A study on the benefits of implementing domestic safeguards activities by supporting the IAEA training course

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1. Introduction

Currently, ROK is actively supporting IAEA safeguards activity and contributing total 18 tasks to IAEA in-cash and in-kind through the Member State Support Program (MSSP). These consist of total 6 fields such as training, safeguards approaches, Analysis Support and NWAL Coordination, information analysis, Safeguards Information Systems and System Usability. Among them, ROK has the most budget support for training. In ROK, there are various reactor types such as LWR, CANDU, research reactor and so on. Using these facilities, ROK provides total four training courses on LWR, CANDU, BHF, Engineering scale of pyroprocessing for IAEA inspectors.

Since ROK joined MSSP in 1997, ROK has performed 42 support programs including safeguards approaches, training, information management, analytical services, etc. Among them, training takes up many parts in the Support Programs. Currently, ROK has completed 22 tasks and rest 18 tasks are on-going.

Table I: ROK Support Programs

Title
Portable Monochromatic Micro-focusing X-ray Fluorescence System(MMXRF)
NRTA System Documentation and Requirements Gathering
Analysis of Environmental Samples supplied by the IAEA
Advanced Comprehensive Inspection Exercise at LWRs and CANDUs in ROK
Contribution to a Safeguards Technical Report on Pyroprocessing
MSSP Umbrella Task: Support for Instrumentation Technology Foresight
Pyopprocessing Course at an Engineering Scale Demonstration
Development of Virtual Training for Bulk Handling Facilities
Comprehensive Inspection Excercise at Bulk Handling Facility
Trilateral safeguards and security working group (SSWG) under the USA/ROK Joint Fuel Cycle Study (JFCS)
Creation of E-learning Modules, Supporting the Preparation of State Declared Information
Development of SGs Measures and Equipment for a Pyroprocessing plant using Related Facilites
Update of the Physical Model
SSAC Course for Newcomer Sates
Expert-SSAC Training Officer
Development of Safeguards Guidelines for Facilities under Decommissioning and Post-Accident Facilities
Provision of Open Source Information
Safeguards by Design for Small Modular Reactors

2. Support for the IAEA Inspector training course

2.1 Advanced Comprehensive Inspection Exercise at LWRs and CANDUs

This training course offers inspectors a unique opportunity to understand diversion scenarios and to familiarize themselves with instruments specifically used at CANDU and LWR facilities (OFPS & DCVD), as well as spent fuel dry storage transfer verification activities and dry storage dual sealing arrangements.

Through this support program, IAEA inspectors receive the training in the same course as the general safeguards inspection. First, through the safety rule education for the facility, they check the safety guideline of the facility, and check the safeguards related information and the accountancy report. After the education, the main practice course is carried out. Especially, it is a theoretical education & Practices, and most of the participants have the safeguards implementation experiences of several years, so the training was carried out in high level. The practices for all safeguards inspection equipment of the light-water reactor and heavy-water reactor were carried out. Each practice activity was composed of a team of 2 trainees, and they went through the verification equipment test practice in turn for each facility. 4 domestic participants (NSSC, KINAC, KHNP) also attend this training course.

Practice of all safeguards inspection activities in the LWR and CANDU reactors includes as below

- New fuel verification (HM-5)
- Used nuclear fuel verification (SFAT, OFPS)
- Non-nuclear fuel material verification (IRAT)
- Containment surveillance related equipment installation and information analysis plan
- Checking of information and practice for preparing report for additional access activities
- Design information verification and nuclear material accountancy verification
- Containment surveillance facility measurement and evaluation (nuclear fuel storing place)
- Additional access simulated training (Chemical analysis lab inside the plant)
- Unmanned surveillance data evaluation plan (comprehensive nuclear fuel surveillance equipment)

