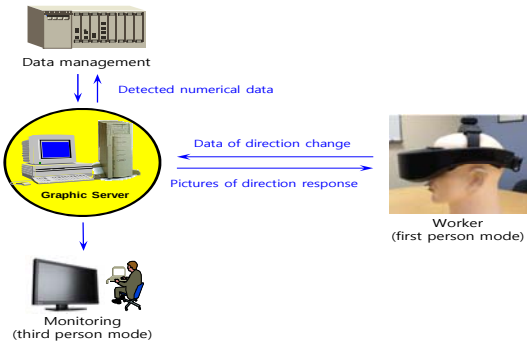

Fig. 1. Configuration of the training system.

2.2 Method of the training system

The virtual reality system of decommissioning is different from other system in examination of radiation exposure. It is essential to inspire the radiation exposure estimation of worker into the virtual reality system because decommissioning is under high radiation and work difficulty. The radiation exposure of worker could be estimated from space dose distribution multiplied by duration time of worker. The data of the space dose distribution was calculated by the MCNP code.

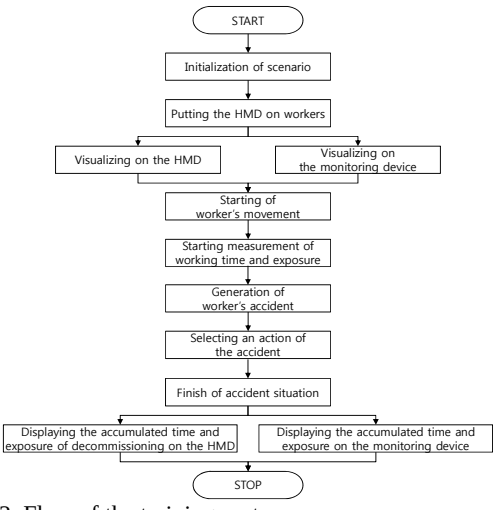

Fig. 2. Flow of the training system.

Fig. 2 presents how to operate the training system. As presented in Fig. 2, the training system is started by initializing the scenario of decommissioning. The subject of the training system then put the HMD on his head. The visualization of a decommissioning scenario is displayed for the subject through HMD and for the

supervisor through the monitoring device of the subject. If the subject starts to move in virtual environment, the working time and radiation exposure of the subject start to be measured. Also, if an accident takes place, alternatives of counter-actions of the accident are provided and choice of the alternatives is made. After finish of the accidental situation, the accumulated working time and radiation exposure are displayed on the subject's HMD and on the monitoring device of supervisor.

2.3 Performance test of the training system

The assumption on testing of the training system is that the worker's falling accident rises during installation of cavity pool seal. The performance test of the training system is shown in Fig. 3. Once the subject puts the HMD on his head, he can look at the cavity pool seal lifted by a crane. The one subject starts to go down from the upper floor to the below cavity pool, the other subject supports the moving of the one subject. The other subject plays a role in supporting the one fallen subject in case of an accident. At this time the working time and radiation exposure of the subject are for the first time measured. During installing and checking of the cavity lines around the cavity pool seal, an accident of the one worker's falling takes place. The other subject observing the moving of the one subject goes down to the accident spot on a ladder and both of them gets to the upper floor. In the end, the accumulated working time and radiation exposure of the subjects are measured and displayed on the HMD in first mode and on the monitoring device in third mode.

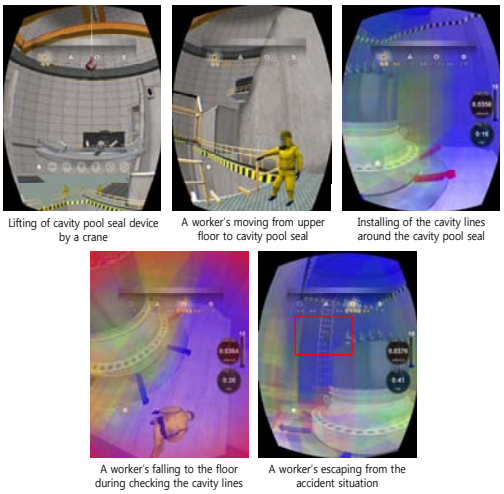

Fig. 3. The performance test of the training system.

3. Conclusions

The performance testing of the training system was satisfactory for the requirements and proved the systematic interactions of the data management module. The visualization and measurement in the training system were real-time done according as changes of the decommissioning scenario.

It can be concluded that this training system enables the subject to improve his familiarization about working environments and to prevent accidents during decommissioning of nuclear facilities. In the end, the safety during decommissioning of nuclear facilities will be guaranteed under the principle of ALARA.