Equipment and procedures for safe handling of activated material

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In December 2022, a vacuum leak was caused in the chamber made of copper in the SRC by a beam irradiation. Three months after, the equipment was still highly radioactive with a surface dose rate of approximately 1 mSv/h. Welding repair work of activated equipment can provide airborne activity, which can cause internal exposure of workers and radioactive contamination of the surroundings. Therefore, safe equipment and procedure were developed by taking measures to prevent external and internal exposure as well as the spread of contamination.

Figure 1 shows the workhouse of internal-radiation safe called Tent used for the repair set in the IRC room. The size of Tent is 2.5 m wide, 5 m long, and 2 m high. Tent is ready-to-assemble made of flame-retardant sheets to prevent fire caused by welding sparks. The sheets can be cut into small pieces to dispose easily even if they are contaminated with radioisotopes. The entrance has an opening for easy access to the large equipment. A partition is placed at the entrance to provide space for changing contaminated protective clothing. Additionally, the floor sheet and Tent can be separated so that the large equipment can be imported from above. Air containing radioactive airborne dusts from the processing work of radioactive material in Tent can be exhausted outside by a local exhaust fan with a high-performance filter. The air inside the 25 m^3 volume Tent was replaced once/min by an exhaust fan. Two types of filters, pre and HEPA filters, are stacked to remove radioactive dust. HEPA filters had a collection efficiency of 99.97% for particles 0.3 μm in diameter or larger. The exhaust ducts were made of aluminum, and a spark filter box with stainless steel wool was placed between Tent and the local exhaust fan to prevent sparks by welding from entering the local exhaust fan and igniting it. Moreover, two layers of spark sheets and flameproof sheets were used on the floor to withstand sparks generated by welding.

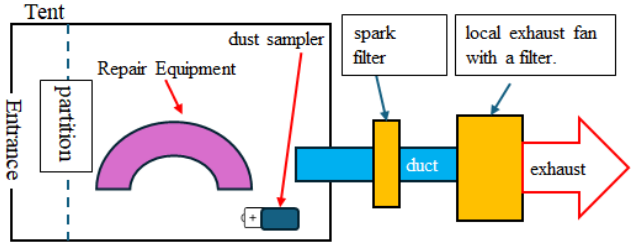

Fig. 1. Schematic view of the Tent used for the repair.

To prevent internal exposure and workers body surface contamination, workers wore welding masks and protective suit. The welding mask is supplied with safe air by a fan with a HEPA filter.

Workers welded with digital dosimeters with alarms to keep external exposure below limited value of 200 μSv/day. Figure 2 shows a TIG welding operation with the mask and the protective suit.

Fig. 2. TIG welding operations.

Concentration of radioactive airborne dust in the Tent air during welding operations on copper chamber were measured. The airborne dust was collected by a dust sampler filter and the radioactivity of the filter was measured by using a Ge detector. Be-7, Co-57, Co-58, Co-60, and Mn-54 were detected. However, the concentration of radioactive dust was low enough for the sum of the ratios to the legal limit to be 1.1×10^{-4}.

By using Tent and with these safe procedures, radiation safety against internal and external exposure, contamination for worker and environment was achieved allowing other work for activated materials in future.

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