Transactions of the Korean Nuclear Society Spring Meeting
Jeju, Korea, May 10-11, 2007

Dismantling the Bio-shielding Concrete of the KRR-2

Seungkook Park, Sangbum Hong, Kiwon Lee
KAERI, Dukjin-dong 150, Yusong-gu, Daejeon

skpark2@kaeri.re.kr

1. Abstract

According to the KRR-1&2 decommissioning project, the KRR-2 bio-shielding concrete was dismantled. Total 1,913 tons of concrete, where both the activated and non-activated concrete dismantle was more than the estimation with a volume of 650 m^3 from the size of 9.7 m (W) × 17.4 m (L) × 7.8 m (H). The density of the normal concrete was around 2.4 Ton/m^3 and that the heavy concrete was around 3.0 ~ 3.2 Ton/m^3. Before the main activities, the radiation was evaluated to create a boundary between the activated and non-activated concrete. For the dismantling, the technologies of a core boring, diamond wire sawing and hydraulic crushing were applied. During 6 months, a total of 1,964 man-days were consumed. Among the dismantled waste, only 13.2 % of the concrete waste was classified as radioactive waste which is temporally being stored in the KRR-2 reactor hall as 38 EA, 4m^3 containers and 59 EA, 200 liter drums.

2. Radiation Characterization

Before the dismantling the concrete, the radiation was evaluated. This evaluation is needed to divide the area of the activated and non-activated zone of the concrete. To get the samples, two areas were selected where the inside of the exposure room part (north) and around the thermal column and embedded the beam port area (south). Total 97 points of the core was dry type bored with a diameter of 50 mm and a depth of 400 mm with a diamond core bit. All cored samples were manufactured by as a powder type specimen from 1 cm of the core, by. As a result, the maximum radioactivity was 4.68 Bq/g in the north part and 200 Bq/g in the south part with radionuclide of Co-60, Eu-152 and Eu-154. The activation depth was 15 cm under the 0.4 Bq/g and 30 cm under the 0.04 Bq/g in the north part.(Fig. 1)

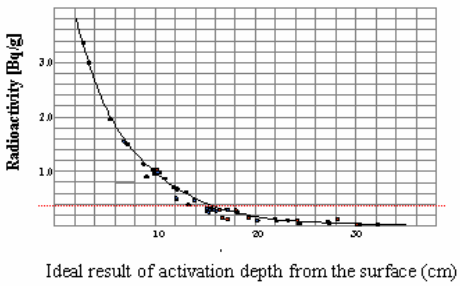

Fig. 1 Result of the radioactivity of the concrete core

But the activation thickness was decided on as 50 cm, which is considered to be the margin because of the structural safety. The activated south part was set up according to the partial activation boundary in Fig. 2. This activated area was designed with a 3D modeling and the cutting line was marked directly on the surface of the concrete and it was cut as following the marked line.

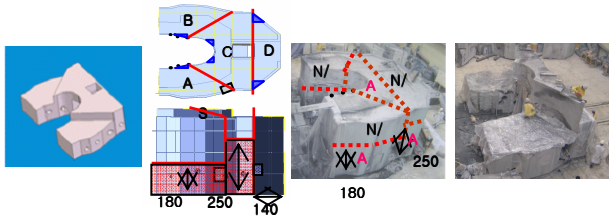

Fig. 2 Designed using the 3D model

3. Planning

According to this result, the technology, work procedure and protection system for the release of the radioactive material were planed. Many factors were considered such as device cost, access condition, radiation condition, second contamination, waste handling and embedded items, etc. First, the strategy was set up that the non activated part was dismantled first. This is takes advantage of the protection of a release of the second contamination materials from the activated concrete part during dismantling activities. Another reason is the area of the activated concrete part is very narrow which could not be accessed by the devices and it is difficult to get the dismantled concrete pieces out but for handling as radioactive waste for packing.

The technology for dismantling the non activated concrete part is selected as a core boring and diamond wire cutting. And all the cut pieces of the concrete are handled by using an over head crane and forklift. The activated concrete part received a hydraulic crushing and breaking in a green house. Than, it was put into a 4m^3 container and 200 liter drum by a hydraulic bucket. These containers are being temporally stored in the KRR-2 reactor hall till the national repository is operational.

