Investigation to Radioactive Contamination of Water Pool According to Take in/out Radioactive substance in IMEF

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Abstract

The pool (3 m x 6 m x 10 m) in Irradiated Materials Examination Facility is generally used to transport irradiated materials between entrance area and hot-cell. During the operation in the pool such as loading/unloading the cask, handling specimen and bucket elevation, water maybe contaminated by radioactive or contaminated impurities from the irradiated materials. Then, it must be purified and filtered continuously to keep the radioactivity lower than that of regulation prescribed by RCA Korea Activity sa part of radioactive contamination control. This paper describes the radioactive contamination distribution of water in the pool with each transported material, which is related to the effective operation of the purification and filtration system.

1. Introduction

Generally, irradiated materials including nuclear fuels must be contained in a cask for transportation. For inspection, these irradiated materials are moved to hot-cell in IMEF(Irradiated Materials Examination Facility). The cask is opened under water to protect from neutrons and radioactive diffusion.

The pool in IMEF was built with Stainless Steel 304L lining and the thickness of structure was designed with the assumption that nuclear fuel with 10^6 Ci of 1 MeV gamma rays should be shielded below 9.0×10^{-6} Sv/h.

200 m^3 of water in the pool circulates at 1 cycle for 72 hours with the flow rate(16 m^3/h) of the pump. A filter and ion-exchange resin were installed to keep the radioactivity of the water below 10^{-4} μ Ci/cc. An exchange device for the filter and ion-exchange resin was added to the purification system. Also, the shielding cover was set up to protect against a radiation from the contaminated filter and the ion exchange resin. During the a cask work in the pool, the water must be cleared due to the visual work. So, the turbidity of the water must be kept below 3 NTU by filtering out the impure particles(> 6 μm). In addition, the water is preserved with a condition of 5 μs/cm of conductivity and a 5 < pH < 8. Radiation dose rate of the circumference and water level should be kept below 15 mR/h and more than 8.30 m of depth, respectively.

2. Experimental

A purification system placed in the basement. Two pipe lines(4 inches of dia.), which are the in-let and out-let, connected the bottom of the pool and the purification system. A skimmer was installed in the in-let line as well. The equipment in this system is as follows;

- 4 pre-filters in the housing remove the large particles (>6 μm) from the water.
- Main filter removes the small particles (>1 μm) from the water.
- Ion exchanger and resin cartridge (E-001)

This equipment removes the radioactive ion particles using resin.

Besides, a conductivity cell and an indicator, a DPS & DPA, control panel, shielding wall, pump & motor, basket strainer, piping system, valves & gauges and a filter & Ion-exchanger cartridge handling tool were also equipped.

There are two filtration methods for purification. One is a normal operation where the water circulates via a pre-filters and filter(F-002) to remove the impurity particles. The other is where the water circulates via filters and ion-exchanger to remove the radioactive ion if the water seems to be contaminated. The resin used in an ion exchanger is useful for removing both negative and positive ions.

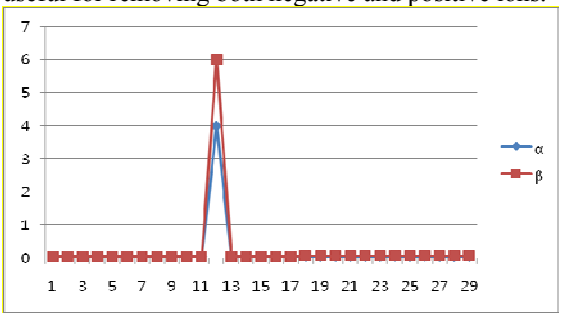

Fig 1. Gross α, β

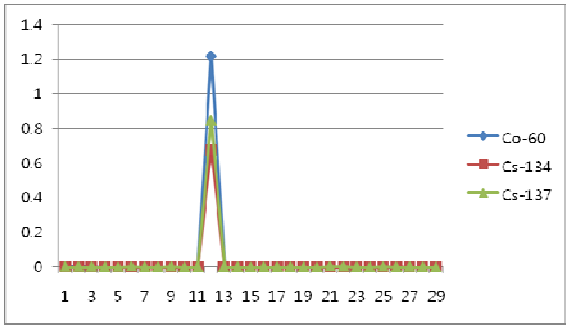

Fig 2. Co-60, Cs-134, Cs-137

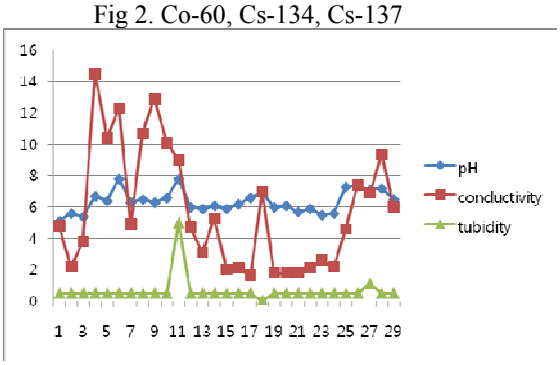

Fig 3. pH , conductivity, turbidity

3. Results and Discussion

Radioactivity and quality of water in the pool has been measured from January, 2007 to JulyAugust, 2009. In Fig. 1, α-contamination level was low steadily but several peaks of β-contamination level were observed during a month after transportation of monitoring capsule. In this time, radioactivities of Co-60 and Cs-137 were remarkably high in December, 2007 as shown fig 2. Turbidity in fig 3. shows no change. As shown for the pH values were high in 2007 and the electric conductivity peaks observed remarkably stable.

4. Conclusion

The radioactivity contamination level of the water in the pool for 2 years and 7 months does not increased and it kept below the regulation limit continuously. Several high peaks were shown but decreased after a change of the filter and purification with an ion exchanger. Turbidity is kepting very low with only filtration. If the radioactive contamination of the water is not to severe, a normal filtration after purification with an ion exchange resin for one(1) week should be effective. It is concluded that the filter must be changed often (up to 4 kg/cm^2) and the purification system operated for eight(8) hours in a day at least. Also, it is important to control the pH and electric conductivity.

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