Consideration on Containment and Surveillance Measures of Safeguards Approach to Light Water Reactor(LWR) Spent Fuel Dry Storage

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1. Introduction

In 2016, the wet storage capacity of LWR spent fuel in ROK will be expected to saturate. Significant portions of spent fuel assemblies in wet storages should be transferred to a certain type of dry storage facility in order to continue the operation of LWR. We have the only experience of safeguards approach to CANDU spent fuel (from heavy water reactors in wolsong site) dry storage.

The IAEA designates fuel items for a dry storage facility as 'difficult- to-access' which means that it is difficult for the IAEA inspectors to access the items in the dry storage for verification and identification. On the consideration of LWR dry storage cases in other countries, the Containment and Surveillance(C/S) measures play the key role in the safeguards approach to the dry storages facilities.

On design of a LWR dry storage facility, specification of containment and surveillance measures for the facility and the way to apply the measures to the facility will be suggested in this paper.

2. Containment and Surveillance(C/S)

2.1. Containment

Containment in safeguards approach means structural features of a facility, containers or equipment which are used to establish the physical integrity of an area or items (safeguards data, container, fuel assembly etc). Examples are the walls of a storage room or of a storage pool, transport flasks and storage containers. The continuing integrity of the containment is usually assured by seals, surveillance measures and periodic examination of the containment during an inspection.

2.2. Surveillance

In safeguards approach, surveillance means the collection of information through inspectors and/or instrumental observation aimed at detecting movements of nuclear material or other items. Surveillance may also used for observing various operations or obtaining relevant operational data. IAEA inspectors may carry out surveillance assignment continuously or periodically at strategic points (key measurement points).

2.3. C/S measures

In order to maintain the continuity of knowledge of the area or items and complement nuclear material accountancy, C/S measures apply to nuclear facilities. The C/S measures are aimed at verifying information on movement of nuclear material, items or equipment under safeguards.

For instances, the C/S measures are applied 1)during flow and inventory verification, to ensure that each item is verified without duplication and that the integrity of samples is preserved, 2)to confirm that there has been no change to the inventory previously verified and thus reduce the need for re-measurement, 3)to ensure that IAEA equipment, working papers and supplies have not been tampered with, 4)if necessary, to isolate nuclear material that has not been verified until it can be measured.

The ultimate resolution of the C/S measures is provided by nuclear material verification. But an evaluation of the C/S measures for difficult-to-access items as a whole acceptable may serve as a basis for drawing safeguards conclusions for material balance evaluation and for timely detection.

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4. Case study for C/S measure

4.1. Open dry storage facility

Taiwan Power Company(TPC) in cooperation with the Atomic Energy Council(AEC) manages dry facilities. TPC operates 6 LWRs which are 2 units in Chinshan, 2 unints in Kuosheng, and 2 units in Lungmen. TPC started to manufacture transportable storage canisters in September of 2008 and completed all the facility (Fig.1) in July of 2012. Transfer campaign of spent fuel is planning to start in November of 2012. On the final stage of operation after the transfer campaign, the dual C/S measure which is seal and seal will be applicable to the dry storage facility.

Fig. 1. Dry storage facility in Chinshan, Taiwan

4.2. Dry storage in building facility

The Belgium utility electrabel presently operates 7 LWR nuclear power plants which are located in Doel (4 units) and Tihange (3 units). The spent fuel of the first 3 units (Doel 1, 2 and Tihange 1) was sent to cogema reprocessing company in France and the other spent fuels from Doel 3, 4 and Tihange 2, 3 are transferred to the interim dry storage facility (Fig. 2) in Doel, Belgium.

A dual C/S measure with back-up which could be a camera and/or neutron detector is applicable to the building type of dry facility (Fig. 2).

Fig. 2. Dry storage facility in Doel, Belgium

5. Consideration

On design of a LWR dry storage facility, we have to take into account a dual C/S measure since the fuel items designated as 'difficult-to-access' store in the facility for the certain period of time over several decades. According to the case study in other countries, the dual C/S measure plays the key role in the safeguards approach.

Two different independent seals where a dual C/S measure is seal and seal could spontaneously be damaged in rare possibility. In case of the breached dual C/S there would be no measure for verification of the difficult-to-access fuel items.

One seal and one camera where a dual C/S measure is seal and surveillance are usually backed up with other different seal (eg. COBRA seal, Metal seal etc). This kind of dual C/S can be applied to dry storage in a building type of dry storage facility. Since it is easy to install surveillance camera in the building facility, IAEA usually applies the COBRA seal and surveillance camera with back-up (eg. metal seal, Non-destructive Assay equipment) to that kind of dry storage facility.

In any case of storage facility, a dual C/S should be taken into account on design of the facility.

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