The present status of HANARO radiation monitoring system and trend investigation

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1. Introduction

The normal ventilation system of HANARO is divided into reactor hall area, supporting and instrumenting area, RCI (Reactor Concrete Island) area and general management areas. In HANAO the radiation monitoring is performed by the radiation safety management team. However, usually the level of emitted radiation is lower than DAC (Derived Air Concentration). So we have been easily missing the radiation changed at low dose value. To improve this situation, we compare this week's dose (mean and maximum values) values to last week's dose values. So, if it is very lower dose but increased more than two times by last week's values, we start to investigate the reason.

2. Methods and Results

For example, Fig 1 shows the tritium concentrations in HANARO.

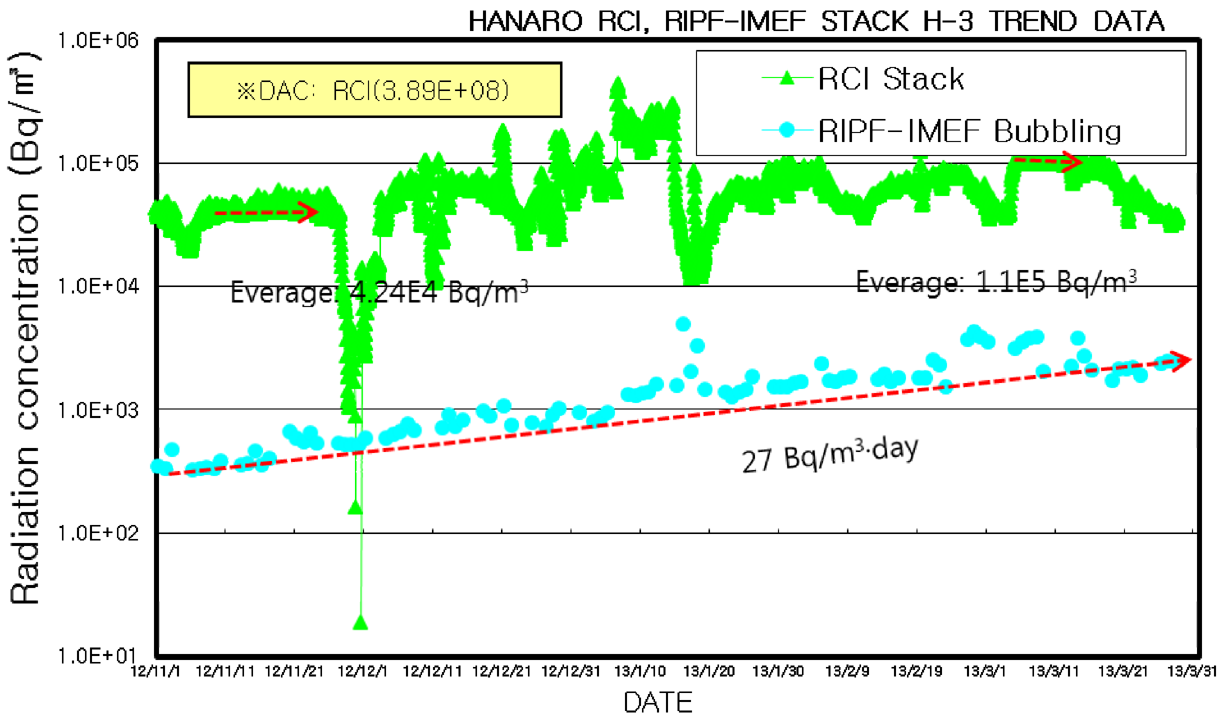

Fig 1. Example of RCI, RIPF-IMEF stack H-3 tend

The tritium is mainly come from a reflector system. Thus, Small leakage of heavy water in the reflector system can increase the concentration of tritium in RCI. There are no tritium sources in the RIPF-IMEF facility. But this facility's tritium concentration increased by degrees at 27 Bq/m^3·day. It was very lower values, but we investigated the reason and found the reason was not owing to the increase in tritium concentration.

Table 1 shows the example of weekly HANARO radiation trend report. In this report indicates limiting point or high set points and average and maximum values of each two weeks. And the report has increasing ratio so we can easily compare the trend of all RMS at one sight.

