Actual Results of D&D in Uranium Refining and Conversion Plant – 14076

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ABSTRACT

The Uranium Refining and Conversion Plant (URCP) is an institution owned by the Japan Atomic Energy Agency (JAEA). Construction of the plant began in fiscal year (FY) 1979, and the plant was in operation from FY 1981 to FY 2000. About 750 tons of uranium hexafluoride was manufactured using natural and reprocessed uranium as raw materials during this period. The floor space of the controlled area is 7300 m^2, and two conversion processes were undertaken at this plant: a wet process for converting natural uranium and a dry process for converting reprocessed uranium. The URCP was dismantled in FY 2008 to FY 2013. Dismantling produced about 480 tons of waste over a total manpower time of 12 000 man-days. The amount of uranium that was present inside the main equipment for dismantling was surveyed before decommissioning the URCP. This information is important for drawing up a D&D plan. No special tools were used in dismantling of the URCP, but saws and plasma cutting tools were employed. In addition, large-sized equipment was detached from the plant, moved to the cutting hood, and cut within the hood, which improved the working efficiency. As a result, the necessary manpower was reduced by 15%. This is the first case in Japan of the decommissioning a nuclear fuel facility of a commercial scale. For this reason, a system was constructed to collect the dismantling work records using mark sensing cards. This information was collated into a database and is available on the intranet.

INTRODUCTION

The commercial-scale Uranium Refining and Conversion Plant (URCP) is an institution owned by the Japan Atomic Energy Agency (JAEA) and located in the erstwhile Ningyo-toge Environmental Engineering Center (NEEC). The NEEC was originally a uranium mine (after the discovery of a uranium outcrop in 1955), and research and development of refinement, conversion, and uranium enrichment, which are part of the "front end" of the nuclear fuel cycle, was performed at this location. Construction of the plant began in fiscal year (FY) 1979, and the

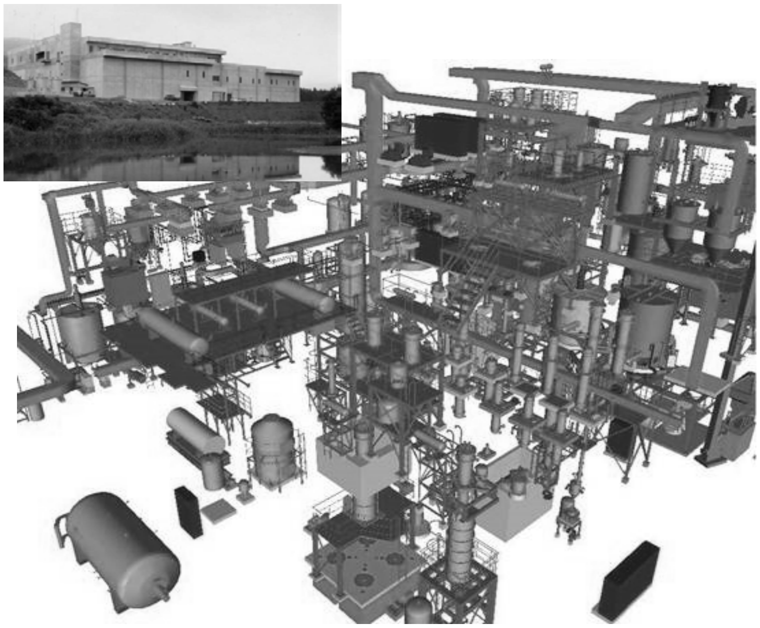

Fig. 1 Outline of the URCP.

plant was in operation from FY 1981 to FY 2000. About 750 tons uranium hexafluoride was manufactured using natural uranium and reprocessed uranium as raw materials during this period. Fig. 1 shows a photograph of the URCP, which is spread over three floors with a controlled floor-space area of 7300 m^2. Two conversion processes were undertaken at this plant: a wet process that converted natural uranium, and a dry process that converted reprocessed uranium. Dismantling of the URCP began in FY 2008, and dismantling of the main process in the controlled area was completed in FY 2011. In addition, the fluidization media storage underground tanks (FMSUT) and ventilation system of the attached building were dismantled from FY 2012 to FY 2013. The actual results of the D&D at URCP are presented here.

AIM OF URCP D&D PROJECT

The decommissioning of the URCP is the first case of a commercial-scale nuclear fuel cycle facility decommissioning project performed in Japan. For this reason, the safety and economic efficiency of decommissioning have been investigated. Moreover, work indices such as manpower and information required for the systematization of decommissioning work procedures were collected. This information was arranged as a work breakdown structure (WBS). Furthermore, the experience and information gained through this have been reflected in the systematization of the decommissioning engineering system that JAEA is currently building. If decontamination of the building is included, then the time needed to decommission the URCP will increase and a significant amount of radioactive waste will be produced. To carry out the decommissioning rationally, it is important to take these points into consideration when drawing up a decommissioning plan. Therefore, the policies of the URCP decommissioning project are those listed below.

