The Status of the KRR-1&2 Decommissioning Activities

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ABSTRACT

The decommissioning project of the KRR 1 & 2 was started in January 1997. The actual decommissioning activity was started at the RI production facility and was finished at the end of 2002. The dismantling works of all components including the reactor structure of the KRR-2 was started in January, 2003 and will be carried out for 2 years till the end of 2004. The project schedule is estimated to delay for 4 ~ 5 months beyond the original plan because of delaying on the cutting of thermal column nose and removal of the graphite bricks, but it may be caught up during the removal working of concrete from biological shielding structure. This paper summarizes the general status of the KRR 1 & 2 and decommissioning activities.

Keywords : Decommissioning, KRR-1&2

1. INTRODUCTION

The project for the KRR-1&2 decommissioning was approved from the government (MOST) in November 2000. In consideration of the first decommissioning project on the domestic nuclear facilities and for the accumulation of basic technologies and experiences, somewhat long preparation period was required to start the actual dismantling work of the radioisotope production facility of the KRR-2, and it was finished at the end of 2002. The most wastes, generated from the RI production facility, were practically not contaminated or slightly contaminated. So, these wastes will be treated as the industrial wastes after evaluating the pubic exposure dose according to the prescribed scenario.

The activated materials on the inside of the reactor core, such as the dummy fuels, the specimen guide tubes for radioisotope production, the rotary specimen rack, the spent fuel storage racks, the cooling & purification system, the beam ports, the biological shielding concrete and the pool liner have been dismantled from January, 2003 and the dismantling works will be finished by the end of 2004. After removing all radioactive materials inside the reactor building and after decontaminating on the surface of ceiling, walls, and floor, the reactor building will be used for the temporary storage of the drums and containers of the radioactive waste until they will be transferred to a national repository facility in 2008.

2. DESCRIPTION OF THE RI PRODUCTION FACILITY AND REACTOR HALL

2.1 Outline of the RI Production Facility

The RI production facilities of the KRR-2 are composed of 12 laboratories, 2 large concrete hot cells, 1 small concrete hot cell, and 10 lead hot cells. The others are a hallway, entrance and exit for carrying equipment and taking waste, and a shower room remodeled from the existing one. Among these facilities, 3 laboratories were converted into the spaces for keeping and managing various kinds of equipment for the decommissioning activities. In the hallway, there is a separated facility for the entrance and exit of workers. There are 15 steel on wood fume hoods, 25 experimental tables, and sinks installed in the other 8 laboratories. The sinks were connected to the very-low-level-radioactive liquid waste storage tanks located in underground of the building outside. The upper plate of the laboratory table is covered with stainless steels.

2.2 Outline of the Reactor Hall

The reactor pool consisted of a normal concrete structure of density of 2.6 g/cm^3. and its size was 9.5m high, 17m long and 10m wide. The inside of the reactor pool was lined with the aluminum plates. The reactor core structure was located at 30cm above from the bottom of the pool and was hang on the man-bridge, installed on the top of the pool water tank. In the pool, there were installed the 14 guide tubes for RI production, the spent-fuel storage racks, the PTS (pneumatic transfer system) line, and the cooling & purification system. At the front end of the reactor pool, the 6 cylindrical beam ports and the rectangular type thermal column are laid in the biological shielding concrete. An exposure room, which was 300 cm long, 360 cm wide and 270 cm high, was linked on the backside of the reactor pool, and the walls of the room were coated with boron of the thickness of 30 cm.

The reactor core is composed of the 2 aluminum cylinders (shroud) with the inner diameter of 45 cm and the thickness of 6mm, which were connected by the 42 stainless steel screws, and the 3 grid plates for supporting the fuels. The reactor core can be moved by hanging on the man-bridge.

The rotary specimen rack with the 41 tubes for irradiation of the specimen, was fabricated with aluminum, and had a shape of an annulus cylinder, and installed as a ring surround the reactor core. In the annulus container, a driving mechanism for rotating the specimen tubes was installed and operated by the operation system on the man-bridge. The driving mechanism was evaluated as one of the highest activated reactor components by the activation of the stainless steel.

The pneumatic transfer system, connected to the radiochemical laboratories of the isotope production building, is made by aluminum pipe. This system was operated by the compressed air and used the neutron activation analysis.

