Evaluation of the UCP Decommissioning Activities in 2008 using DECOMMIS

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1. Introduction

In early 1992, Korea Atomic Energy Research Institute (KAERI) decided that the operation of the Uranium Conversion Plant (UCP) would be stopped due to a relatively higher production cost than that of the international market. The conversion plant has been shut down and minimally maintained for the prevention of a contamination by a deterioration of the equipment and the lagoon. In 2000, the decommissioning was finally decided upon and a decommissioning program was launched to complete the following tasks by 2010 with the total budget, 10 million US dollars: planning and assessment of the environmental impact; dismantling of the pipes, tanks, vessels and equipment for a canning or reuse; decontamination of the dismantled metal wastes for release, decontamination of the building for an reuse as an another experimental facility, and the treatment of the sludge waste and the demolition of the lagoon. The decommissioning works started in 2004.

The Uranium Conversion Plant building is composed 3 stories and the floor area is 2,950 m^2. The equipments and facilities consist of chemical reactors such as a dissolver and FBR, tanks, pumps, pipes, and electric and electronic equipment. The radiological conditions before a dismantling were as follows; radiation dose $3x10^{-4}$～$3x10^{-2}$ mSv/hr, surface contamination of equipment and structure 0.001～3.6 Bq/cm^2, and surface contamination of concrete 0.01~1.4 Bq/cm^2.

The lagoon is used for store the waste water which generated during an operation. The lagoon consists of two artificial ponds constructed by a concrete structure with a lubber coating and the surface area is 760 m^2. Total weight of the sludge is about 330 tons. The major compounds are ammonium nitrate, sodium nitrate, calcium nitrate, calcium carbonate, and natural uranium of 1 wt%. Radiological conditions were as follows; radiation dose $1x10^{-4}$～$3x10^{-3}$ mSv/hr.

The DECOMMIS, which is the data base system, developed in 2005 for the decommissioning project management on the nuclear facilities decommissioning such as KRR-1&2 and UCP. The all information and data of the decommissioning activities were collected and be inputting from the each site.

2. Decommissioning Activities

In 2008, the decontamination on the concrete surface, melting decontamination of the metal waste, and sludge waste treatment were performed. The stainless steel metal waste was decontaminated by a chemical with ultrasonic and a melting technology was applied for the carbon steel. The concrete in the building is being decontaminated and the lagoon sludge waste is being treated at present.

The stainless steel waste was decontaminated by a steam cleaner for a washing, first. The chemical decontamination system has the follow conditions; ultrasonic 28 kHz, chemical 10 wt% of nitric acid, temperature 50 ºC, decontamination time 1 hour, steam pressure 6 kg/cm^2, steam temperature 170 ºC. Decontamination goal is that alpha is less than 0.2 Bq/g. As result, the stainless steel waste was decontaminated by over 85% on the first decontamination in this condition.

The carbon steel waste was decontaminated by a steam jet, but it was not perfect, because of a contamination on the corrosion and painting. So, the melting decontamination was selected for the carbon steel materials. The melting system with an induction melter, a cooling system, and a ventilation system were installed and it is performing now. The throughput of the melting system is 200 kg/batch and 4batch/day.

Figure 1. Chemical and melting decontamination

The inside concrete surface of the building has been decontaminated. A grinder, breaker, mini-excavator, scabbler, and a wall grinding lift system used for decontamination. The wall grinding lift system was developed for a wall and ceiling decontamination. This can be installed as a grinder or a scabbler on the lift. The criteria of decontamination are under the 0.4Bq/cm^2 of alpha on the whole building surface of the plant, as the area of 9,200m^2.

