Korea Research Reactor-2 Decommissioning Activities in 2004

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1. Introduction

According to the Korea Research Reactor (KRR)-1 & 2 Decommissioning project, till 2003, all components in the reactor pool of the KRR-2 was decommissioned. The objects for decommissioning were reactor core, rotary specimen rack (RSR), fuel racks, and pipes for the experiment for irradiation. In 2004, after pool water be drained, the goal of decommissioning activities is decommission the some part in the reactor pool which is connected the reactor biological shielding concrete structure such as thermal column and eight beam ports nose part cutting, removal the irradiated graphite bricks in the horizontal thermal column liner and dismantling two heavy thermal column door and one exposure room door. And removal the residual, except the nose parts, embedded ten beam ports in the biological shielding concrete structure are same target. Total 23,828 man-hours were consumed in 2004. During the decommissioning activities, total 69 tons of dismantled waste was raised.

2. Radiation Characterization

In the planning phase, the decommissioning objects were estimated by low irradiation because of most were made by aluminum material. But it is carried out that the real data through surveying and analysis is very high-irradiation value. The plan should be changed from hand-on activity to remote controlled activity for the safe exposure dose for the workers. The maximum exposure dose rate near the thermal column and eight beam ports nose part is surveyed as 56 mSv/h. The monthly average result of the exposure dose rate in the reactor hall is 0.62 ~ 13.83 μSv/h. This is the main reason for the workers who cannot access the decommissioning objects for the hand-on activity. Total 257 persons were consumed with 13,460 hours for the radiation works. The collective dose for the workers was evaluated as 11.06 man-mSv. This result is less than 24 % of estimation value 44.31 man-mSv in 2004.

3. Decommissioning Activities

In 2004, the decommissioning activities are the thermal column and eight beam ports nose part cutting, removal of irradiated graphite bricks in the horizontal thermal column liner, removal the ten embedded beam ports in the biological shielding concrete structure and dismantle the two thermal column doors and one exposure door those are partly activated. All activities were proceeded by the Work Plan Procedure (WPP), which was established by decommissioning specialist, KOPEC. The radiation workers, health physics, QC and specialists organize the working group in the site. Each WPP of the radiation decommissioning work should be submitted for approval to the health physics and be estimated and be evaluated the exposure dose for the workers.

3.1 Horizontal thermal column and eight beam ports nose part cutting

The thermal column and eight beam ports nose part was installed up to into the southern part of the reactor pool inside. These parts are made by aluminum material. The thermal column is divided by horizontal and vertical part. The nose part of the horizontal thermal column is high irradiated as 16 mSv/h. The eight beam ports nose part is also high irradiated. These parts were planed to cut by diamond wire saw, which was remote controlled from the top of the reactor pool with the wire length, 30m. During performance, the unexpected jamming is occurred from the beam port nose part because of the aluminum material properties that is mild. Then this method should be changed instead of wire sawing to plasma arc torch cutting. The plasma arc torch is installed at the end part of the long reach tool that could be approached to the object, which is penetrated the shielding lead plate. The horizontal thermal column nose part is also be cut by this method. All segments from these parts were separated from the origin body to into the reactor pool inside for collecting and storage into the shielding container.

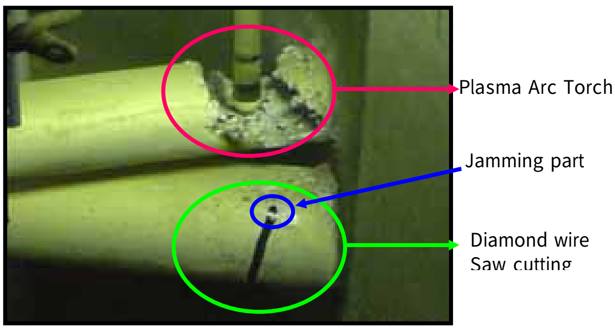

Figure 1. The reference of diamond wire saw cutting and plasma arc torch cutting on the beam port nose part.

3.2 Graphite bricks removal activity

The total 212 pieces of graphite bricks was installed behind of 10 cm thickness lead bricks in the horizontal thermal column liner. These graphite bricks were all irradiated as 0.5 ~ 0.7 mSv/h exposure dose. For this removal activity, the remote controlled equipment should be required. The equipment was developed and manufactured. This equipment is installed out side of entrance of the horizontal thermal column. This equipment is used the remote controlled movement as up and down and forward and back. And using the vacuum pad system, the graphite bricks were removed by piece by piece from the top layer to the bottom layer. All removed graphite bricks were packed and storage into the three $4m^3$ containers.

3.3 Removal the embedded ten beam ports in the biological shielding concrete structure

After cut the nose part of the eight beam ports, residual part, which is embedded in the biological shielding concrete with maximum size, 200 mm diameter, should be removed. This was all made by stainless steel so which was very high irradiated as exposure dose, 56 mSv/h inside of the beam port. It is impossible to access through the inside route of the pool for the workers. The core boring method from the out side is selected for removal of these. This technology is the same case of the removal the beam port in Virginia University Reactor Decommissioning project in U.S. The hydraulic core boring machine, Hilti DD-LP32 and DD 750 and 400 mm of diameter diamond core bit was used. The segment of core bit is composed the diamond particles and bonding metal. Through the experimental test, the dry methodology which is used the compressor air for cooling the core bit is failed because that the air pressure for the vacuum for the removal the sludge is up, then the core bit could not go forward more. Another cooling system using the water is selected. To be finished the core boring, the cut ten beam ports were pulled out from the concrete body. The pulled out beam port liners were remote controlled separated from the coated concrete and cut by small pieces for storage into the shielding container. Total 29.86 m of length core boring was cut in 30 days and 587 man-hours were consumed.

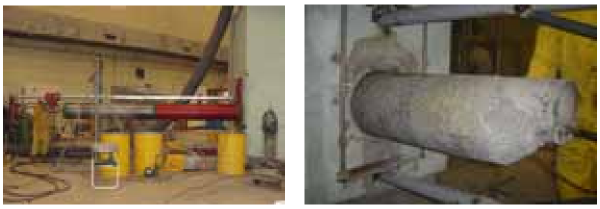

Figure 2. Beam port core boring and pulled out

3.4 Evaluation the decommissioning activities and data

The result of the decommissioning activities and raised data in 2004 was evaluated used the Decommissioning Project Management System. The system is developed for the in-put system first and now developing for the next phase, out-put system and proto typing. Using this system, the manpower consumption that is according to the time schedule, Work Breakdown System (WBS) and working code was evaluated. The decommissioning waste treatment and cost estimation were also evaluated. Total 23,828 man-hours were consumed in 2004. Among, the main worker parts are 34 % of radiation workers and 26 % of waste treatment and 21 % of health physics as the next. The manpower consumption of waste treatment activities, such as secondary decontamination, volume reduction is will be covered the cost of waste disposal. In 2005, the decommissioning project management system will be established.

4. Conclusion

In 2004, the decommissioning activity on the KRR-2 reactor is successful completed. Total 11.06 man-mSv is evaluated which is only 24 % of the estimation as 44.31 man-mSv. The 69 tons of decommissioned waste was raised. Among, only 5 tons of waste is classified by radioactive waste and others is non-radwaste. Through the natural evaporation system, 65.2 m^3 of liquid radwaste was disposed. The KRR-2 decommissioning activities will be completed the end of this year, 2005.

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