In front of the shielding concrete structure, there were installed 4 radial type beam ports of 152 cm diameter, two through type beam ports of 203cm diameter, a thermal column, square shaped with a width of 1,200 by 1,200 cm and length of 3,300cm. Inside the thermal column, graphite bricks of 10 by 10 by 120 cm size were filled in.

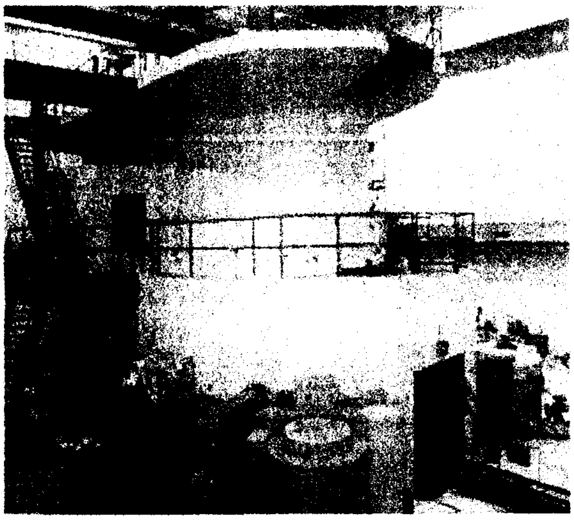

Fig. 1 The view of the KRR-2 site.

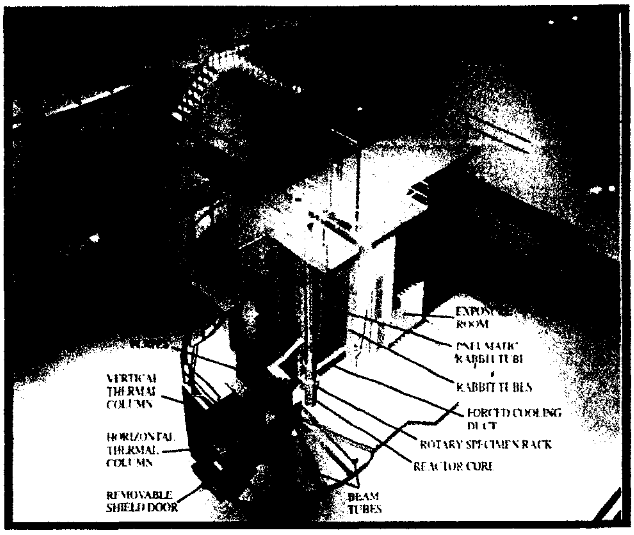

Fig. 2 The computer modeling on the facilities.

3. WASTES GENERATION

The generated wastes in the KRR-2 RI production facility are almost non-radioactive wastes and can be treated as an industrial waste. Some contaminated metallic wastes are being decontaminated by decontamination equipments at the site for the classification to the free release level.

3.1 Non-Radioactive wastes

The non-radioactive wastes have been generated form the KRR-2 RI production facility.

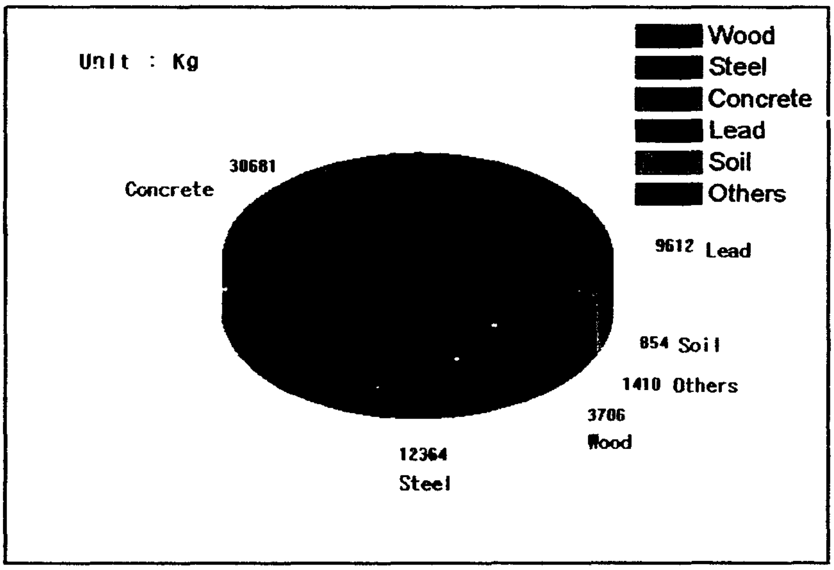

Fig. 3 The generated Non-Radioactive wastes from the RI production facility.

