

## Preliminary Evaluation on Characteristics of Waste from Pyro-processing (FS v5.1)

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### 1. Introduction

To reduce volume and toxicity of PWR SNFs, the P&T technology using pyro-processing and SFR is under development in KAERI. In accordance with this R&D, the A-KRS was developed by KAERI for disposal of waste from pyro-processing. After A-KRS concept development, material balance has been revised and characteristics of waste have been changed. To solve impending saturation of storage capacity of NPP sites, national policy on SNF management seems to be determined shortly. Demand on detailed analysis on impact of P&T using pyro-processing and SFR as base data is increasing. To compare direct disposal scenario to the P&T scenario using pyro-processing and SFR, updating of A-KRS reflecting amendment of material balance is required. In this study, characteristic of waste from pyro-processing which based on material balance FS v5.1 is evaluated for revising of A-KRS concept.

### 2. Methods and Results

#### 2.1 Assumptions and Methods

To evaluate characteristics of waste form pyro-processing, below reference fuel is used.

- Type: Plus7
- Initial enrichment: 4.5 wt. %
- Discharge burn-up: 55 GWd/MtU
- Cooling time before pyro-processing: 10 years

Fig.1 shows schematic diagram of pyro-processing and brief information about material balance[1], FS v5.1, is described below.

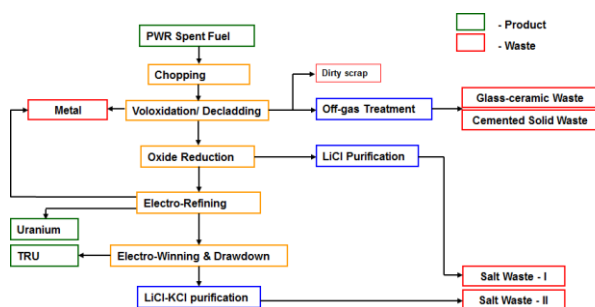


Fig. 1. Schematic Diagram of pyro-processing

- Capacity: 30 MtHM of above mentioned ref. SNF
- Base: 1 year operation of KAPF
- Output: 11 types
- Waste: 8 types
  - Metal:
    - Compacted NFBC
    - Melted Hull
  - Off-gas(glass or ceramic):
    - Ca(A) Filter containing Tc
    - AgX Filter containing I
    - Fly ash filter containing Cs
  - Off-gas(cemented)
    - Ca(B)/MS5A Filter containing H-3, C-14
  - Salt waste
    - Sr containing waste
    - RE containing waste
- Product: 2 types
  - U ingot
  - U/TRU/RE ingot

To evaluate characteristics of outputs from pyro-processing based on material balance FS v5.1, ORIGEN-ARP code was used

#### 2.2 Results

Fig.2, Fig. 3, Fig. 4 show evaluated decay heat, radioactivity and radiotoxicity of outputs from pyro-processing based FS v5.1. The U/TRU/RE ingot occupies most of decay heat, radioactivity and radiotoxicity after about 300 years. By complete reuse of U/TRU/RE ingot, decay heat, radioactivity and radiotoxicity can be reduced greatly. Within about 300 years, fission product containing wastes take most of decay heat, radioactivity and radiotoxicity. The fly ash filter containing Cs, salt waste containing Sr are important wastes in terms of short-term decay heat and radioactivity. Importance of RE containing salt waste reduced due to low decay heat and radioactivity according to increased recovery fraction as results of refinement of material balance. According to decisions on transmutation without I and Tc in SFR, AgX filter waste containing I and Ca(A) filter waste containing Tc are newly considered.