RMS	Radiation	Limit or High set point	Unit	Average			Maximum			
				Last Week	This Week	Increasing rate	Last Week	This Week	Increasing rate	Ratio of max. to limit
18-secondary cooling Water	Alpha	600	cpm	1.22E+02	1.21E+02	**0.99**	1.26E+02	1.27E+02	**1.01**	21.19
19-Rx hall	Particulate	3.84E-09	uCi/cc	6.23E-11	7.20E-11	**1.15**	3.47E-10	5.69E-10	**1.64**	14.81
	Iodine	2.05E-08	uCi/cc	3.12E-11	3.11E-11	**1.00**	3.23E-11	3.18E-11	**0.98**	0.16
	Noble gas	2.10E-06	uCi/cc	2.08E-07	1.94E-07	**0.93**	2.74E-07	2.82E-07	**1.03**	13.43
20-RCI DUCT	beta	2500	cpm	9.71E+01	1.14E+02	**1.17**	1.03E+02	1.20E+02	**1.16**	4.80
21-RCI DUCT	beta	2500	cpm	1.03E+02	1.11E+02	**1.08**	1.07E+02	1.18E+02	**1.10**	4.73
22-Rx	Particulate	6.72E-07	uCi/cc	9.23E-12	9.89E-12	**1.07**	6.13E-11	1.99E-10	**3.24**	0.03
	Iodine	1.34E-07	uCi/cc	1.45E-11	1.44E-11	**0.99**	3.64E-11	3.29E-11	**0.90**	0.02
	Noble gas	1.78E-04	uCi/cc	1.68E-08	1.70E-08	**1.01**	3.47E-08	3.60E-08	**1.04**	0.02
23-RCI	Particulate	5.17E-06	uCi/cc	4.06E-11	4.00E-11	**0.99**	7.46E-11	1.34E-10	**1.79**	0.00
	Iodine	1.03E-06	uCi/cc	1.40E-11	1.39E-11	**1.00**	1.85E-11	1.87E-11	**1.01**	0.00
	Noble gas	2.14E-03	uCi/cc	1.69E-08	1.50E-08	**0.89**	4.73E-08	4.25E-08	**0.90**	0.00
24-RIPF/IMEF	Particulate	4.91E-06	uCi/cc	1.24E-11	1.26E-11	**1.01**	4.30E-11	5.28E-11	**1.23**	0.00
	Iodine	9.82E-07	uCi/cc	5.26E-11	5.30E-11	**1.01**	1.22E-10	1.24E-10	**1.02**	0.01
	Noble gas	9.82E-03	uCi/cc	3.61E-08	2.62E-08	**0.73**	1.30E-06	1.39E-06	**1.07**	0.01
Rx stack H-3	Tritium	5.07E+06	Bq/m^3	-1.32E+04	-1.36E+04	**1.03**	-1.17E+04	-1.14E+04	**0.00**	-0.23
RCI stack H-3	Tritium	3.89E+08	Bq/m^3	2.62E+04	2.22E+04	**0.85**	3.30E+04	2.52E+04	**0.76**	0.01
RIPF/IMEF	Particulate	1.68E+03	Bq/m^3	4.69E-01	5.21E-01	**1.11**	2.55E+00	2.83E+00	**1.11**	0.17
auxiliary stack	Iodine	7.52E+03	Bq/m^3	4.27E-01	4.26E-01	**1.00**	1.27E+00	1.21E+00	**0.95**	0.02

Tab 1: Example of weekly radiation trend report

RMS No.	22-P	22-I	22-G	23-P	23-I	23-G	24-P	24-I	24-G	Rx-H-3	RCI-H-3	110-P	110-I
[unit]	[uCi/cc]									[Bq/m^3]		[uCi/cc]	
① Max	3.47 E-10	5.92 E-11	1.88 E-07	3.28 E-09	6.83 E-11	4.00 E-07	1.9 E-10	1.13 E-09	1.09 E-05	1.45 E+04	4.35 E+05	1.12 E+01	2.91 E+01
② DRL	6.72 E-07	1.34 E-07	1.78 E-04	5.17 E-06	1.03 E-06	2.14 E-03	4.91 E-06	9.82 E-07	9.82 E-03	5.07 E+06	3.89 E+08	1.68 E+03	7.52 E+03
①/②×100	0.052	0.044	0.106	0.063	0.007	0.019	0.004	0.115	0.111	0.287	0.112	0.668	0.387
DATE	2/26 10:00	7/26 10:00	1/1 3:00	1/18 10:00	7/2 10:00	1/11 10:00	2/18 12:00	7/5 10:00	2/7 14:00	1/12 16:00	1/6 22:00	2/15 9:00	2/15 9:00
Reason	RMS check	Filter exchanging	Uncertain	Filter exchanging	Uncertain	Filter exchanging	RI production	Filter exchanging	RMS server backup	Small leakage	Small leakage	Filter exchanging	Filter exchanging