2.2 Comprehensive Inspection Exercise at Bulk Handling Facility

This task supports an on-site training course for

safeguards inspectors at KINAC and KEPCO-NF. The course is essential for training inspectors to perform effective verification activities at bulk handling facilities. In particular, this course is the only course among the MSSP member states to be held in ROK. Inspection training at the nuclear fuel fabrication plant was carried out by the continued demand of the IAEA. IAEA inspections of nuclear fuel fabrication plants are a complex process that requires the use of different verification equipment for a long time and in various zones, so training courses are essential. However, since it is practically difficult to conduct training at a nuclear fuel processing plant, which is a commercial facility, the IAEA has had difficulty in securing a training site. As a result, the IAEA has requested continuation of the training course in ROK, which is equipped with manufacturing process of LWR and CANDU reactor fuel in one facility. Finally, it was decided to hold a training course in ROK. This training course consists of two weeks of training and practice to ensure the IAEA inspectors' ability to verify nuclear fuel processing plants. This training is attended by a total of 12 IAEA inspectors along with four IAEA instructors. The curriculum includes a lecture on the overview of inspections such as the use of verification equipment necessary for inspecting nuclear fuel processing plants, the introduction of the processing of nuclear fuel processing plants, and the inspection methods of weighing control books. The practical training of the two-week process at the fuel fabrication facility is a burden to the facility, so one week of theoretical training is conducted at KINAC, and the facility tour and confirmation process is conducted at KEPCO-NF. The second week of practices is held at KEPCO-NF, and the last day for the wrap-up is held at KINAC. This training process promoted our side effects (expansion of training courses, securing of curriculum, participation of international cooperation organizations) and reduce burden.

Table II: Training schedule for the BHF

Date	Schedule	Major Contents
Day-1	Lecture	· Design information(DI) analysis & verification, Material value evaluation
Day-2	Lecture	· Enrichment measurement, CIOSP
Day-3	Practice	· equipment check & accountancy report review
Day-4	Lecture	· Nuclear fuel process introduction
Day-5	Lecture	· Verification plan establishment and discussion
Day-6	Practice	· Destruction analysis sample collection, item counting, UF6 verification, UO2 powder N/D measurement, DI verification and pellet verification, LWR fuel rod verification
Day-7	Practice	
Day-8	Practice	
Day-9	Practice	
Day10	Wrap up	· Discussion, Certificate ceremony

2.3 Pyroprocessing Course at an Engineering Scale Demonstration

The objectives of this task are to deepen the expertise of safeguards inspectors regarding the theory, practices and essential equipment associated with pyroprocessing from a safeguards standpoint and provide participants with the necessary knowledge for conducting visits related to design information examination and verification, developing safeguards approaches for pyroprocessing capabilities (facility level and State level) and conducting verification activities at the pyro-processing facility, such as measurement techniques for nuclear material accountancy and process monitoring. A training course relating to pyroprocessing has already been developed with the US Support Program, providing participants with the fundamental knowledge and skills for the recognition of indicators of pyro-processing technology and for the safeguarding of such technology. However, due to the increasing amount of research and development in pyroprocessing and plans for using this process at industrial scale, it is now necessary to complement this basic course with a new course at an engineering scale facility. For the purpose of effectiveness and relevance, this training should take place at an operational R&D scale facility. The PRIDE facility in the ROK does not use irradiated nuclear material (it uses only depleted uranium and surrogates). For this reason there is a better access to all the areas of this facility and to the different equipment used. This facility is the first engineering scale pyro-processing demonstration facility for which the Agency has developed a safeguards approach based on the model safeguards approach for reference engineering scale pyroprocessing facility. This was done in collaboration with the ROK SP. Generally, this training course consists of 8 participants from the IAEA accompanied by 2 IAEA instructors. 4 Korean participants also attend this course.

3. Conclusions

Currently, ROK has various nuclear facilities such as LWR, CANDU, fuel fabrication plant, and research reactor. Taking advantage of nuclear facilities, IAEA inspector training courses for BHF, LWR, CANDU and PRIDE are held in ROK through the MSSP project. These courses are a great opportunity for IAEA inspectors to know how facilities operate, how they verify nuclear material and how safeguards approaches are applied. By allowing national inspectors and facility operators in ROK to attend these training courses, they can experience actual IAEA inspections and identify safeguards trends. It also made it possible to improve the ability of the National Inspection Service to verify safeguards. Lastly, ROK will continue to cooperate with the IAEA and endeavor to develop domestic safeguards verification through support for various training courses.

Abbreviations and Acronyms

NWAL : NetWork of Analytical Laboratories
LWR : Light Water Reactor
CANDU : Canadian Deuterium Uranium Reactor
BHF : Bulk Handling Facility
NRTA : Near-Real-Time Accounting
SSAC : State's system of accounting for and control of nuclear material
OFPS : Optical Fiber Prove System
DCVD : Digital Cerenkov Viewing Device
NSSC : Nuclear Safety and Security Commission
SFAT : Spent Fuel Attribute Tester
IRAT : Irradiated fuel attribute tester
CIOSP : Common Inspection Onsite Software Package
PRIDE : PyRoprocessing Integrated inactive DEmonstration
ROK SP : ROK Support Program

REFERENCES

[1] ROK SP Handbook, 2013, ROK,
[2] Development & Implementation Support Program(D&IS) 2016-2017, 2018-2019.