- Optimization of the whole decommissioning cost including future costs associated with, for example, disposal.
- Clearance and recycling of the metal.
- Systematization and generalization of the results and lessons learned.
- Cooperation with local companies and universities for steady decommissioning.
    - Succession of decommissioning technology and information (cooperation with local companies) and practical use as a research field (cooperation with universities)

OUTLINE OF THE URCP D&D PROJECT

Decommissioning of the URCP will be carried out in three phases: dismantling, disposal, and demolition. Because of the age of the URCP, deterioration has reached a critical stage, and it is therefore necessary to dismantle the URCP as early as possible to reduce maintenance costs and to take safety measures to prevent accidents. However, Japanese laws pertaining to uranium waste disposal have not yet been finalized.

The dismantling phase, in which all of the radiation control area equipment was dismantled, took about six years and was budgeted at 15 million dollars.

DISMANTLING ORGANIZATION

Dismantling Organization in FY 2008

The dismantling work organization in FY 2008 is shown in Fig. 2. During this time, the main dismantling project was that of the room containing large-sized equipment, that is, a rotary kiln for grinding and drying UF_4, UF_6-product cold trap, and UF_6-product filling cylinder. Moreover, system decontamination of the cold trap using water was carried out as a measure against HF generation at the time of cutting. Safety and minimizing the dismantling time were the main priorities in this period, and for this reason, the dismantling work was performed by general contractors from several specialized companies. In addition, both safety and radiation control were each overseen by both a JAEA employee and a contractor.

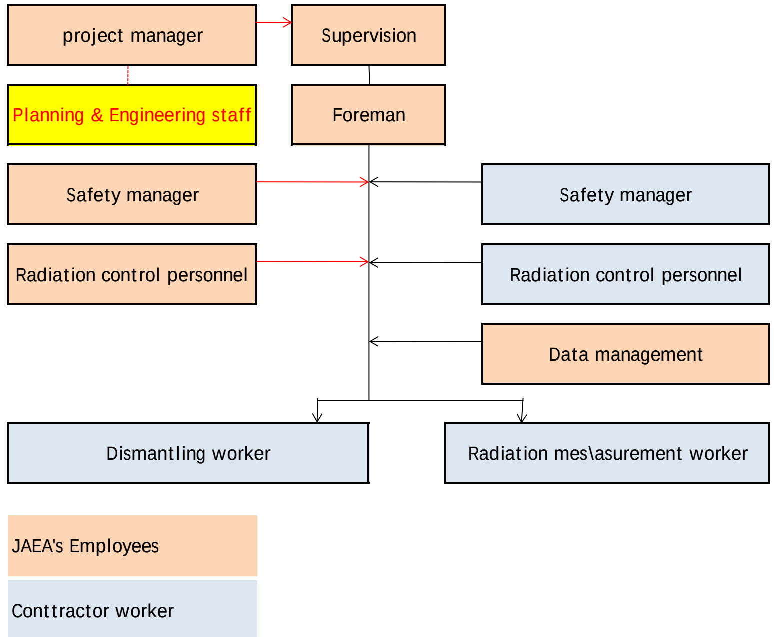

Fig. 2 Dismantling organization in FY 2008.

Dismantling Organization since FY 2009

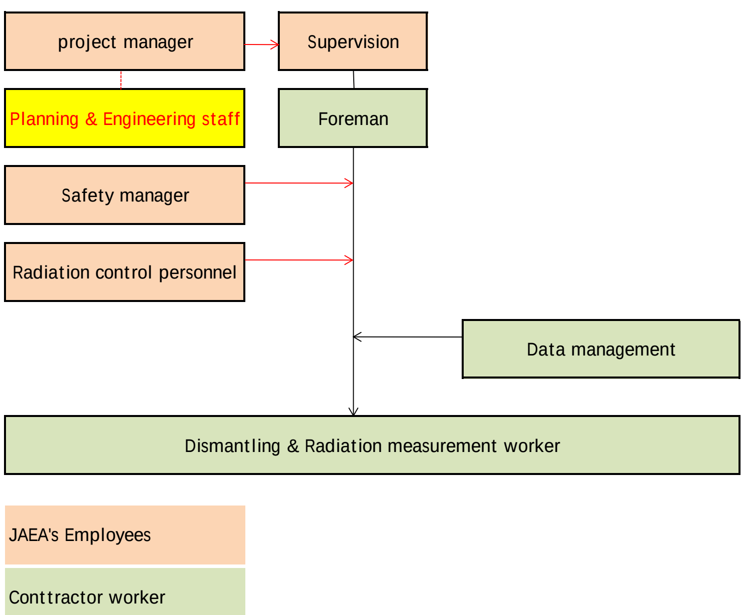

Fig. 3 Dismantling organization since FY 2009.

