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Measurement for the Leak Rate enhanced by a Improved Method

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1. Introduction

The leak rate measurement of the HANARO such as a research reactor that adopts a confinement concept for a reactor hall is very important one during a period inspection. This test verifies whether the reactor building could maintain the negative pressure or not when radiation is perceived by abnormal accidents. Of course, this may not cause a problem in a reactor operation only if it can satisfy the design requirement, but it is necessary to have some margin of a limitation value because a reactor hall should be managed more conservatively than the design reference. To meet the requirements of this strict design condition, previous method was changed to a new type of test with more stable and robust measuring method. The new leak rate measurement method is briefly introduced and the merits of this proposed method are shown through the data analyzed for last 3 years.

2. Methods and Results

2.1 Problems in Existing Measurement Method

During a normal reactor operation, a reactor building maintains a slight negative pressure to prevent a radiation release through a confinement boundary. If the radiation accident happens, simultaneously a emergency ventilation starts automatically and after, the reactor building maintains a increased negative pressure.

However, if the emergency fan is not possible due to an unexpected matter, the reactor hall must be isolated by blocking all the penetration parts. The configuration of the HANARO ventilation system is represented for Figure 1.

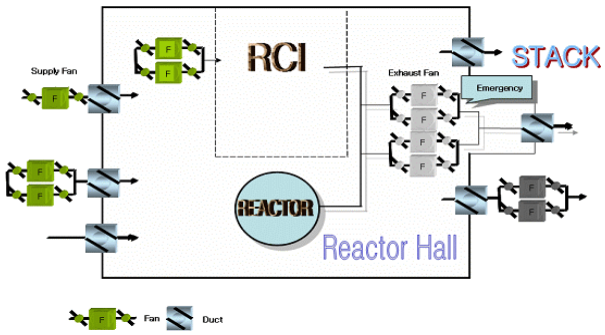

Figure 1 Configuration of HANARO HVAC system

Under this condition, regrettably, a small release could occur by a pressure difference between the inside and outside of reactor building, produced by a high speed wind. