

A Preliminary Study of the determination of a Reference Pyroprocessing Facility Concepts for a Safeguards Approach Development through a Member State Support Program

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1. Introduction

Considering the current activities related to the development of pyroprocessing technology and the existing plans to construct pyroprocessing facilities, the International Atomic Energy Agency (IAEA) should enhance its technical knowledge related to pyroprocessing and prepare for the development of a safeguards approach for pyroprocessing facilities. Regarding this issue, the IAEA made a contract with the 3-year long Member State Support Program (MSSP) for the 'Support for Development of a Safeguards Approach for a Pyroprocessing Plant' with the Republic of Korea in July 2008. The action plan schedule is shown in Fig. 1. In this MSSP, main task of the 1st year covers collection and analysis of all the relevant information (characteristics and flowsheet of the processes, and nuclear material) on pyroprocessing facilities, and determination of a reference pyroprocessing facility concept. A preliminary study for the reference pyroprocessing facility concept is described in this paper.

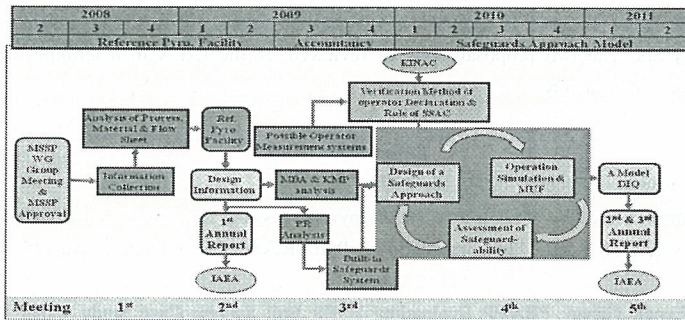


Fig. 1. MSSP Plan and Schedule.

2. A Study for the Determination of a Reference Pyroprocessing Facility

Many concepts of pyroprocessing facilities have been suggested worldwide, only six concepts [1-4] have some basis information: facility structure, process characteristics and material flow. These six concepts were suggested by US, Japan, and Korea. Historically pyroprocess originated from the facility to manage and recycle metal spent fuel from EBR-II of INL. The facilities concepts are similar to the Fuel Conditioning Facility (FCF) or a slightly modified FCF in the part of the electrorefining process that separates TRU from metal spent fuel to a process fabricated fresh fuel for a fast reactor. Most of them are still in conceptual design phases but the FCF is only an operating facility for the metal spent fuel treatment. And Pyroprocess Integrated DEMonstration (PRIDE), which uses natural uranium and has an equipment function of Engineering Scale Pyroprocess Facility (ESPF) [4], is near completion of a detailed design. Most concepts equally consist of spent fuel chopping, granulation, reduction, and refining. The reason for having a similar unit process line is largely due to the use of pyroprocess components suggested by INL or ANL, or slightly modified ones. The common point of all six concepts is to have the path of pyroprocessing spent LWR fuel to produce fresh fuel for a fast reactor. This path should be certainly involved in a reference pyroprocessing facility.

In view of the safeguards, it is advantageous to have a large-scale facility as a reference facility because a small facility is easily safeguardable if the large facility is proved to be safeguardable. But it is also important that the facility concept will be realized within near future (~10 year) because the process

technology is updated fast. So, it is a way to determine an minimized facility, which includes all essential processes, as the reference processing facility. Most processes are very similar to each other so that it is not necessary to focus on the process, itself, too much. It is more important to focus on the materialization of facility construction and the quantity of nuclear material handled.

In accordance with the above described determination principles of a reference pyroprocessing facility, the following two proposals are suggested; the 1st proposal is a facility that mostly accommodates the six facility concepts and the 2nd proposal is one that has a high potential for construction and operation. The GEN-IV PR&PP Model is composed of a combination of facilities characteristics and material balance is established together with an advanced faster reactor. The GEN-IV PR/PP model combined with a UO₂ recovery process and the continuous process proposed by Korea, is selected as the 1st proposal for the reference pyroprocessing facility. It is of significance that the 1st proposal includes most of the conceptual design specification of different facilities reviewed previously. Since the ESPF is planned for construction in 2016, the facility has high potential to be realized. So we selected the ESPF as the 2nd proposal.

3. Conclusions

In this report, pyroprocessing facilities suggested by US, Japan, and Korea were analyzed and the determination principles were established to determine a reference pyroprocessing facility. Two proposals for a reference pyroprocessing facility were suggested based on the principles. The 1st proposal is based on the GEN-IV PR/PP model in which UO₂ recovery process of Japan and the continuous electrorefining process of Korea are added. The 2nd proposal is determined to be the ESPF of KAERI, which is planned for construction within 7 years. The two proposals will be reviewed by the IAEA to determine the final version of a reference pyroprocessing facility.

References

- [1] Mike Goff, "Non-Aqueous Process," Dec. 16, 2008.
- [2] T. Inoue, K. Uozumi, L. Koch, "The Incentives of pyroprocessing for deployment in nuclear fuel cycle and its future direction of R&D," 2nd International Pyro Research Conference, Aug.25-27, 2008, Jeju, Korea(2008)
- [3] GEN-IV PR&PP Expert Group, PR&PP Evaluation: ESFR Full System Case Study, Final Report, March, 2009.
- [4] Hansoo Lee, et al., The Current Status of the Pyroprocessing Technology at KAERI, internal report, 2009.