Methodology to Assist in The Training of Pump Operation Maneuvers of A Nuclear Plant Using Virtual Reality

A. Gustavo S. P. Santos[1], B. Antônio C.
A. Mol[2], C. Claudio H. S. Grecco[3], D.
Yuri L. Fernandes[4], E. Joaquim E. M.
Santos[5], and F. Paulo F. Oliveira[6]

[1] *gspsantos2208@gmail.com,*
ELETRONUCLEAR/IEN/CNEN
[2] *mol@ien.gov.br, IEN/CNEN*
[3] *grecco@ien.gov.br, IEN/CNEN*
[4] *uri.lemos@gmail.com, IEN/CNEN*
[5] *joaquim.eugenio.mattos@gmail.com,*
IEN/CNEN
[6] *paulo_sisc@hotmail.com, IEN/CNEN*

1. Introduction

This article proposes a methodology to promote the training [1] of operators of a nuclear plant in the task of operating the oil pumps of the main cooling water system, without compromising the plant's operation and availability, effectively and close to reality, through of immersive training in Virtual Reality [2], using the program Unity 2018.3.10f1.

2. Methodology

In order to define the main operations to be carried out on the oil pumps of the Main Cooling Water system, the following documents were consulted: the system operation manual, the system description, the system handout, the system flowchart, the sheet of logic, operational experience, as well as interviews with experienced operators and instructors. With all the information above, the main components were created in a virtual environment [2]: a main pump, such as oil pumps, pipes, pressure gauge and the electrical panel that allows maneuver between the oil pumps, as well as the characteristic noise of the environment. In the Figure 1 is showed the final result in the virtual environment. The main points to be observed according to the plant's operating manual, were highlighted (discharge pressure, operating time, number of oil pumps in operation, reset), and the following operational maneuvers were reproduced: Low efficiency of the oil pump , Oil pump locking, Manual switching with and without success, Automatic switching with and without success.

Figure 1:   Main Cooling Water System.

To meet the planned maneuvers, a menu of malfunctions was created [2] shown in Figure 2.

Figure 2:   Electrical panel of oil pumps and malfunction menu.

3. Results and Discussion

Professionals with years of experience ranging from 10 to 41 years of experience in a nuclear power plant [1] were invited to use the tool. These professionals were chosen and separated into 3 groups. Group 1 - Nuclear power plant field operators; Group 2 - Nuclear power plant control room operators; Group 3 – Instructor Simulator and Conventional. In order to assess the opinion of these professionals, on the use of a virtual environment in a nuclear power plant as an auxiliary tool, in the establishment of strategies for training and professional qualification, they filled out a research questionnaire.

The research questionnaires continue to be delivered, however it is possible to notice that the result so far indicates that the 3 groups affirm that training with simulations in the virtual environment is recommended before practicing in a real environment.

4. Conclusions

Improvements to existing training and the creation of new training for the practice of maneuvers that are infrequent in different systems of the plant can be developed using this methodology. In this way, human performance, knowledge retention, availability and safety of a nuclear plant are increased.

Acknowledgements

References

[1] Mól, A.C.A.; Passos, C.; Silva, M. H.; Carvalho, P.V.R. Collaborative virtual environment for training radioprotection agents. Instituto de engenharia nuclear: Progress Report, v. 3, p. 1-1 (2018).

[2] Da Silva, M. H.; Legey, A. P.; Mól, A.C.A.. Review study of virtual reality techniques used at nuclear issues with emphasis on Brazilian research. Annals of Nuclear Energy, v. 87, p. 192-197 (2016).