The dismantling work organization since FY 2009 is shown in Fig. 3. The biggest difference from that in FY 2008 is the change to the dismantling team, which consisted of annual contract-for-service members (temporary staff) and JAEA staff. This simplifies the dismantling system. In addition, safety and radiation control were overseen only by JAEA staff. The results of the dismantling work in FY 2008 showed that it was inefficient to divide the dismantling and survey work, and therefore, this was improved by combining the two. Furthermore, comparatively smaller scale equipment was dismantled from FY 2009, and it was thought to be important to change the organization of the dismantling work so that it is more flexible and the dismantling work is more efficient.

ACTUAL STATE OF THE URCP D&D

Dismantling of the equipment and facility in the radiation control area began in April 2008 and was completed in September 2013. The typical dismantling work performed in each FY is described below.

FY 2008

In FY 2008, dismantling work was performed using the inside dismantling method, with the work performed by general contractors. Priority was given to equipment that was difficult to handle such as large-sized equipment and equipment that may generate HF gas. These facilities for dismantling were the cold trap and UF_4 drying rooms.

FY 2009

In FY 2009, the movement dismantling method was used for the dismantling work, which for the first time was performed by a dismantling team consisting of temporary and JAEA staff. For this reason, the dismantling and removal of noncontaminated facilities, work which is comparatively easy, were mainly carried out. Typical facilities for dismantling were the hydration and conversion rooms.

FY 2010

In FY2010, the same movement dismantling method and dismantling team as that in FY 2009 was employed. Based on the experience and results in FY 2009, it was judged that the dismantling team could also dismantle large-sized contaminated equipment. For this reason, the dismantling team was increased to from a 10-person team to a 20-person team. A typical facility for dismantling was the dewatering and conversion room. Moreover, observations of the inside of the FMSUT and the soaked fluidization media (used bed media) were also performed.

FY 2011

In FY 2011, the movement dismantling method was continued and the same dismantling team was employed. Dismantling of the large-sized contaminated equipment was completed in FY 2010, and the main work in this FY was demolition of the fiber-reinforced plastic (FRP) tank and post-dismantling. A typical facility for dismantling was the yellow-cake dissolution room. Moreover, the FMSUT was decontaminated in preparation for demolition.

FY 2012 and FY 2013

In FY 2012 and FY 2013, the ventilation system of the attached building was dismantled and the FMSUT was demolished. After this, the ventilation system and waste-liquid-treatment system of the main building were the only remaining facilities, and this completed the dismantling phase. The FMSUT was decontaminated to background levels in FY 2011, and demolition was therefore completed easily. However, the inside of the alkali scrubbers of ventilation system were found to be covered with a large amount of sludge, which was not expected.

TYPICAL RESULTS OF THE URCP D&D

All the process equipment in the radiation control area was dismantled by FY 2011, and approximately 480 tons of dismantled equipment was collected over 12 000 man-days. From this result, the working efficiency was evaluated to be more than 40 kg/man-day, which is somewhat unsatisfactory. Therefore, a detailed analysis of the data will be conducted. It is important to judge

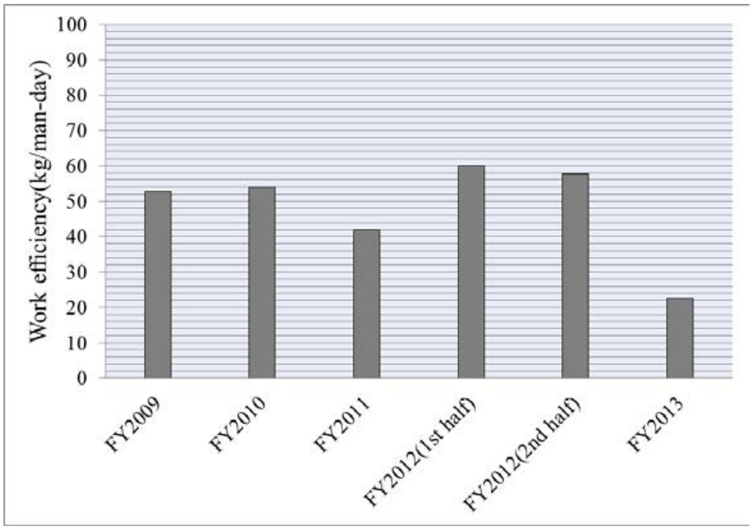

Fig. 4 Work efficiency.

whether the inefficiency was caused by the structure of the URCP or the dismantling work organization.

