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Korea-IAEA Unattended Safeguards Approach on the Spent Fuel Transfer to Dry Storage in Wolsung NPP

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1. Introduction

The field trial of an unattended monitoring system for SF transfer verification ended in June 2005. The system is aiming to improve the safeguards measures applied during SF transfers and reduce inspection effort currently required by the Operator, NNCA and the IAEA[1]. They were reviewed based on its technical performance and other issues in this paper.

2. New Monitoring Safeguards Approach for CANDU System

2.1 Spent Fuel Transfers Process

In Korea, one of the major issues for safeguards implementation is spent fuel transfer verification at CANDU type reactors. ROK and IAEA are developing a new approach for a streamlined inspection scheme which enables considerable savings in the inspection efforts[2].

2.2 Traditional Safeguards

In the CANDU facilities the spent fuels are stored into the interim dry storage in baskets. Each basket can contain 60 spent fuel bundles that are packed at the underwater loading station in the area of spent fuel bay. The baskets are then welded and transferred to the dry storage facility in a shielded flask mounted on a truck. The baskets are loaded by layers in a concrete silo that can contain 9 baskets. Fully loaded silos are welded and kept under dual C/S. Human labor of inspection to these transfers must be present on site in order to ensure continuity of knowledge over the entire transfer process.

2.3 New System

New system substitutes for the inspector's presence during the campaign periods by a system of camera surveillance, radiation monitoring, and remote monitoring. Figure 1 shows the new system.

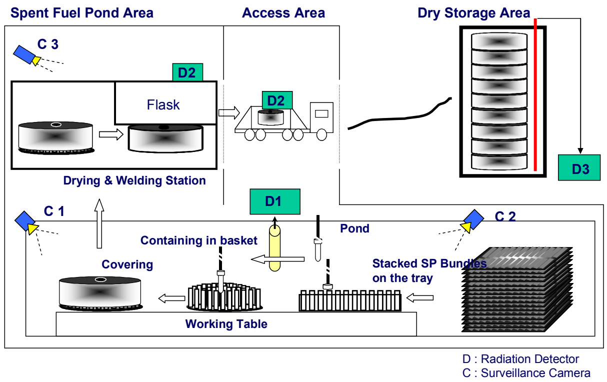

Figure 1. Diagram of unattended system

Safeguards monitoring system was installed, of spent fuel bundles transfer to dry storage at Wolsung 1 and 2 from January 10 to 25, 2005. The field trial was running for 4 months afterwards

2.3.1Basket Loading Area

The operation of loading a basket is performed manually one bundle at a time. A bundle verifier was installed to monitor the spent fuel bundles, consisting of 2 gamma detectors (D1), and 2 underwater cameras (C1, C2)(Fig. 1). Figure 2b shows a typical signal pattern obtained during the bundles packing into a basket. It is possible to discriminate 12 signals from each bundle per tray.

Figure 2a. The NDA detector assembly used for the measurement of the basket during the loading (D1).

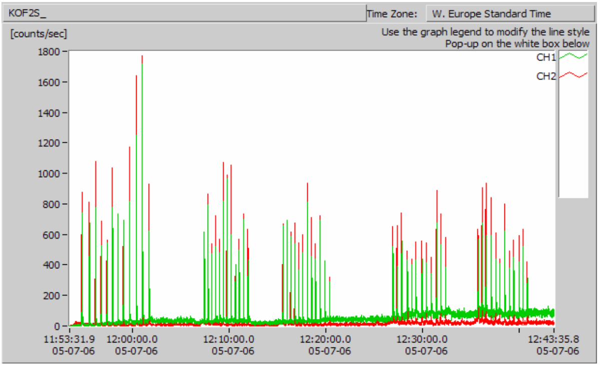

Figure 2b. NDA signals from the measurement of the basket during the loading (D1).

2.3.2 Transferring passage from welding station to the Dry storage

2 neutron detectors set up on the top of the transport flask to assure the COK shown as figure 3a. Radiation activities and time information is recorded for the basket movement activity in a small device with a battery pack. As Figure 3b shows the MUND(Mobile Unit Neutron Detector) signal from the basket coming in and out of the flask.

Figure 3a. 2 Neutron detectors were mounted on the flask (D2).

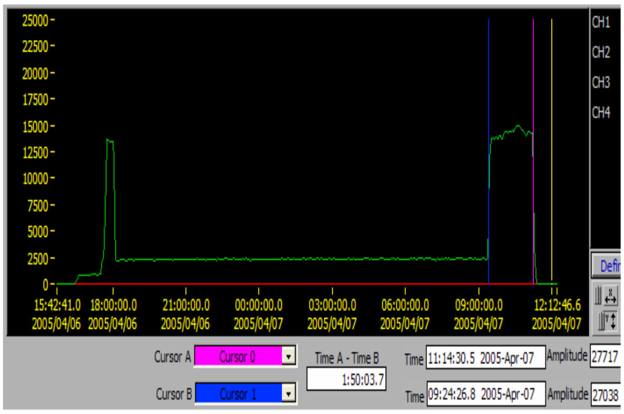

Figure 3b. NDA signals from the flask (D2).

2.3.3 Silo Loading Area

D3 consists of 2 gamma detectors with different heights in seal tubes. Figure 4 shows a pair of gross gamma detectors collecting 2 signals with a time gap of each detector arising from the basket entry to a silo

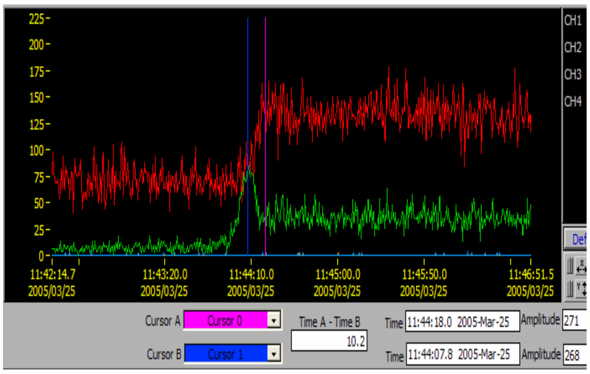

Figure 4. 2 NDA signals from canister loading (D3).

3. Conclusion

After the field trial of transfer campaign, both IAEA and ROK analyzed the performance of the system. The main points discussed were the sensitivity of the detectors, the redundancy implemented within the system, data quality and backup measures in case of equipment failure on September 21, 2005[3]. The attended system has been assessed to be a valid substitution for the conventional system during the transfer process. But one more field trial was suggested for an exhaustive investigation at the unit 2 in the next transfer campaign period beginning from September 2006. This test includes RM data transmission without inspector's presence.

REFERENCES

[1] Cesare Liguori, "Test Measurement during Transfer Campaign of spent Fuel to the Dry Storage Facility", IAEA Technical Report, 2002.

[2] TCNC, 13th ROK-IAEA Joint Review Meeting on the Safeguards Implementation, p. 240, Nov. 2004

[3] Minutes, "Meeting on the Evaluation of an Unattended Safeguards Monitoring for Transfer of SF to Interim Dry Storage at Wolsong NPP", Sep. 2005.