Feedback Experience from Decommissioning of Uranium Conversion Plant

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1. Introduction

KAERI has been conducting decommissioning activities of Uranium Conversion Plant (UCP) for the last decade. As a result of all this work KAERI has accumulated significant experience in the field of decommissioning of nuclear facilities. On the basis of the experience gained from decommissioning activities, this paper describes several lessons learned.

2. UCP Background

UCP was used to manufacture 100 tons of UO_2 powder for the Wolsong-1 CANDU reactor and has been shut down and minimally maintained for the prevention of a contamination by the deterioration of the equipment. The conversion plant has a building area of 2916 m^2 and two main conversion processes. An ADU (Ammonium Di-Uranate) and an AUC (Ammonium Uranyl Carbonate) process are installed respectively in the backside and the front side of the building. UCP has two lagoons, which is to store all wastes generated from the plant operation. Sludge wastes stored 150m^3 and 100m^3 in Lagoons, which was two ponds constructed by concrete structure. In 2000, the decommissioning of the plant was finally decided upon and a decommissioning program was launched to complete by 2010. In the middle of 2004, a decommissioning program obtained the approval of the regulatory body and decommissioning activities started. The project was completed at the first half of 2011 with a total budget of ₩12 billion.

Fig. 1. UCP and lagoon

3. Decommissioning Activities

The decommissioning project scopes are to dismantle all the equipment, decontaminate of the dismantled metal waste, decontaminate the building inside, to treat the lagoon sludge waste, decontaminate the lagoon structure, and perform the final survey of the building and the site.

The decommissioning activities that have been performed as follows: All of the process systems and steel structures in the plant have been dismantled. The steel structure and the waste treatment facilities such as the lagoon sludge waste treatment facility and melting decontamination equipment in the AUC process region has been dismantled.

There is a strong emphasis on the decontamination of materials for re-use. The metal waste was decontaminated by a chemical decontamination with ultrasonic for the stainless steel and melting for the carbon steel. The stainless steel waste was decontaminated by a chemical decontaminator with ultrasonic and steam cleaner for washing. The releasable waste was 53 tons. The carbon steel waste was decontaminated by melting with induction melting. The releasable waste was 76 tons.

Concrete inside the building was decontaminated by using a grinder, breaker, scabbler, and mini-excavator. The concrete in the building has been decontaminated. Soil under the building was contaminated through sump and trench, which was spilled during plant operation, during a guarantee test of the UCP. The contaminated soil was removed and transported to the storage house. And the final survey was performed for release of the building and the site. The site release criterion is 100 μSv/y. In this criterion, DCGL is 440 dpm/100cm^2 for building and 10 Bq/g for site.

The major compounds of the lagoon sludge waste were ammonium nitrate, sodium nitrate, calcium nitrate, and calcium carbonate, and natural uranium of 1 wt%. The sludge waste from the lagoon was treated using a thermal denitration process. The lagoon sludge waste of 300 tons was treated completely. This process reduced the sludge volume by 70%. The lagoon was decontaminated and remodeled for use as a waste storage facility.

Fig. 2. UCP after decommissioning and remodeled lagoon

Radioactive wastes were generated after completion of the decommissioning as follows: Solid waste is about 10,795 drum of 200L. Most waste is soil. Liquid waste

is 2.8 tons of TBP solution which was collected in the solvent extraction process facilities. Uranium reside is 27.4 tons which are 2.8 tons of uranium residue collected in the process facilities and 24.6 tons of the treated sludge waste. This waste involves uranium of 15 wt% and is managed as a disused nuclear material. The releasable waste is 143.3 tons.

4. Lessons Learned

Planning for decommissioning

The characterization of the plant such as physical, chemical, radiological status, and plant history was surveyed before decommissioning planning. However, it was not known at the decommissioning planning step that the soil was contaminated during the plant operation. Unexpected budget and time were required for removing the contaminated soil. Project period was extended two times to the initial planning. Major reasons of the first extension were the licensing and sludge waste treatment. Licensing took two years against expectation of one year. It took so many times to develop sludge waste treatment technology and there were lots of difficulties to treat sludge waste on a large scale. Second time was extended for removing contaminated soil. Therefore, thorough investigation and characterization should be needed before planning.

Specialty of worker

KAERI contracted with the engineering company organized a consortium with three subcontractors for the decommissioning of UCP. The consortium consisted of engineering, radiation safety and radioactivity analysis, waste management and quality assurance, and dismantling and decontamination. But proper worker with specialty didn't put into and work efficiency was low at the initial stage. Worker could be trained on-site experience. Although training of expert is need, there is a little nuclear facility to decommission now.

Waste treatment facilities

Dismantled metal wastes were decontaminated on the decommissioning site and sludge waste was also treated on-site. These treatment facilities were also dismantled with the completion of the decommissioning works and it is not easy to be used them later. It is necessary that the decontamination facilities for the dismantled waste are constructed in KAERI site and we are pushing construction for the dismantled waste treatment.

Waste storage house

Dismantled wastes are generated much more than any operation of nuclear faculties. Although wastes were stored in a part of UCP plant, which was dismantled and decontaminated first, it was small to store later. So, waste storage house should be prepared before decommissioning.

Final survey of building and site for release

After all dismantling and decontamination works are completed, final radiological status of building and site is surveyed and estimated. Enough time was needed to perform final survey but time assigned for this activity was deficient. Enough time for final survey was given at the planning of decommissioning.