

Study on the Integrated Safeguards approach at LWRs

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1. Introduction

Since IAEA Safeguards inspection started in Korea, IAEA and Korea have been looking for possible cooperation ways to perform more efficient and effective safeguards inspection. As a part of the efforts, during the 8th JRM in 1999, the IAEA and Korea agreed the LWRs enhanced cooperation between both sides. It is traditional safeguards approach based on the remote monitoring. In 2004, the additional Protocol was in force in Korea. Since then, both sides have been now considering new approaches according to all the facility types under the integrated safeguards. This study analyzes which options suggested by the IAEA is the best approaches to Korean LWRs.

2. New Safeguards Approaches

2.1 Inspections at LWRs in 2004

In 2003 and 2004, the inspection efforts performed at LWRs by the IAEA for the enhanced cooperation are 57 person-day-inspections. All interim inspections, pre-PIV and Seal detach activities are the subject of the enhanced cooperation inspection by the MOU agreed by both sides. Among these inspections, the IAEA selected randomly 19 inspections and performed them with national inspectors in 2004. And the rest of inspections were carried out by national inspector solely. Table 1 shows inspection efforts performed at the LWRs.

Table 1. No. of inspection at LWRs in 2003 and 2004

| | No. of inspection | Enhanced cooperation inspection | With agency inspector | Avg. No. of inspection per LWR |
|------|-------------------|---------------------------------|-----------------------|--------------------------------|
| 2003 | 95 | 57(17) | 55 | 3.4 |
| 2004 | 106 | 57(19) | 68 | 4.3 |

2.2 The new approach under the Integrated Safeguards for LWRs

Considering the concept of the Integrated Safeguards (IS) for achieving a greater effectiveness and efficiency, the Agency is trying to develop the State Level Approach (SLA) instead of current facility level approach. However, the Agency's conclusion of non-diversion of declared nuclear materials in a state has to be drawn as required under a comprehensive safeguards

agreement. This conclusion is based on the evaluation results of inspection activities performed at nuclear facilities in the State and a qualitative assessment of all other information available to the IAEA. The IAEA suggests general inspection guideline under the integrated safeguards like this.

- For irradiated direct-use material, Timeliness goal extended from 3 months to 1 year.
- For irradiated direct-use and indirect-use material defect verification and detection probability lowered one level.
- No change for more than 1 SQ un-irradiated direct-use material verification, except the timeliness goal for fresh LWR MOX fuel assemblies changed from 1 month to 3 months.
- For material under successful C/S, no re-measurement or re-verification necessary.
- No change verification activities for more than 1 SQ un-irradiated direct-use material.

And, the IAEA considers to perform at least 1 Random Interim Inspection (RII) in the population of LWRs (20% selection probability) and 1 Physical Inventory Inspection (PIV) in a year (PIV-EQV: 50% selection) at the LWR without MOX. The selection of facilities for random interim inspections will be made from the entire population of LWRs in a State with a 20% selection probability per year, and with the selection of at least one reactor per year. The detection probabilities and defect tests for verification of fresh fuel and irradiated fuel without MOX can be one level less than those in the current Safeguards. However, the lowest level of defect test is the gross defect test and the lowest detection probability remains 20%. Table 2 shows the comparison of traditional and IS approaches for LWR.

Table 2. Comparison of Traditional and IS Approach for LWR

| | Traditional | Integrated |
|---|--|--|
| Timeliness | 1 year for fresh LEU | 1 year for fresh LEU |
| Detection Goals | 3 months for spent fuel | and spent fuel |
| Permanent C/S measures applied to spent fuel pond and reactor | Surveillance on spent fuel pond and reactor. Seal on reactor core | No permanent surveillance. Seal on reactor core. |
| Evaluation of C/S measures by the Agency | During inspection, quarterly | During PIV and random interim inspection |

2.3 Options for LWRs without MOX under Integrated Safeguards.

The agency developed three options for LWRs without MOX like this.

- Unannounced Random Interim Inspection and no-surveillance (ISP-1) during closed core period.
- Random Interim Inspection (short notice) with Remote Monitoring (ISP-2).
- Random Interim Inspection (short notice) with Surveillance in Overwrite (ISP-3).

ISP-1 is the base proposal, which uses temporary surveillance during refueling, unannounced inspections and other (pre-PIV, post-PIV, PIV-equivalent and seal attach). However, ISP-1 and 2 are able to be chosen by the state, considering state and facility's conditions. It is expected that inspection efforts at LWRs decrease from 3.75 PDIs to 2.2 PDIs under the Integrated Safeguards. Table 3 explains three options according to the inspection activities.

Table3. LWRs without MOX Fuel: Base IS Approach and Its Options

| | PIV | Interim | Surveillance | | Seals |
|-------|--------------------|---------------------------------------|------------------|-------------------|-----------------|
| | | | During refueling | Between refueling | |
| ISP-1 | PIV/PIV-equivalent | Unannounced | Yes (Temporary) | No | On reactor core |
| ISP-2 | PIV/PIV-equivalent | Announced random (1day-1 week notice) | Yes (Permanent) | Yes (with RMS) | On reactor core |
| ISP-3 | PIV/PIV-equivalent | Announced random (1day-1 week notice) | Yes (Permanent) | Yes (Overwriting) | On reactor core |

2.4 Comparison of the LWRs enhanced cooperation in Korea and Integrated Safeguards Approach

The IAEA inspectors have performed approximately four inspections at each facility of LWRs a year in 2003 and 2004. Accordingly, considering 16 months average refueling period time, it is expected that the inspection efforts decrease from 3.75 PDIs to 2.2 PDIs under the Integrated Safeguards. And, under the integrated safeguards, core inventory is verified by the differences of fresh fuel and spent fuel numbers between pre-PIV and post-PIV. Lastly, DIV will be done during open reactor core selected under approximately 20% of LWRs scheduled periodical service.

3. Conclusion

The IAEA suggested three options mentioned above to the Korea and we held working group meetings between both sides to decide which option is the best for Korean LWRs, considering current status and policy. However, in case of their concepts, three options require same inspection efforts, but require little

different surveillance way at LWRs. Until now, the Korea considers all of three options and decides which one is the best option. And it is necessary that we carry out its field test because we have to solve unexpected matters in advance, which seem to happen in the future.

REFERENCES

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 [2] IAEA, "Guidelines for the USE of Unannounced and Short Notice Inspection in Integrated Safeguards", 2002-09-18, Rev. 2