New Unattended Monitoring of the Spent Fuel Transfer to the Dry Storage in Wolsong NPP

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1. Introduction

IAEA installed new safeguards equipment to monitor the spent fuels to be transferred to the dry storage at Wolsong unit 1 and 2 from January 10 to January 25, 2005. ROK set up routing and wiring of power and signal lines, and laying protective conduits. The system consists of 2 underwater cameras in the spent fuel bay, and 2 non-destructive analysis (NDA) detectors in the spent fuel pond and on the transfer flask, respectively. In the dry storage, 2 NDA detectors were installed, as well.

2. New Monitoring Safeguards Approach for CANDU System

2.1 Spent Fuel Transfers Process

For spent fuel transfer from the spent fuel storage bay to dry storage canister, bundles are verified by item counting, serial number identification, and gross defects test before loading into a basket. The continuity of knowledge (COK) should be maintained during drying and welding of baskets and loading baskets into dry storage canisters. After loads of 9 baskets, dry storage canister is placed under dual C/S and fingerprint is taken for each canister for future re-verification.

2.2 Traditional Safeguards

IAEA verifies the spent fuels according to the safeguards obligations by means of inspector's presence throughout the transfer campaign. To verify the spent fuels, 60-80 person-days of inspection (PDI) are necessary for about 3 months on a single unit. Figure 1 shows trends of the inspection efforts for the transfers in Wolsong unit 1. Average inspections for one basket are 0.7 PDI per basket in 1993, gaining about half compared with early 1990s. There were no transfers in 1994. From this year, nuclear safety standards have been stricter for the transfer campaign, causing 50 % more transfer periods. Moreover, it is expected that PDIs will increase 3 times more due to the transfers in the unit 2, and 3 for the first time. Maintained current safeguards system, it will reach as much as 420 PDIs for the 4 units from 2006.

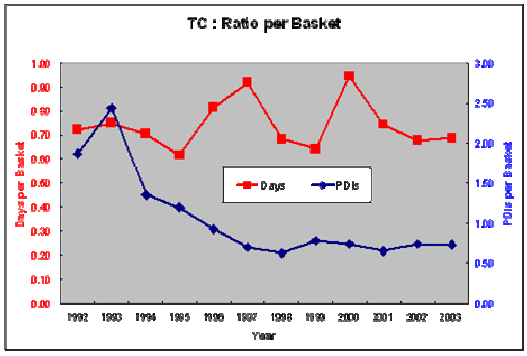

Figure 1. Annual inspection efforts of the transfer campaign.

To reduce the drastically increased safeguards PDI and its efforts, IAEA and ROK jointly have developed new safeguards system since the first field test in 2002.

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 2 shows the new system.

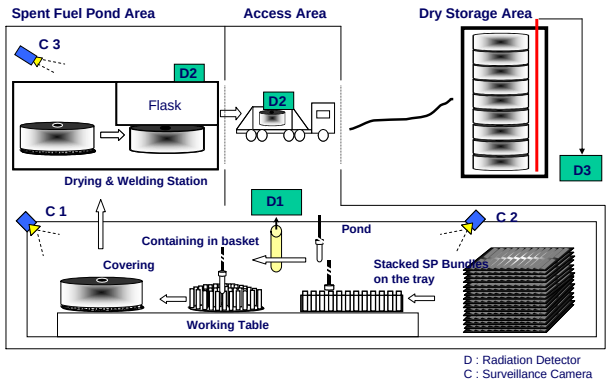

Figure 2. Diagram of new system.

Safeguards monitoring system was installed, of spent fuel bundles transfer to dry storage at Wolsung 1 and 2 from January 10 to 25, 2005.

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).

Figure 3. The NDA detector assembly used for the measurement of the basket during the loading (D1).

Figure 4. The underwater camera system used for the counting of the basket during the loading (C1 and C2).

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. Radiation activities and time information is recorded on the basket movement in a small device with a battery pack.

Figure 5. 2 Neutron detectors were mounted on the flask (D2).

2.3.4 Silo Loading Area

Radiation detectors were installed to cover the basket loading activities into the silo. D3 consists of 2 gamma detectors with different heights in seal tubes. They detect the presence of the spent fuels and determine the direction of flow of the materials.

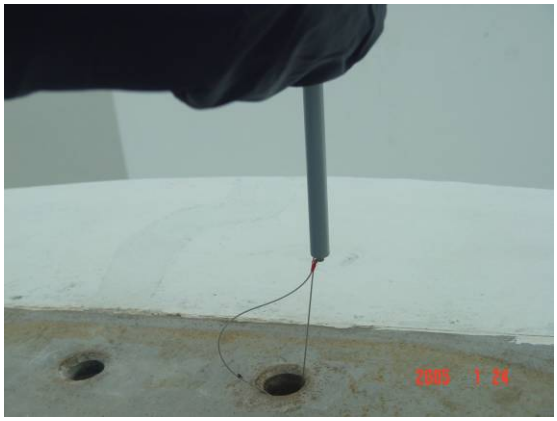

Figure 6. 2 Gamma detectors were mounted in the seal tubes (D3).

4. Conclusion

In November 2002, IAEA tested an enhanced monitoring system with NNCA (National Nuclear Management and Control Agency, previously TCNC; Technology Center for Nuclear Control) [1]. IAEA proposed to install this system at Wolsong site in Jun 2003. ROK has agreed on the proposal in the 13th ROK-IAEA Joint Review Meeting on the Safeguards Implementation, December 2004 [2]. The installation of the monitoring system was completed at Wolsong unit 1 and 2 from January 10 to January 25, 2005. At the end of the transfer campaign of Wolsong unit 2, both IAEA and ROK will analyze the performance and reliability of the system and discuss the possible implementation of the new verification concept.

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