4. Dismantling Activities

The procedure of the concrete dismantling activities was divided into 4 steps according to the geometry and

activation, of both the activated and non-activated part. The dismantling was started by the non-activated part, first. The 3 steps for the non-activated part are the top area, middle area and body area. The first activity is to dismantle the top area. In this step, before the dismantling, the decontamination work was needed because this platform area was heavily contaminated during the operation period. A scabbler was used to decontaminate the surface of the concrete. For the concrete cutting, core boring technology and diamond wire cutting technology were applied. 50 mm O.D. of a diamond core bit and a 10 mm diameter diamond wire were used. To handle the cut pieces of the concrete, an overhead crane was used with a capacity of 7.5 tons. This has a disadvantage because it could not cut a large size piece of concrete. Total 48 pieces of concrete blocks were cut and treated as non-radioactive wastes and they are being temporally store a site, but they will be self disposed as an industrial waste.

After dismantling the 1st and 2nd step concrete, the height of concrete body was reduced down to 4.2m, it is possible to handle a large size of concrete by using a high capacity a forklift with 25 tons. In this step, a piece of concrete with a weight of 20 ~ 25 tons was cut by a higher capacity diamond wire sawing device. All the cut concrete pieces should be surveyed for a surface contamination and treated as waste according to there classification. During the 3rd step of a concrete body dismantling, total 1,016 tons was cut as 82 pieces of concrete.(Fig 3)

Fig. 3 Non activated concrete dismantling

The two parts of the activated concrete was dismantled by a hydraulic jackhammer and crusher within a temporally containment with a ventilation system. Total 253.1 tons of the activated concrete was generated and these cut small pieces of concrete were put into $4m^3$ containers and 200 liters drum, directly and they are in containers being temporally stored in the KRR-2 reactor hall till the national repository is operation.(Fig 4)

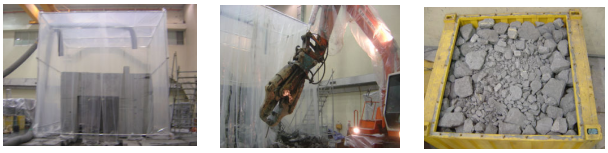

Fig. 4 Activated concrete dismantling

4. Conclusion

During 5.3 months, 1,659.7 tons of the non-activated concrete was cut and it is temporally being stored at the site but it will be treated as an industrial waste. Total 155 pieces, than the estimated by 130 pieces, was raised. The 328 points of the core were bored with a length of 450m. The cut area was 940 m^2. 1,920 man-days was consumed

The 263.1 tons of the activated concrete was generated than all the input to the 38 EA of the $4m^3$ containers and 59 EA of the 200 liters drums. 44 man-days were consumed and 172 hours of the device operational time was needed during the 22 days of the dismantling operation. As a result, the manpower consumption was evaluated as preparation work 32%, core boring work 1.7%, cutting & handling work 50.2% and decontamination & surveying work 16.1% of the ratio. There is no dose exposure for the workers during the dismantling activities.

REFERENCES

[1] 박승국 외, TRIGA 연구로 폐로를 위한 시설현황 및 방사선/능 조사보고서, KAERI/TR-1153/98, 한국원자력연구소, 1998

[2]정기정 외, "연구로 1호기 및 2호기 폐로사업 해체계획서", KAERI/TR-1654, 2000.

[3] J.Lyons, K.Lowther, K.Riding, Reference Method Statements KRR-1/KRR-2, TRD-220-B-001 BNFL, 1998.

[4] 이봉재 외, "TRIGA Mark-II, III 연구로 시설의 폐로를 위한 시설내 잔류 방사선/능 평가", 제24권 제2호, 대한방사선학회지, 1999

[5] 박진호 외, 원자력시설 제염해체사업, KAERI/RR-2625/2005, 한국원자력연구소, 2006

[6] 박진호 외, 원자력시설 제염해체사업, KAERI/RR-2700/2006, 한국원자력연구소, 2007