Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 7 (2011) 391–395

Energy Procedia

Asian Nuclear Prospects 2010

Korean Pyrochemical Process R&D activities

Hansoo Lee, Jin-Mok Hur, Jeong-Guk Kim, Do-Hee Ahn, Yung-Zun Cho, and Seong-Woo Paek

Korea Atomic Energy Research Institute

1045 Daedukdaero, Yuseong, Daejeon, Korea 305-353

Abstract

Korea is operating 20 nuclear units, producing about 700 t/yr of spent fuel. This spent fuel should be managed in a safe and practicable way. One option for this spent fuel management is treatment with pyrochemical process. Pyrochemical process flow sheet in KAERI includes voloxidation, electroreduction, electrorefining, electrowinning, and waste salt treatment processes. Each unit process has been tested in lab-scale, and these unit processes will be incorporated in PRIDE (PyRoprocess Inactive integrated DEmonstration) Facility in late 2011 in order to evaluate scaled-up design on the basis of the information of lab-scale experiments, integrity of each unit performance, and safeguards of integrated process, etc.

Keywords: Pyroprocessing; electroreduction; electrorefining; electrowinning

1. Introduction

Currently Korea is operating 20 nuclear units, and according to national energy commission, about 18 units more will be constructed to satisfy energy needs by 2030. Since Korea imports about 97% energy from abroad, nuclear energy is a unique practical energy resource. However, nuclear energy inevitably generates spent fuel which is an issue to be resolved in near future. Table 1 shows the current nuclear power plants in Korea and the spent fuel produced. With national energy commission's plan and annual spent fuel production rate which is about 700 ton/yr, the accumulation of spent fuel at the end of this century is anticipated to be more than 100,000 t.

*Corresponding author. Tel.: +82-42-8682395
E-mail address: hslee5@kaeri.re.kr

1876–6102 © 2011 Published by Elsevier Ltd. Selection and/or peer-review under responsibility of Indra Gandhi Centre of Atomic Research
doi:10.1016/j.egypro.2011.06.051

Table 1 Status of Spent Fuel Storage

	Storage(ton)	*Capacity(ton)*	*saturation*
Kori	1,790	2,254	2016
Yonggwang	1,786	3,528	2021
Ulchin	1,486	2,326	2018
Wolsong	6,053	9,155	2017
Total	11,115	17,262	

There are two ways to manage the amount of spent fuel: direct disposal and recycling by proper treatment. Direct disposal means disposal of spent fuel in deep geological media resulting in reduction of radiological impact from spent fuel on the environment to miminumt. This seems an easier way to cope with spent fuel issues and relatively cost beneficial. However it has taken 19yrs to secure a single Liquid Intermetiate Level Waste (LILW) repository in Korea, and it has causedserious social discord and required huge expenses. If a repository is to be usedfor for spent fuel, then it would need more cost, time, and cause more social problems.

Treatment of spent fuel is the alternate option. It can reduce the repository area by removing heat emitting elements, and increases resource utilization. Another benefit is to reduce the radiological impact on the environment by transmutating TransUranium elements(TRUs). PUREX is the likely process to be used for treating the spent fuel. But it is not considered the appropriate process by many countries ,as it is able to separate pure Pu which could be diverted to weapon production. That is a proliferation issue.

Pyroprocessing is a promising technology mitigating proliferation concerns([1,2]) and providing the above mentioned benefits. Korea has chalked out the R&D national plan to develop the pyroprocessing technology through Atomic Energy Commission(AEC) in 2008. Fig. 1 shows the R&D plan.

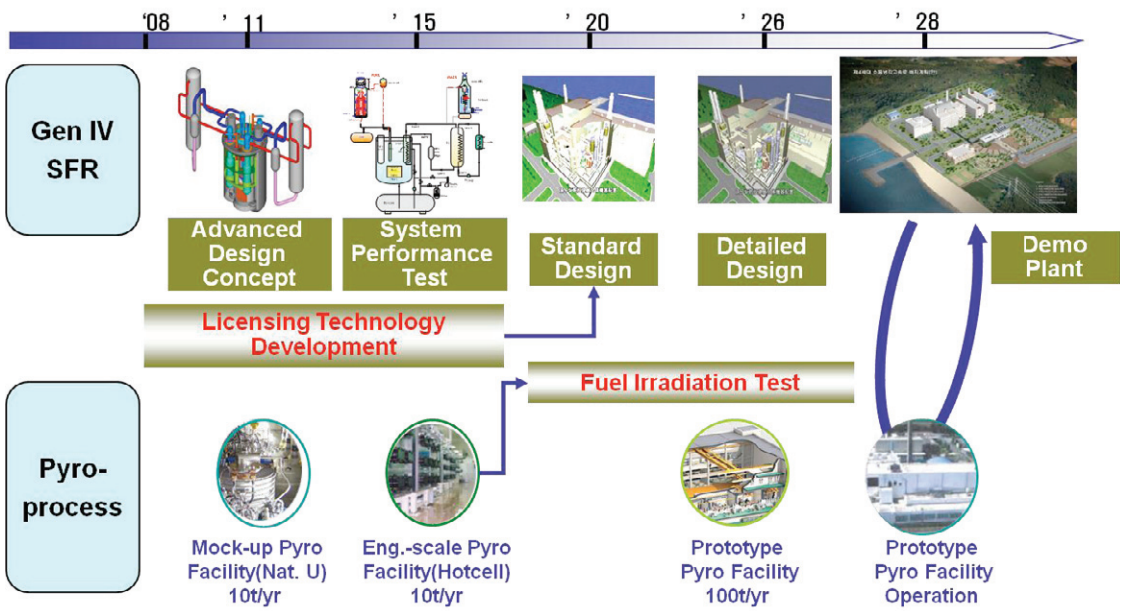

Fig. 1. R&D Plan for SFR & Pyroprocessing Technology Development

2. Pyroprocessing technology

Pyroprocessing development in KAERI started in 1997 with electroreduction process. Fig. 2 shows the flow diagram of process. The process includes pretreatment, electroreduction, electrorefining, electrowinning, and waste salt treatment.