

## KAERI Nuclear Material Management: Uranium Residue Storage Facility

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### 1. Introduction

Korea Atomic Research Institute (KAERI) has established nuclear material management facilities for integrated and transparent management since middle of 2000s. In 2009 Oct, Uranium Residue Storage Facility (URSF) was constructed to separately manage uranium residue materials.

### 2. Nuclear Materials Management System

URSF is one of the nuclear material management facility at KAERI, and has a function, as follows [1]:

a) “Disused nuclear materials” are the solid and the liquid nuclear materials that have been used in nuclear material handling facility and research and development facility, and are classified as follows.

a-1) “Solid type disused nuclear material” is the solid material that has not been irradiated and is the disused natural or depleted uranium.

a-2) “Liquid type disused nuclear material” is the liquid material that has not been irradiated and has been contaminated with the disused natural or depleted uranium

b) “Surplus nuclear materials” are un-irradiated nuclear materials that has been left in nuclear material handling facility and research and development facility, and have no plan to use for more than 1 year.

The disused nuclear materials are divided into two types depending on their physical properties; solid nuclear material and liquid nuclear material. The solid type nuclear material is managed after transfer to URSF. The liquid type disused material is treated after transfer to Radwaste Management Facility (RMF). The surplus nuclear material is transferred to Nuclear Material Storage Facility in Sae-bit Fuel Science Building and re-used when necessary (refer to Fig. 1).

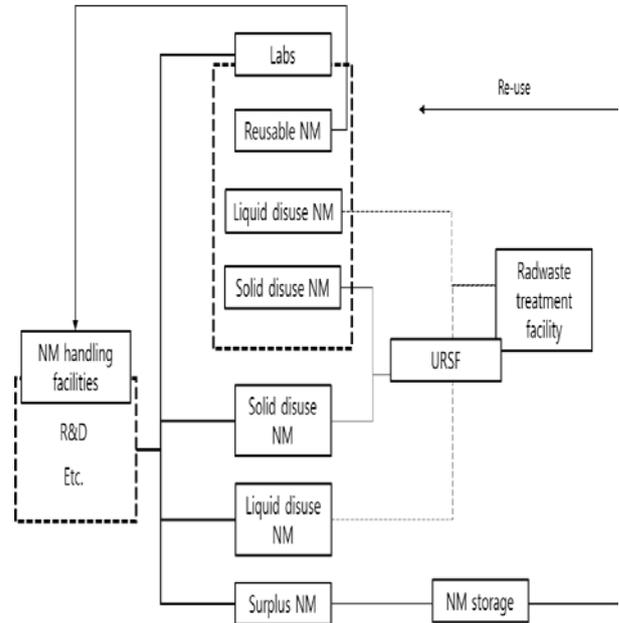


Fig. 1. Nuclear material management process in KAERI [2]

### 3. Uranium Residue Storage Facility (URSF)

A URSF is consisting of two storage rooms: storage 1 and 2. Storage 1 is located the basement of the Auxiliary Building attached to Cold Neutron Laboratory and storage 2 is an annex of the building Cold Neutron Laboratory [3].

The URSF is purposed to storage various nuclear materials:

- Powder, pellet, U-alloy, scrap, metal, rod, bundle and solid waste;
- Depleted-UF<sub>4</sub>(DUF<sub>4</sub>), DUF<sub>6</sub>; and,
- Other U compounds.

At the beginning, capacity of USFR were

- Storage 1: natural uranium (NU): 10,000 kg-U; depleted uranium (DU): 40,000 kg-U, DUF<sub>4</sub> (sludge & powder) about 10 ton
- Storage 2: DUF<sub>6</sub>: 125,000 kg-U

### 4. Uranium Residue Material management

#### 4.1 Uranium residue materials

From Jan. 2019 to May. 2020, there were 7 times of trials to put into nuclear residue materials in URSF, as shown in Table I.

Table I. Uranium residue materials management

No	Date	NM type	Weight	Acceptance
1	19.02.20	NU Powder UO <sub>2</sub> , U <sub>3</sub> O <sub>8</sub>	0.185kg	YES
2	19.08.23	NU Scrap, Pellet UO <sub>2</sub>	60kg	NO
3	19.09.17	Th	0.046kg	YES
4	19.09.30	U (compounds)	0.012kg	NO
5	20.01.20	DU	104.97kg	YES
6	20.02.03	Th Powder, Th(NO <sub>3</sub> ) <sub>4</sub>	0.025kg	YES
7	20.03.25	Nu Powder UO <sub>2</sub>	322.71kg	YES

#### 4.2 Limitation of nuclear material types

Only 5 times of 7 times trials were accepted and the others were rejected. About 2 rejected cases, details are as follows.