3.2 Free Release Level Waste

The value of the specific radioactivity of the clearance level wastes was defined as the below 0.4Bq/g according to the decommissioning plan in this project. Those wastes are packed and kept in the container and hereafter will be transported to Daejeon and also disposed at Daejeon site.

The quantity of clearance level concretes and soil is 2,919Kg. And other contaminated metallic wastes will be finally determined with re-measurements after decontamination.

3.3 Radioactive Waste

No generated waste has been classified as a radioactive waste. Only junk sources and irradiated samples stored in the concrete hot cell were removed, transported to Daejeon and are being managed. These sources will be reused or treated as solid radioactive waste.

4. HIGHLIGHTS DURING ACTUAL DISMANTLING WORK

The rotary specimen rack (RSR), a highly radioactive reactor component, was removed from the KRR-2 reactor core, packed into the shielding container, and transported to the experimental pool in KRR-1 reactor hall. The RSR will be dismantled together with two RSRs from KRR-1, which are temporary stored in the experimental pool of the KRR-1. The stainless steel parts of the RSRs, the driving mechanism, will be separated from aluminum body. A specially designed device has been developed for this. After removal of the stainless parts, the remained aluminum part could be treated as low-level radioactive waste. It is expected that the volume of the LLW could be much reduced because of low radioactivity of the aluminum materials.

The KRR-2 reactor core was separated from the man-bridge installed at the top of the reactor pool by the removal of bolts from two channels, connected between the bridge and reactor core. The shroud of the reactor core was divided into the upper and lower part, by removal of total 42 stainless screws using a long reach driver under the water. The reactor structure was manufactured by the aluminum and it was evaluated that the radioactivity would be very low. But the radioactivity was measured up to 18R/h and it was not desirable to pull it out of the pool. It was finally determined that the shroud should be cut into the small pieces under the water. For this, a long reach cutting tool was developed.

At the backside of the reactor pool, 14 irradiation guide tubes for RI were fixed with two supporting structures of the pool liner. The radioactivity at the end part of the tubes was higher than estimation value. The shielded cutting device was installed on the top of the reactor pool, utilized for cutting and separating the highly activated parts (lower part), which were located adjacent of the reactor core during operation. After removal of this part, the remained part of tubes for IR irradiation would be classified to the very low radioactive wastes.

The neutron source (Am-Be), used for the reactor operation, was removed and will be transported to Daejeon for further utilization in HANARO. It was imported as 3 Ci in 1972. Now the remained activity was approximately evaluated as 2.8 Ci to be still useful for research in the future.

The thermal column, embedded in the biological shielding concrete, was filled with graphite bricks into two parts. The graphite bricks of front part can be easily removed by hand-on tools but behind part could not remove, because of its high dose up to 12.5 R/h. Therefore, the remote equipment should be developed for the dismantling works of removing the remained graphite bricks.

5. PROBLEMS AND SOLUTIONS

5.1 Problems

On the establishment of the KRR-2 decommission plan, it was estimated to be possible to access to appliances (reactor core shroud, irradiation tubes, and beam port & thermal column's nose etc.) that were made by aluminum, because the radiation dose was to be sufficiently attenuated for reactor shut down period of 7 years. But the radiation dose on the surface of the thermal column under the water was measured to maximum 18R/h, 0.9R/h for the RI irradiation guide tubes, and 12.5R/h for the beam port nose and it was impossible to access to the appliances. The cause of high radiation dose would be explained by a very small amount of activated impurities, contained in aluminum materials. It was planned to sample and exactly to analyze the radionuclide.