Moreover, as shown in Fig. 4, the difference between the working efficiencies of each FY was stable at around 30%. However, as disassembly of the hollow structure duct was mainly conducted in FY 2013, this is thought to be the main reason for the low working efficiency.

Fig. 4 Work efficiency

Characteristic Subject to Dismantling

The features of the dismantling work are shown in Fig. 5, which shows a breakdown of the dismantling. About 80% of the dismantling was related to piping supports, trestles, and the concrete foundation. Fig. 6 shown a breakdown of the dismantled material. Metal and concrete make up no less than 90% of the total, which shows clearly that the URCP dismantling was mainly the dismantling of a metal and concrete structure.

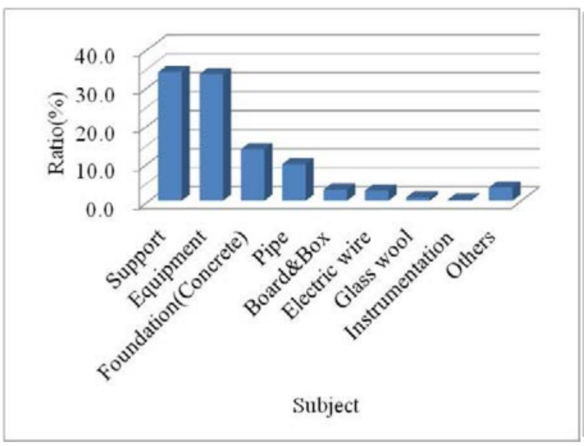

Fig. 5 Breakdown of the dismantling.

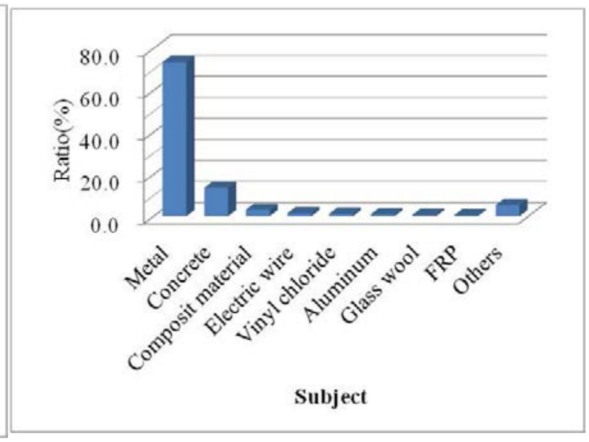

Fig. 6 Breakdown of the dismantled material.

Manpower

The dismantling team was divided into groups consisting of five people. One person was the foreman, and the other four held dismantling work and radiation control posts. The work rate for each worker is shown in Fig. 7; the percentages of the workload of the foreman, demolition worker, and radiation control worker were 15%, 66%, and 19%, respectively. If the work is classified into preparation, dismantling work, and post-dismantling work, the percentages of each type of work were 10%, 60%, and 30%, respectively. In addition, the dismantling of about 480 tons generated about 1 ton of secondary waste. The main secondary waste was green-house

Fig. 5 Rate of equipment for dismantling

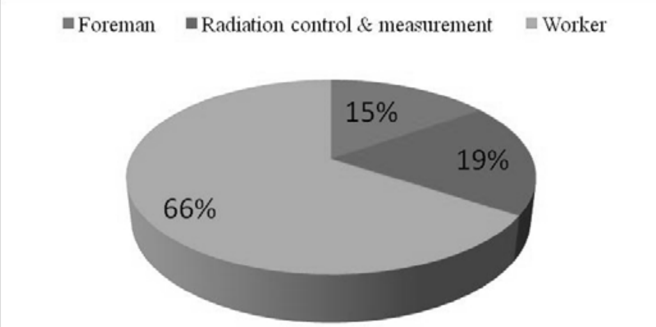

Fig. 7 Work breakdown for each worker.

materials and radiological protection outfits. The secondary waste volume will be reduced by incineration.

Exposure Dose Rate

Individual exposure doses were managed using thermoluminescent dosimeters (TLD). The exposure dose of every worker was below the regulation dose. JAEA regulations set a maximum exposure dose of 20 μSv/h and an acceptable annual exposure dose of 50 mSv. The acceptable exposure dose over five years is less than 100 mSv. Naturally, there were no workers who exceeded this regulation value. Almost all of the workers recorded exposure doses below 1 μSv/h, which is the lower measurement limit of the TLD.

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