- a) NU (UO<sub>2</sub>) scrap & pellet :  
According to the USRF license, this facility cannot store the NU scrap and pellet.
- b) U compounds:  
According to the USRF license, this facility cannot store the uranium compounds.

In accordance with license, suitable materials are as follows;

Table II. List of URSF license

Types of NM	Physical forms	Chemical forms
U-235/U-238 : 0.72%	Powder	MgU <sub>2</sub> O <sub>7</sub>
U-235/U-238 : 0.72% <	Powder	U <sub>3</sub> O <sub>8</sub>
U-235/U-238 : 0.72%	Load	UO <sub>2</sub>
U-235/U-238 : 0.72%	Powder	UO <sub>2</sub>
U-235/U-238 : 0.72%	Powder	U <sub>3</sub> O <sub>8</sub>
U-235/U-238 : 0.72%	Powder	AUC
U-235/U-238 : 0.72% <	Load	UO <sub>2</sub>
U-235/U-238 : 0.72% <	Powder	UO <sub>2</sub>
U-235/U-238 : 0.72%	Metal	U
Th-232	Powder	ThO <sub>2</sub> , Th(NO <sub>3</sub> ) <sub>4</sub>
U-235/U-238 : 0.72%	Pellet, Scrap	U <sub>3</sub> O <sub>8</sub>
U-235/U-238 : 0.72% <	Powder	UO <sub>2</sub>
U-235/U-238 : 0.72% <	Powder	UF <sub>6</sub>

U-235/U-238 : 0.72% <	Powder	UF <sub>4</sub>
U-235/U-238 : 0.72% <	Disassembled equipRments	UF <sub>4</sub>
U-235/U-238 : 0.72% <	Debris	UO <sub>2</sub>
U-235/U-238 : 0.72% <	Metal	U(Ti, Mo, Si)

The license of URSF clarifies exact physical and chemical forms of material. Therefore, except those materials, other nuclear materials cannot be stored in the facility.

The purpose of the URSF is centralized management of disused nuclear materials. Nevertheless, unlikely the purpose of centralized management of disused nuclear materials, it does not function practically due to limitation of URSF's license.

According to the license, for the usage of nuclear material, KAERI has 33 facilities to handle the nuclear materials about 70 different types of physical and chemical properties. 15 types of nuclear materials are allowed to use, which are classified into 10 types of physical properties. The types and amounts of nuclear material stored in the each facility are different, because every facility has its own license.

The license of USFR cannot cover the whole nuclear materials mentioned above. It means, it cannot practically manage nuclear materials as original purpose. One of the recommended solution for this problem is that physical properties does not exactly describe on the license. Instead of that, we can get a license with U<sub>x</sub>O<sub>x</sub> or solution form. Then, USFR can store the all type of Uranium oxide form and some compounds solution even they mixed with small amounts of products. For example, on the license, some laboratory has license with UAl<sub>x</sub> and U<sub>3</sub>O<sub>8</sub> solution. KAERI has been recognized the problem and tries to revise the license.

#### 4.3 Concept of taking out

NU (UO<sub>2</sub> form) powder with No. 7 case which was returned to the facility after taking out about 40 kg of nuclear materials to Advanced Fuel Science Building in KAERI (distribution is shown in Fig. 2). The guideline did not mention that taking out from URSF to other facility. However, if we focused on the effective usage of materials, uranium residue materials also could be re-used.

For the experiment with nuclear material, we generally import the materials from other country. It is complicated process and takes long time. Therefore, it would be better to re-use nuclear materials instead of disposal. For this, it is necessary to revise the guideline with the concept of disposal and re-use of stored materials in URSF.



Fig. 2. Nuclear material distribution (case No.7 in Table I.)

### **5. Conclusions**

Nuclear materials cannot be sent to permanent disposal facility yet. Therefore, it should be stored in the site and managed effectively. The URSF was built for centralized management of disused nuclear materials at KAERI. However, it does not function well because of limitation of URSF's license. The license only covers few types of nuclear materials which are being used in KAERI site. For the centralized management, KAERI needs to expand the scope of NM types. The URSF guideline describes only taking into facility without taking out for re-use. However, re-using the nuclear materials would manage effectively and save resource. KAERI recognizes those problems and will revise the license and guideline in the near future.

### **REFERENCES**

- [1] KAERI, DESIGN INFORMATION QUESTIONNAIRE, N-71/Rev. 1 (Nov. 76), 2008
- [2] D.S Hwang etc., Guideline for disused and residue nuclear material management, KRS, 2009.
- [3] KAERI, Guideline for disused and residue nuclear material management, 2009.
- [4] D.S Hwang etc., Disused nuclear material management, KNS, 2009