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Development of Virtual Environment under Member State Support Program

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1. Introduction

Member State Support Program (MSSP) is a voluntary support program for the IAEA to help maintain its ability to implement safeguards. MSSP is comprised of various programs such as development of safeguards approach, training, information analysis and so on. Each support programs would be evaluated biennially through coordinators' meeting. IAEA publish 'Development and Implementation Support Programme for Nuclear Verification' so that the member state can review it. In the program, IAEA specify the need to develop the virtual reality based training tools.

The objective of this project is to develop comprehensive training software dedicated to verification activities in the field based on the virtual environment. The training for the IAEA inspector is indispensable to maintain or improve their verification capability and to be prepared for the inspection of the complicated facilities. However, the grabbing of the available facility is not easy due to following limitations such as security, confidentiality, interference of the commercial operation and so on. Therefore, the virtual environment, which can replace a real facility, is required for the IAEA training [1].

2. Methods and Results

In this project, we developed the virtual environment on the fuel fabrication of the light water reactor only. First, we analyzed safeguards approach for each fuel fabrication process, and identify safeguards relevant activities.

2.1 Analysis of the Fuel Fabrication Process [2, 3]

The PWR fuel fabrication process starts from the receipt of UF_6 cylinders and it ends by shipping the fuel assemblies to the nuclear power plants. Considering safeguards approach, we divided the fuel fabrication plant as six areas. It includes UF_6 cylinder storage, UO_2 powder fabrication, pellet fabrication, rod and assembly fabrication and an interim storage.

2.2 Analysis of Safeguards Approach [2, 3]

Since the software aims to train the safeguards inspectors, it is required to introduce the safeguards relevant information as well as the fabrication process in the software. In this regards, it is essential to understand, from a safeguards perspective, the flow of nuclear material and the processes involving nuclear material at the facility. Material balance area (MBA) to be used for nuclear material accountancy and key measurements point (KMP) and other strategic points are important to determine nuclear material flow and inventory and need to be identified in the software. The information is specified in the Facility Attachment, and we implemented this part in the left side of the screen for the user to check it easily.

2.3 Analysis of the Safeguards Activities [4]

The verification activities for the nuclear material are also defined in the facility attachment according to the safeguards approach. In case of fuel fabrication facility, various verification activities are used. They include identification (A), weighing (B), sampling & analysis (D), variables test by NDA (F), Attribute test by NDA (H) and item counting (I). Each activity requires specific equipments such as IMCG, IMCN, MMCN, HM-5, UNCL, LCBS, ULTG and etc. Since assembling and usage of these equipments are also needed for the beginner, we develop the pop-up module for the equipments with introduction of principle, usage and reporting methods.

2.4 Structure of the software

In designing the facility, the three-dimensional model was adopted to show the whole facility at a look. Also, users can look through the process from the center. Also, the model has a zoom-in/out function and the viewpoint can be controlled freely.

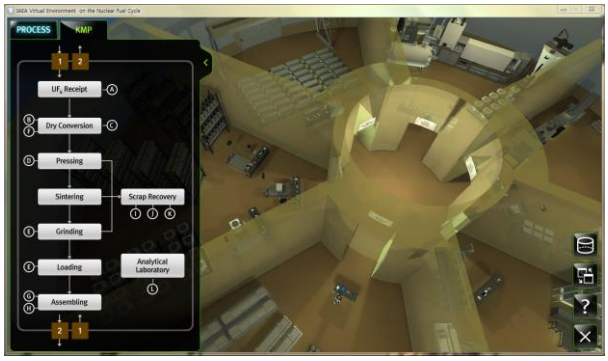

Fig.1. the outside frame of virtual environment

Fig.1 shows the outside of the frame. There are two tabs in the left side. Once the user clicks it, it shows the overall process and each key measurement points. By clicking the tabs in the diagram, the user will move directly to the corresponding location of the model facility. In the right side of the screen, there are

navigator buttons which the user can change the viewpoints.

Fig.2. the inside frame of virtual environment

Fig.2 shows the inside frame. The pop-up window shows the example of the verification equipment by responding to the click. This example shows the animation regarding the fuel assembly verification. The popup window provides information related to safeguards approach such as design information, verification procedures, equipment instructions and working papers.

2.5 The Evaluation Model

When we develop the software, we discussed with the IAEA. We agreed to develop this software useful both to the trainee and trainer. After the discussion with the IAEA, we added evaluation module in the software. The evaluation mode is similar to the training mode, but in the evaluation mode, we deleted guiding information. Instead, the trainee should finish the mission assigned at the beginning. At the end of the task, the software will provide the log report on all activities the trainee performed. Then the lecturer can check the log report to see whether the trainee has done the mission successfully without mistake. We are still under discussion to add more functions to be useful for the evaluation.

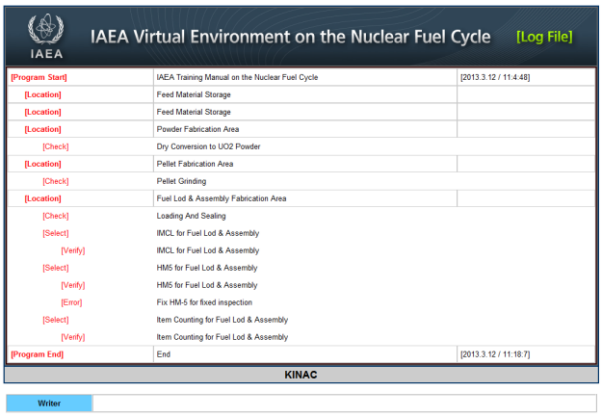

Fig.3. the example of the log report.

3. Conclusions

The objective of this software is to support the IAEA's verification capability. It is useful for the trainer and trainee to better understand how nuclear materials are processed in the fuel fabrication facility and what kind safeguards approaches are needed at each process before inspections. The final product will be integrated in the IAEA safeguards training courses to improve the efficiency of the safeguards training. Also we are going to make a decision if additional projects such as CANDU fuel parts or other facilities depending on evaluation results at the IAEA training course will be held on Korea in this year.

REFERENCES

[1] IAEA, "Development of Virtual Training for Bulk Handling Facilities", Task Outline from SPRICS database, August 2011.
[2] IAEA, "Fuel Fabrication IAEA Training Manuals on the Nuclear Fuel Cycle", Revised Edition (STR 364-03), February 2011.
[3] IAEA, "IAEA Safeguards Glossary", 2011 Edition, June 2011.
[4] IAEA, "Safeguards Techniques and Equipment", International Nuclear Verification Series No.1 (Rev.2), 2011