The lagoon sludge contains a lot of nitrate compounds, which are easily dissolved in the water and are deliquescent. It is not permissible for the sludge to be directly canned after a simple drying. All the nitrates are easily decomposed to oxides by a simple heating. However, a thermal decomposition has a difficulty for ammonium nitrate decomposition. Ammonium nitrate is explosive and is decomposed by evolving a great deal of gas. The bottom layer sludge of the lagoon 1 was expanded greatly because of many large bubbles. So a large volume size of the reactor is required and this size should be dependent on the decomposition rate. Through the study, this problem was solved by a simple filtration of the sludge. The explosive problem of the ammonium nitrate can be prevented by a suction of the evolved gas for an off-gas treatment. The treatment process consists of sludge transportation, a filtration for the lagoon 1 sludge, a thermal decomposition, off-gas treatment, and finally to be solid waste. Main facilities for the sludge treatment are as follows; furnace for a thermal decomposition, sludge transportation equipment, off-gas treatment equipment and a final solid waste crusher. The final solid wastes after a treatment were stable compounds for storage. The off-gas from the thermal decomposition could be treated at less than 50 ppm by the selected catalyst reduction system. The lagoon 2 sludge waste was treated completely and the lagoon 1 sludge waste is being treated now. The volume of the lagoon sludge waste could be decreased by over 70 %.

Figure 2. Surface decontamination & sludge treatment

3. Waste Management

In 2008, 46.3 tons of dismantled waste was generated. Total amount of dismantled waste is 318 tons. Metal is 189 tons. Concrete is 58 tons. Cable is 6 tons. Uranium in the process equipment is 3 tons. Others are 20 tons. Liquid organic waste from the solvent extraction process is 4 tons. Final solid waste after a treatment of the sludge is 38 tons. Dismantled metal wastes were cut into small pieces for the secondary decontamination as the following sizes; plate 40 × 40 cm and pipe length 40 cm. The cutting equipments such as nibbler, band saw, wheel saw, and plasma cutter were used.

Radioactive and conditional release wastes were produced as follows until now. Radioactive waste is 115.3 ton. 245 drums of 200L were produced, which are combustibles, incombustible waste, and treated lagoon sludge waste. Total 19 containers of $4m^3$ were generated, which are concrete and metal such as motors and pumps. The conditional releasable waste is 70.1 ton, which are stainless steel after a chemical decontamination with ultrasonic, carbon steel by steam jet decontamination, and concrete.

4. Conclusion

Using DECOMMIS, during 249 working days in 2008, the data from the UCP decommissioning activities were collected and input for the project management. Also these data were evaluated according to each condition. As a result, a total of 24,356 man-hours were consumed on the 4,350 unit process with 14 site workers. Figure 3 shows the consumption of each group where the decommissioning work is 7,432 man-hours, Radiation control part is 5,789 man-hours, waste management is 6,440 man-hours and specialist and Q/C are 4,704 man-hours. On evaluation of the collective dose, a total of 0.45 men-mSv were exposed to the workers than that was estimated, 5.3 men-mSv

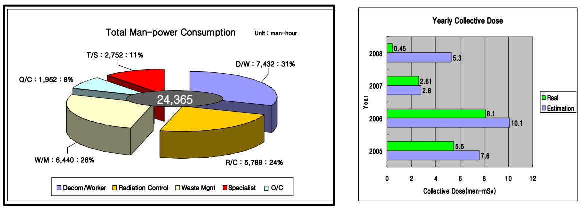

Figure 3. Man-power consumption and collective data

In 2008, almost radioactive material was removed, that is why the actual collective dose is only 8.5 % than the estimation. And the total 2,314 packages of the dismantled waste were treated and are stored in the site.

Through the evaluation, when the decontamination on the concrete surface of the building, the table 1 shows the result of the man-power per 1 m^2 on the same characterized rooms.

Table 1. Unit workability on decontamination of the concrete surface

Description	Decontamination Area (A)	Man-power consumption (m-h)	Efficiency (m-h / A)	Remark
Room 6210	283.1 m^2	655 m-h	2.31 m-h/ m^2	Kiln Room-2
Room 6306	329.7 m^2	553 m-h	1.68 m-h/ m^2	Kiln Room-3
Room 6213	266.4 m^2	982 m-h	3.69 m-h/ m^2	Solvent Room-2
Room 6303	193.0 m^2	645 m-h	3.34 m-h/ m^2	Solvent Room-3

These evaluated data could be applied for the next decommissioning project as a basic design and engineering sources.

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