An observation of the radiation level while making up HANARO pool water

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1. Introduction

A make-up of HANARO pool water was made through the reactor pool in the beginning. But it is now done through the service pool to reduce the impact to the hot water layer. The make-up of the pool water through the service pool was not easy, because an operator should control the valve manually, and it was hard to access the valve due to surrounding facilities. Therefore, it has been considered to return to a previous method to make up the pool water.

This paper describes the behavior of the pool radiation and response of a radiation monitor located in a duct of the HVAC exhaust system around the reactor core when a pool water make-up is done through the reactor pool of HANARO.

2. Experimental Methods

HANARO is an open pool type, and a pool water make-up should be made once every other day due to a natural evaporation of pool water and the hot water layer.

At the design stage of HANARO, the make-up of the reactor pool water was designed to be done through a make-up pipe located 12.30 m away from the bottom of the pool as in Figure 1 [1]. The level of the reactor pool when the reactor is operated is kept between 12.20 m and 12.25 m normally.

In the early stage of the reactor operation, the hot water layer was installed to reduce the radiation level on the pool water surface due to the activated elements. Since then, the pool water make-up has been done through the service pool.

The make-up through the service pool is more reliable than the one through the reactor pool because the make-up pipe of the service pool is away enough from the reactor pool and the make-up of the pool water is done at the bottom of the service pool which is below the hot water layer.

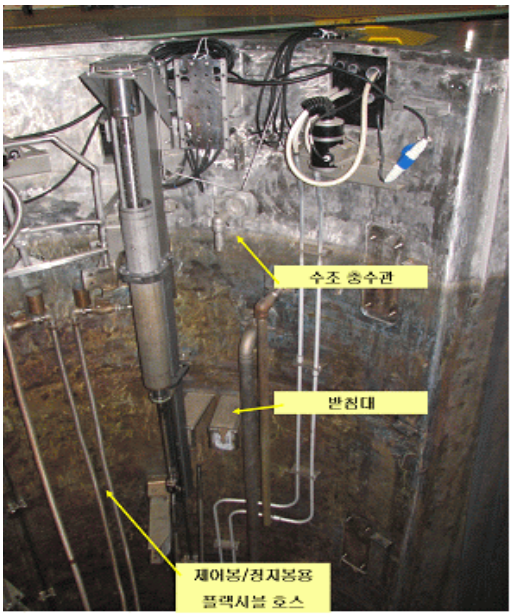

Figure1. A view of facilities in the reactor pool of HANARO.

However, the make-up through the service pool has a problem in the access to the manual valve of the make-up. This made us reconsider the make-up through the reactor pool.

First of all, it was considered that the flexible hose to be connected to the make-up pipe of the reactor pool should be installed 6 m below from the hot water layer and then we observed the pool top radiation and the duct monitor of the HVAC system while the make-up to the reactor pool was handled carefully.

2.1 Evaluation of the bubble behavior during the make-up (1st test)

The first test was conducted during in the make-up of the pool water from 19:25 to 20:09 on Jan. 28. That test was conducted under the reactor shutdown condition. Bubble in the pool top was observed while the make-up valve was operated

three to seven times. The bubble was believed from the make-up line.

Before the 1st test was put into practice, the reactor was kept under the shutdown condition for a long time. Therefore an observation of the value for the pool top radiation and the duct radiation was not possible.

2.2 Evaluation of bubble behavior during the make-up (2nd test)

The second test was commenced in the same condition as the first one from 18:15 to 18:45 on July 2. It was done at a reactor shutdown condition. Bubble was observed while the make-up valve was operated once to five times. After the valve was operated once a little mount of air bubbles was observed [2]. Table 1 shows the result of the 2nd test of operating with the make-up valve.

Table1. Result of the 2nd experiment of handling with the make-up valve

Time	Level (m)	Turns	Pool Rad. (nGy/hr) (Ch. A/B/C)	Duct Rad. (cpm) (#20/#21)
18:10	12.177	0	4350/5550/2020	130/73
18:15	12.177	1	4220/5300/2000	101/113
18:17	12.177	1	4180/5100/2000	460/382
18:25	12.197	2	4080/5050/1870	106/119
18:35	12.198	3	3980/4780/1970	105/132
18:40	12.215	4	4000/4830/1900	89/111
18:45	12.215	5	3820/4630/1760	98/112

The average of the pool radiation was about 5,000 ~ 6,000 mGy/h while the reactor was operating although it had some differences for each channel, and it was about 150~170 cpm in the case of the duct monitor. Figure 2 shows the trend of the pool radiation and those of the duct monitor. When a bubble is produced by the opening of the make-up valve, a duct radiation peak was produced in a moment as Table 1 shows, but a pool radiation didn't increase. Although a change of the duct radiation was insignificant it was more sensitive than the pool radiation. The reason is that the duct monitors measure the activity in the air sucked just above the pool top surface and the pool top radiation is measured at the point 50 cm above the pool top surface.

An air bubble was produced at 18:17 as Figure 2 shows regarding the 2nd test of operating the make-up valve, and then the value of the duct radiation monitor (#20) was 460cpm and the other one (#21) was 382cpm, which indicate a single peak [3]. This result proves that the status is safe because the values are much less than 2,500cpm which is a high alarm level of the duct monitor.

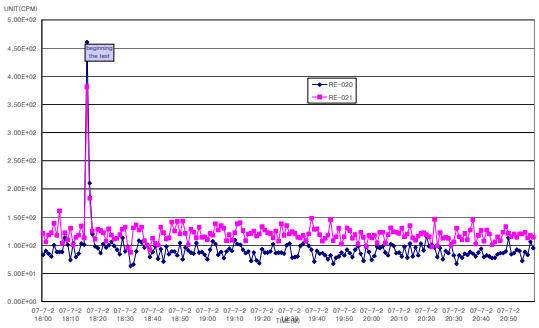

Figure2. Single peak of the duct radiation (2nd test)

3. Remarks

The result of the 1st and 2nd tests couldn't show the real situation precisely because those tests were conducted under a reactor shutdown condition to prevent the increase of the radiation and any safety problems.

Hereafter a few more tests will be conducted at shutdown condition for the real application.

[1] Y.C. Park, "Improvement of the reactor coolant make-up", HAN-RS-CR-400-06-001, Internal Memo., KAERI, 2006

[2] C.Y. Park, "A Test of the handle with a supplement valve of the reactor coolant for restraint bubble", HAN-RS-CR-722-07-010, Internal Memo., KAERI, 2007

[3] H.S. Lee, "Minutes trend for the RCI's duct monitor", KAERI, 2007