Safeguards System Development Status and Future Prospects of Fuel Cycle Facilities at KAERI

Ho-Dong Kim*, Hee Seo, Se-Hwan Park, Hee-Sung Shin, Dae-Yong Song, Jong-Myung Oh,
Jeong-Hoe Ku, and Seong-Kyu Ahn
Korea Atomic Energy Research Institute, 111, Daedeok-daero 989beon-gil, Yuseong-gu, Daejeon, Republic of Korea
*khd@kaeri.re.kr

1. Introduction

Since the early 1990s, KAERI has developed safeguards systems of several nuclear fuel cycle facilities for research activities on spent fuel treatment. Such facilities include the DUPIC Fuel Development Facility (DFDF), the Advanced spent fuel Conditioning Process Facility (ACPF), and the Pyroprocessing Integrated inactive DEmonstration facility (PRIDE). As part of a cooperative effort with the IAEA to find a safeguards approach for the pyroprocessing facility, the ROK designed a Reference Engineering-scale Pyroprocessing Facility (REPF) and developed a safeguards system for the REPF that was reviewed by the IAEA. An advanced safeguards system, including nuclear material accounting technologies and new safeguards approaches for pyroprocessing facilities, has been under development at KAERI.

2. Safeguards Systems of Nuclear Fuel Cycle Facilities at KAERI

According to the "Agreement for Cooperation between the Government of the Republic of Korea and the Government of the United States of America Concerning Peaceful Uses of Nuclear Energy" revised in 2015, KAERI has been using DFDF for preparing the feed material (porous pellet or fragment) from the used PWR fuel generated in domestic nuclear power plants for the ACPF electrolytic reduction process. The ACPF at KAERI has been refurbished for the test of an electrolytic oxide reduction process using spent fuels.

The safeguards approaches for the DFDF and ACPF have been developed, that include neutron counters and containment and surveillance equipment with a process and radiation monitoring system.

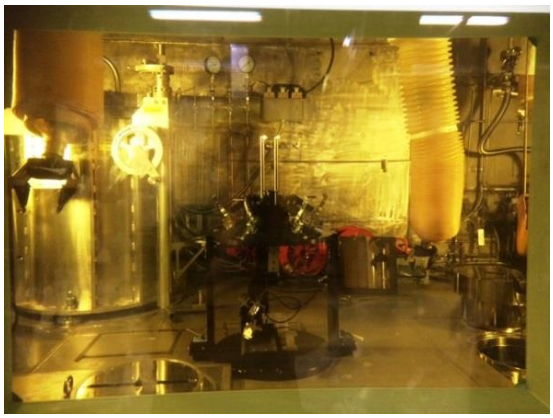

Fig. 1. ASNC and ALIM.

The ACPF can provide a valuable opportunity to test various types of safeguards equipment for nuclear material accountancy, containment and surveillance, as well as process monitoring. At the moment, there are two types of safeguards equipment at the ACPF, i.e., ASNC (ACP Safeguards Neutron Counter) and ALIM (ACP LIBS Monitoring system) [1].

PRIDE is an engineering-scale R&D facility, handling non-irradiated depleted uranium (DU) and

surrogates to develop and test key technologies for pyroprocessing prior to the development and construction of an engineering-scale facility.

The demands for robust safeguards applied to pyroprocessing facilities require the IAEA to develop new measures and techniques to complement the more traditional safeguards systems. The bus bar system, together with portal radiation monitors, were selected and installed in the PRIDE facility to support IAEA safeguards implementation in this facility [2].

Process monitoring data such as voltage, current, temperature, and humidity are collected from the process equipment. Most of parameters relevant to the PRIDE safeguards are collected, and they are displayed and provided to the IAEA.

3. Safeguards System of Reference Engineering-scale Pyroprocessing Facility

The ROK was working closely with the IAEA under the ROK's Member State Support Program to develop a model SG approach for a REPF. REPF design is part of the IAEA's effort to develop an effective SG approach for pyroprocessing facilities. As a result of the project, a model DIQ (Design Information Questionnaire), a model FA (Facility Attachment) and a model SG approach were prepared [3].

Based on the experience with the ROK MSSP, the IAEA is well on the way to establish effective safeguards for future engineering/commercial scale facilities.

4. Conclusion

KAERI has developed several nuclear fuel cycle facilities (DFDF, ACPF and PRIDE) for research activities on spent fuel treatment. The ROK designed the REPF through IAEA MSSP and developed a safeguards system for the REPF that was reviewed by the IAEA.

The application of Safeguards by Design (SBD) to these efforts will contribute to improving nonproliferation and safeguards technology so that pyroprocessing technology can be realized in the future. It is expected that the deployment of these safeguards technologies would be useful for the advanced nuclear fuel cycle.

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