Dismantling the Bio-shielding Concrete of the KRR-2

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1. Abstract

According to the KRR-1&2 decommissioning project, the KRR-2 bio-shielding concrete was dismantled. Total 1,913 tons of concrete, which both activated and non-activated concrete was raised than the estimation as 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 is around 2.4Ton/m^3 and it's of heavy concrete is around 3.0 Ton/m^3. Before the main activities, the radiation characterization was evaluated for making the mapping between the activated and non-activated concrete. For dismantling, the technologies of the core boring, diamond wire sawing and hydraulic crushing were applied. During 6 months, total 1,964 man-days were consumed. Among the dismantled waste, only 13.2 % of concrete waste was classified as radioactive waste than which were temporally store in the KRR-2 reactor hall as of 38 EA, 4m^3 containers and 59 EA, 200 liter drums.

2. Radiation Characterization for Mapping

Before the dismantling performance the concrete, the radiation characterization 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 area 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 cores was dry type bored as out diameter of 50 mm and as depth of 400 mm diamond core bit. All cored samples were manufactured by powder type specimen from the 1 cm of the core, each. As result, the maximum radioactivity was 4.68 Bq/g in the north part and 200 Bq/g in the south part as radionuclide Co-60, Eu-152 and Eu-154. The activation depth is to 15 cm under the 0.4 Bq/g and 30 cm under the 0.04 Bq/g in north part. But the activation thickness was decided as to 50 cm, which is considered the margin because of the structural safety. The activated south part was set up according to the partial activation boundary. This activated area was designed with 3D and the cutting line was marked directly on the surface of the concrete than was cut as follow the marked line.

According to this result, the technology, work procedure and protection system for the release of the radioactive material were decided. These all were considered many factors such as device cost, access condition, radiation condition, 2nd contamination, waste handling and embedded items, etc. To get the access of the south part, the embedded ten beam ports must be removed first because of it's highly activation.

3. Removal the embedded ten beam ports

After cut the nose part of the eight beam ports, residual part, which is embedded in the bio-shielding concrete with maximum size, 200 mm diameter, should be removed. This was all made by stainless steel so which was very highly irradiated as radiation dose, 56 mSv/h near 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.

4. Dismantling Activities

The procedure of concrete dismantling activities was divided 4 steps according to the geometry and activation, both the activated and non-activated part. The dismantling performance was started by the non-activated part, first. The 3 steps for non-activated part, is 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 of this platform area was much contaminated when operation period. The scabbler was used to decontaminate the surface of the concrete. For concrete cutting, the core boring technology and the diamond wire cutting technology were applied. The 50 mm O.D. of diamond core bit and the 10 mm diameter of the diamond wire was used. To handle the cut pieces of concrete the overhead crane was used by capacity of 7.5 tons. This is disadvantage condition, which could not cut by large size of concrete. Total 48 pieces of concrete blocks were cut and treated as non-radioactive wastes and that are all temporally store in site, now than will be self disposed as an industrial wastes.

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

The two parts of activated concrete was dismantled by a hydraulic jackhammer and crusher within the temporally containment with the ventilation system. Total 253.1 tons of the activated concrete was generated and this cut small pieces of the concrete was put into the $4m^3$ containers and 200 liters drum, directly and now, all containers were temporally store in the KRR-2 reactor hall till the national repository operation than will be trans to there.

5. Conclusion

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

The 263.1 tons of the activated concrete was generated then all was input to the 38 EA of the $4m^3$ containers and 59 EA of the 200 liters drums. The 44 man-days were consumed and 172 hours of the device operation time was needed in the 22 days of the dismantling operation. As result, the manpower consumption was evaluated by the 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.

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