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Development of Radioactive Substance Contamination Diffusion Preventive Equipment for a Hot cell

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1. Introduction

The hot cell of irradiated materials examination facility (IMEF), which has been operating since 1996, is generally contaminated by the radioactive nuclides of irradiated nuclear fuels and structural steels like Cs-137, Co-60, Co-134 and Ru-106[1,2,3,4,56,7]. Especially Cs-137 is a main contaminated radioactive isotope which is easily moved here and there due to air flow in the hot cell, water-soluble, extremely toxic, and has a half-life of 30.23 years.

To repair or fix the abnormal function of test apparatus installed in the hot cell, the maintenance door, so called a rear door and located at an intervention area, is opened to enter the hot cell inside. In a moment of opening the maintenance door, dirty air diffusion from the hot cell to an intervention area could be occurred in spite of increasing the rpm of exhaust fan to maintain much low under pressure, but an adjacent area to a maintenance door, i.e. intervention area, is very severely contaminated due to the unpredictable air flow.

In this paper, the development of the radioactive substance contamination diffusion preventive equipment for a hot cell is studied to prevent dirty and toxic gaseous radioactive nuclides diffusion from a hot cell and installed at an intervention area of IMEF.

2. Experimental & Results

2.1 Contaminated Hot cell

The hot cell is generally contaminated by the radioactive nuclides of irradiated nuclear fuels and structural steels like Cs-137, Co-60, Co-134 and Ru-106. Especially Cs-137 is a main contaminated radioactive isotope which is easily moved due to air flow in the hot cell, water-soluble, extremely toxic, and has a half-life of 30.23 years.

It is equipped with both an inlet of fresh air supply from a supply fan to a hot cell and an outlet of dirty air exhaust from a hot cell to a stack. The HVAC (Heating, Ventilating, Adjusting and Conditioning) system is designed to turn the air of a hot cell at least twelve (12) times an hour. The inside atmosphere of hot cell is maintained with about -25 ~ -38 WG under-pressure. The inside of the hot cell except a ceiling is lined with 3 mm and 6 mm thick stainless steel. A working table, which is made of a 6 mm thick stainless steel, is positioned above 900 mm from operating floor level. A maintenance door, which is featured 0.9 mW x 1.8 mH x 1.2 mT with heavy concrete, is installed at the rear wall of a hot cell with rolling wheels, and is moving from forward to backward on the rail by an electrical motor.

2.2 Radioactive substance contamination diffusion preventive equipment

This equipment consists of a door barrier, an air isolation tube and a safety gate as shown fig. 1 and 2, respectively. The dimension of this is 1,700 mm in width, 2,700 mm in length, and 3,100 mm in height.

The function of a barrier is to prevent contaminated radioactive nuclides from a hot cell by squashing up an air isolation tube to a wall of a rear door with four (4) anchoring bolts, so this helps it to balance when it is bolted with an air isolation tube. The material of it is a stainless steel 304. It assures that the door barrier can be tightly stationed on the floor to absorb the impact force and cut off air with a rubber panel installed on the surface of it.

The air isolation tube is also designed to prevent contaminated radioactive nuclides from a hot cell by squashing up an air isolation tube to a wall of a hot cell and a floor with air pressure 6 kg/cm^2(= 6 bar) and equipped with pressure safety valve to release the inner pressure for protecting the PE component. The material of it is a stainless steel 304. It assures that the air isolation tube can be cut off air with a rubber panel installed on the surface of it.

The safety gate is used for keeping an operator safe and made of 50x50 aluminum profile, PE and LM guide block. It also assures that the safety gate can be cut off air with a rubber panel installed on the surface of it.

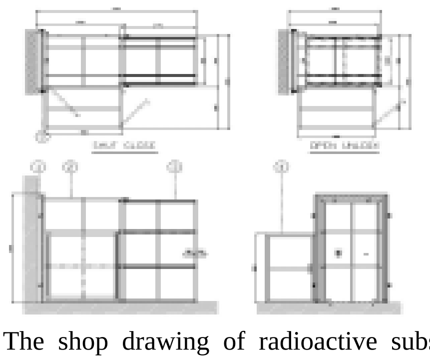

Fig. 1 The shop drawing of radioactive substance contamination diffusion preventive equipment for a hot cell.

Fig. 2 The outer shape of radioactive substance contamination diffusion preventive equipment for a hot cell located in a intervention area of IMEF.

The sealing test was carried out to confirm the air tightness between the rear wall of a hot cell and radioactive substance contamination diffusion preventive equipment with 6 kg/㎠ pressure value and observed the pressure gage furnished in front of safety gate during 30 minutes but no pressure drop signal was seen to notify the air leakage. Some parts of an air isolation tube were swelled by given pressure but it can be adjusted the inner pressure value by controlling the pressure safety valve.

3. Conclusions

The contamination diffusion preventive equipment of radioactive substance for a hot cell is studied and developed to confine dirty and toxic gaseous radioactive nuclides got out of a hot cell and installed at an intervention area of IMEF. It was also tested and satisfied special requirements that is described in technical specification. This equipment is so safe to prevent contamination diffusion from spreading radioactive substance of a hot cell to an intervention area when a rear door is opened in a moment that economic effects are expected such a saving for man-power to get rid of contaminated substance on the intervention area as well as radwaste reduction.

However it is strongly recommended to review and reconfirm the second contamination by operator or this equipment.

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