5.2. Solutions

1. Cutting the core shrouds; developing a remote cutting tool for slicing into small pieces, packing the pieces into the shielding container under the water, taking the container out of the pool and transporting it to the disposal site.
2. Irradiation guide tubes for RI production; separating the irradiation tubes, inserting one end of the tubes into the cutting machine, installed at top of the reactor pool, and packing into the shielding container.
3. Cutting the beam port and thermal column nose; remotely cutting them by diamond wire saw or wheel cutter, installed at the top of the reactor pool, and slicing the nose part into the small pieces and packing into the shield container.
4. Removal the graphite bricks; remotely removing them by special tool from the thermal column and transporting to Daejeon for reuse.

6. SCHEDULE

Dismantling works of all components included the reactor structure of the KRR-2 was started January, 2003 and will be carried out for 2 years till the end of 2004. Figure 4 shows the detailed schedule on the dismantling work in the KRR-2 reactor building. Now the project schedule is estimated to delay for 4 ~ 5 months beyond the original plan because of delayed cutting of thermal column nose and removal of the graphite bricks, but it can be caught up during the removal working of concrete from biological shielding structure.

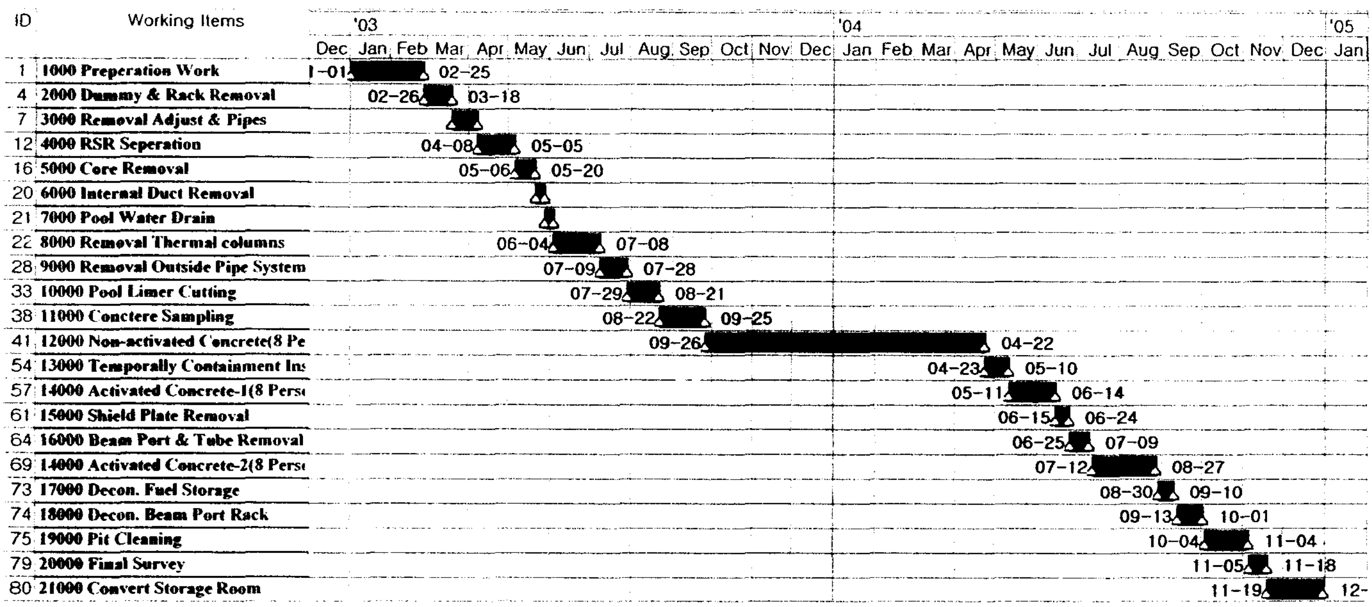

Fig. 4 The schedule of the KRR-2 decommissioning.

CONCLUSION

According to the decommissioning plan, the first phase of activities was completed successfully in December, 2002. The radiation dose for worker and radioactive waste volume were assessed lower than estimation. The procedure for working, radiation protection and waste treatment were set up and also applied all activities. The education and training were implemented for all workers. It is necessary to perform certain R&D

program for carrying out and adopting appropriate methodologies and technologies. As it is in the proven decontamination and decommissioning work to be done at first time in Korea, KAERI will make best efforts to use the current situation as a demonstration opportunity for continuing research and development in the D & D field, in view of preparations for the D & D of the nuclear facilities in the future in Korea.