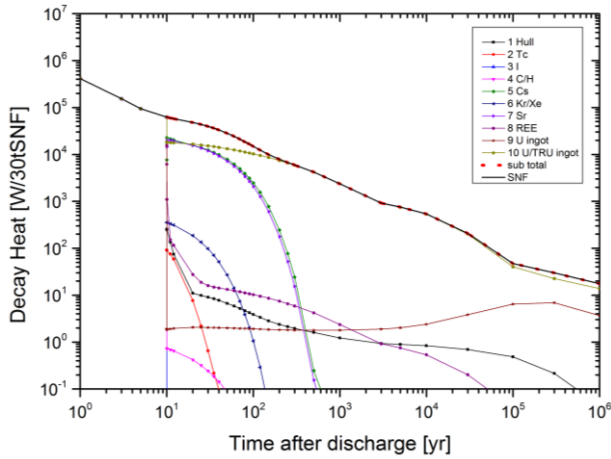


Fig. 2. Decay heat of outputs (FS v5.1)

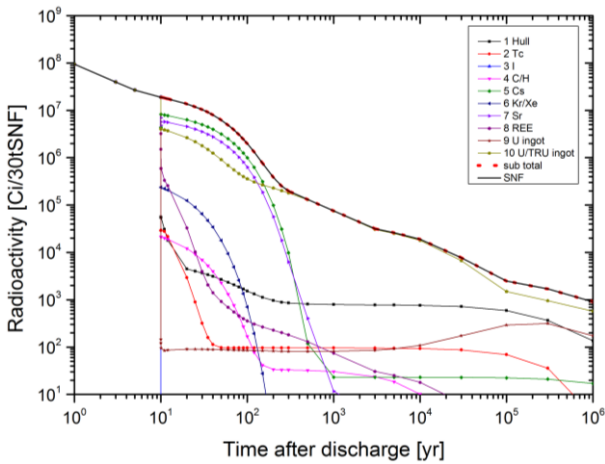


Fig. 3. Radioactivity of outputs (FS v5.1)

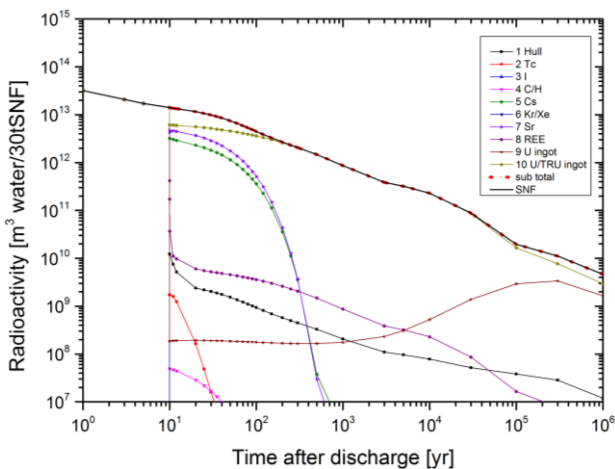


Fig. 4. Radiotoxicity of outputs (FS v5.1)

The target wastes of the A-KRS were RE containing salt waste and metal waste. The RE containing salt waste is designed to be disposed at -500 m level and metal waste are scheduled to be disposed at -200 m level [2]. Adjustment of target waste and disposal level and layout of A-KRS expected to be indispensable, because characteristics and importance of waste are significantly changed after amendment of material balance.

### 3. Conclusions

In this study, characteristics of wastes from pyro-processing which based on material balance FS v5.1 are evaluated. Ten kinds of outputs expected to be generated from pyro-processing are evaluated except compacted NFBC. Great reduction can be achieved by complete reuse of U/TRU/RE in SFR, because most of decay heat, radioactivity and radiotoxicity are generated from U/TRU/RE ingot. Within about 300 years, the fly ash filter containing Cs, salt waste containing Sr are important wastes in perspective of decay heat and radioactivity. Importance of RE containing salt waste reduced. Due to significant change in characteristics and importance of waste after application of FS v5.1, adjustment of target waste and disposal level and layout of A-KRS expected to be indispensable and this study would be used to A-KRS adjustment.

### REFERENCES

- [1] Hun suk Im et. al., Flowsheet for Pyroprocessing Facility with 30tHM/year capacity (KAPF FS v.5.1), KAERI, 2016
- [2] Heui-Joo Choi, Jong-Youl Lee et al., (KAERI/RR-3417/2011) High-Level Waste Long-term Management Technology Development – Development of a Geological Disposal System, KAERI, 2011.