Tab 2: The maximum value of RMS trend (from Jan. to Aug. in 2013)

Table 2 shows the maximum value of RMS trend from January to August in 2013. For the most of part, the reason of maximum value was RMS filter exchanging and RMS examination. And the maximum value was under 1% of DRL(Derived Release Limit).

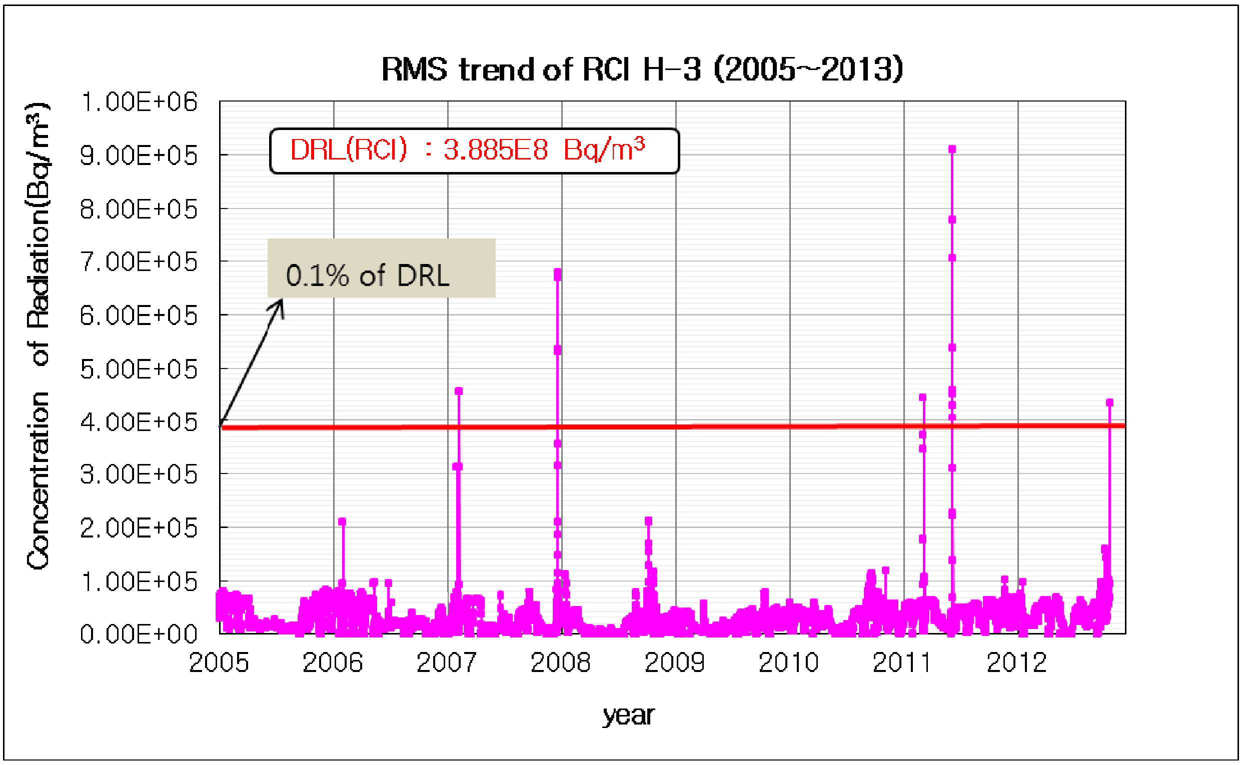

Fig 2. H-3 trend of RCI(2005 ~ 2013), RIPF-IMEF stack H-3 tend

Fig 2 shows radiation concentration of RCI stack from 2005 to 2013. Usually the value is under 1E5 Bq/m^3. There were five times that the number of 0.1% of DRL was exceeded.

Date	① H-3	② DRL	①/② ×100	Reason
	× 10^5 Bq/m^3		%	
2007. 04. 24.	4.56	3885	0.12	PSV007 open
2008. 03. 05.	6.79		0.17	Reflector sealed room discharge V/V open
2011. 05. 19.	4.43		0.11	Disassembling P/P #1 for maintenance
2011. 08. 19.	9.10		0.23	Assembling P/P #1
2013. 01. 06.	4.42		0.11	Minute leak of flange gasket

Tab 3: The maximum value of RCI H-3 in recent 5 years

Tab 3 shows the maximum value of radioactive concentration and the reason. Usually the maximum value is under 1% of DRL. The high value was not lasted long time because operators always monitoring the radiation and find the reason quickly.

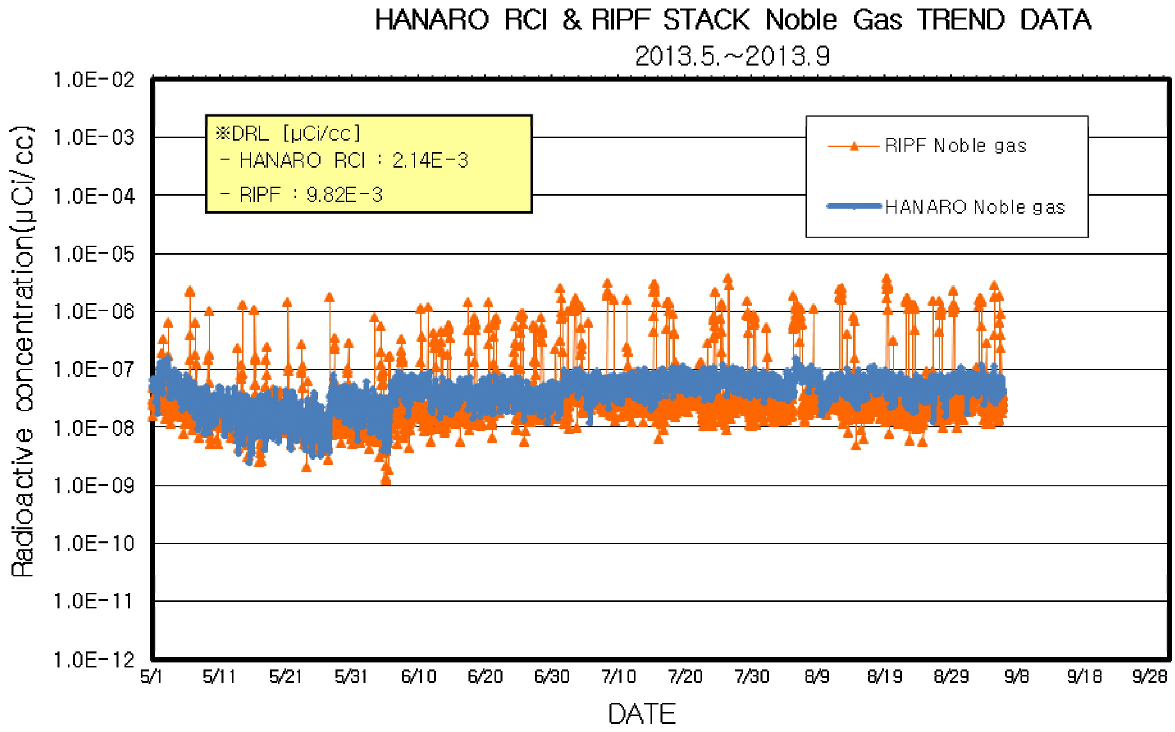

Fig 3. HANARO RCI & RIPF STACK Noble Gas TREND

Fig 3 shows radiation concentration of HANARO RCI stack and RIPF(Radio Isotope Production Facility) stack. The two trends are similar and the value is under 1% of DRL. But some peaks were showed frequently on RIPF trend only. We found that each peaks occurrence time is same to radioisotope production stating time. So the number of peaks means the frequency of works of radioisotope production in RIPF.

3. Conclusion

This paper introduces the method of weekly RMS data trend report and shows any small changes have been investigated to find the reason. As showed the reasons of some trends peaks, we continually monitor the trend and investigate the changes. The investigation data will be accumulated and helpful for finding the cause of radiation increasing quickly. These efforts will improve the safety of HANARO operation and the radiation safety after all.

4. References

[1] Daily E-mailed Radiation Monitoring Data, Radiation safety & management team, KAERI, 2013.

[2]J. S. HAN, A Preemptive Safety Management System for HANARO, HANARO Symposium, 2013.