Estimated Activity of CPP Wastewater and Radioactivity of Evaporative Concentrates

Ki Bang Sung
KHNP Central Research Institute, 70, 1312-gil, Yuseong-daero, Yuseong-gu, Daejeon, Republic of Korea
kind.sung@khnp.co.kr

1. Introduction

When the CPP regenerated waste solution is evaporated under reduced pressure, the gaseous radionuclides and tritium are not concentrated, but the other ionic and particulate gaseous species are condensed together with the non-fugitive renewable wastewater component during the decompression of the CPP regeneration wastewater.

To examine the concentration effect of CPP regeneration wastewater, the expected radioactivity concentration of the CPP wastewater was calculated from the secondary system radioactivity concentration based on the FSAR data of A nuclear plant, and the actual concentration of CPP wastewater was concentrate to analyze the radioactivity and compared to each other.

2. Experimental Methods

2.1 Experimental Apparatus

The apparatus used in this experiment is shown in Fig. 1.

Fig. 1. Experimental Apparatus.

2.2 Purification System of Condensate

Recycled wastes are collected in the condensate purification plant drainage and then transferred to the integrated wastewater treatment plant. If the radioactivity level of the CPP drainage wastes exceeds the high alarm set point(0.365 Bq/cm^3), the waste is transferred to the liquid radioactive waste system. That is, the radioactive liquid wastewater is treated in the radioactive waste treatment system and ~~does~~ not leaked out.

2.3 Expected radioactivity of CPP regeneration wastewater

In the operating NPP, the blowdown ~~estimated~~ radioactivity is estimated assuming the design leakage rate of the SG tubing during normal operation, and the equilibrium radionuclide concentration of the liquid phase and main steam of the secondary side cooling water in the steam generator is calculated considering the radioactivity concentration of the primary system water and the permissible leakage rate .

In the case of the a nuclear power plant, the design leakage rate from the primary side to the secondary side through the steam generator tube is assumed to be 34 kg / day

2.4 Expected radioactivity of CPP regeneration wastewater

The radioactivity of the CPP regeneration

wastewater is calculated from using about 32 m^3 of 6% sulfuric acid solution and then a dilution water of 120 m^3 or more is used.

During the regeneration, all the radioactive materials contained in 8 m^3 of the cation resin are transferred to the regeneration waste water of 32 m^3. Thus, the radioactive material is diluted from 8 to 32 to about 4 times

If the radioactive material is again concentrated by evaporation under reduced pressure, 32 m^3 will be concentrated to 20 times and the radioactive material will be present in the solid matter of about 1.6 m^3.

Therefore, the radioactive material after the decompression evaporation is finally converted from 8 m^3 to 1.6 m^3, which is about 5 times higher than the concentration in CPP wastewater.

That is, the Cs-137 nuclide in the reduced-pressure evaporation dried product, assuming no leakage of the coolant but assuming leakage, is about 0.7 Bq/cc.

Table 1. Estimated activity by equipment and flow path in the secondary chemical control system

nuclide	SG Blowdown (Bq/g)	Condensate (Bq/cc)	CPP Cation IX (Bq/cc)	Dried Waste (Bq/cc)
Cs-134	6.1E-03	1.4E-05	1.0E-01	5.0E-01
Cs-137	8.1E-03	1.9E-05	1.4E-01	7.0E-01
Co-58	3.4E-03	3.1E-06	2.3E-02	1,4E-02
Co-60	3.9E-04	3.5E-07	2.7E-03	8.5E-03
SUM	5.7E-02	1.2E-04	3.1E-01	1.5E+00

3. Results and Discussion

3.1. Result of radioactivity measurement of Residual CPP waste

The radioactivity of the sample was measured for the same 10,000 seconds. The reason for the measurement for 10,000 seconds is that the power plant usually measures about 3000 seconds to check the radioactive contamination at the time of discharge, so it is about 3 times more to reduce the uncertainty of the measurement and to make a clear

First, the background radioactivity was measured, and then the decompressed volatile solids of a nuclear power plant were measured.

As a result of the measurement, the background radioactivity measurement spectrum showed a little 1461 keV peak emitted from the K-40 natural radioactivity in the spectrum.

Table 2. Activity of A plants CPP waste concentrates

Detector Name: DET01
Sample Title: 신고리2호기 CPP 농축액
Peak Analysis Performed on: 2016-11-09 8:49:39 AM
Peak Analysis From Channel: 50
Peak Analysis To Channel: 8192

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	366-	376	370.71	92.63	1.26	1.20E+002	20.56	1.25E+002
2	740-	753	744.30	185.87	0.86	6.64E+001	21.45	1.41E+002
3	951-	960	955.71	238.64	0.74	4.59E+001	13.65	7.01E+001
4	2036-	2056	2047.21	511.06	0.34	1.96E+002	18.85	5.77E+001
5	2434-	2447	2441.30	609.42	0.53	3.99E+001	10.07	2.81E+001
6	5844-	5862	5853.51	1461.05	1.81	1.34E+002	13.14	1.71E+001

4. Conclusion

In the radioactive measurement spectrum of decompressed evaporated water samples, only K-40 natural radioactivity was detected. That is, the spectrum of the dried sample was almost identical, no specific peak indicating the presence of the nuclide was observed, and no detectable gamma ray emitting nuclide was detected at the time of operation.