2007 Status of Uranium Conversion Plant Decommissioning

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KAERI (Korea Atomic Energy Research Institute) constructed a pilot plant for the uranium conversion process for the development of the technologies and the localization of nuclear fuels for HWR (heavy water reactor) in 1982. The final product of the plant was a UO_2 powder of ceramic grade for HWR and its capacity was 100 ton-U/year. After that, a part of the AUC (Ammonium Uranyl Carbonate) process was added and the process was improved for automatic operation. 320 tons of UO2 powder was produced and supplied to the fabrication plant at KAERI for the fuel of the Wolsong-1 CANDU (Canadian deuterium uranium) reactor. The conversion plant has building area of 2916 m^2 and two main conversion processes. ADU (Ammonium Di-Uranate) and AUC process are installed in the backside and the front side of the building, respectively. Conversion plant has two lagoons, which is to store all wastes generated from the plant operation. Sludge wastes stored $150m^3$ and $100m^3$ in Lagoon 1 and 2, respectively. Main compounds of sludge are ammonium nitrate, sodium nitrate, calcium nitrate, and calcium carbonate. In early 1992, it was determined that the plant operation would be stopped due to a much higher production cost than that of the international market. The conversion plant has been shutdown and minimally maintained for the prevention of contamination by deterioration of the equipment and the lagoon. In 2000, the decommissioning of the plant was finally decided upon and a decommissioning program was launched to complete the following tasks by 2009: planning and assessment of the environmental impact; decontamination of the pipe, tanks, vessels and equipment for canning or reuse; decontamination of the building for unrestricted reuse, and the treatment of the sludge and the demolition of the lagoon. In the middle of 2004, decommissioning program obtained the approval of regulatory body and decommissioning activities started. In 2004, pre-work was performed as follows: repair of electrical power supply system, inspection and repair of fire alarm and fighting system, installation of ventilation system, radiation management and access control facility, inspection and load testing of crane, distribution and packaging of existing waste, and pre-decontamination of the equipment surface and interior. This paper introduced briefly decommissioning activities in the first half year of 2007.

Dismantling started first from the reuse area such as temporary waste storage and the decontamination and lagoon sludge treatment. And then, we dismantle in the order of the most remote room from the waste treatment area. Order of dismantling work is as follows: disconnecting of pipe and electric wire, separation of the equipment, cutting into small pieces, grouping of the dismantled pieces for decontamination or packing, decontamination of floor and wall, and measurement of remained contaminants. Now, dismantling was completed of 25 rooms in the 27 rooms. The rest 2 rooms are ventilation and spare parts storage rooms. Table 1 shows an amount of dismantled waste. Dismantled metal wastes are 179 ton in the dismantled waste. These are cut into small pieces by cutting equipment such as nibbler, band saw, wheel saw, and plasma cutter to decontaminate. It will be expected that most metal waste could be decontaminated less than conditional release criteria, 0.2 Bq/g.

Table 1. Amount of dismantled waste

Waste		Amount, ton	
Metal	Carbon steel	179	106
	Stainless steel		73
Concrete		11	
Cable		6	
Uranium		3	
Others		13	
Liquid Waste		14	
Total		226	

Dismantled metal waste is decontaminated with uranyl nitrate, ammonium uranyl carbonate, and uranium oxides. Chemical decontamination with ultrasonic was installed for stainless steel and steam cleaner was installed for carbon steel and washing after chemical decontamination. 10 wt % of nitric acid is used for chemical agent and decontamination is performed at 50℃ for 1 hour. Dismantled stainless steel waste over 85% was decontaminated less than conditional release criteria with the first decontamination. However, dismantled carbon steel waste was not decontaminated well with steam cleaning because of corrosion and repainting during plant operation. This will be decontaminated by melting. Radioactive waste and conditional release waste produced until now are showd in table 2.

Table 2. Amount of radioactive and conditional release waste

Waste			Amount
Radioactive waste (51.7 ton)	200L drum	Combustibles	57 ea (4,350 kg)
		Incombustibles	36 ea (3,612 kg)
		Treated sludge waste	120ea (27,682 kg)
	4M3 container	Concrete	1ea (5,543 kg)
		Metal (pump)	2 ea (4,979 kg)
		Others	1 ea (4,678 kg)
Conditional release waste (48.4 ton)		Stainless steel	30,836 kg
		Carbon steel	14,928 kg
		Other metals	130 kg
		Concrete	2,474 kg

The lagoon sludge waste is treated by thermal dentration and NOx gas evolved during thermal decomposition of nitrate salts is treated by ammonia SCR (selected catalytic reduction) reactor. Treatment facilities consist of furnace, sludge waste transportation equipments, NOx gas treatment equipment, treated solid waste crusher. Sludge waste is decomposed into 3 hours for increasing temperature to 900℃. The residual solid waste consists mainly of Na_2O-Al_2O_3, calcium oxide, and calcium hydroxide and these are stable compounds for storage. Off-gas could be treated less than 100 ppm by SCR system. Sludge waste can be treated by 750 kg/day. Most lagoon 2 sludge waste was treated now. Volume of lagoon 2 sludge waste could be decreased over 40 %.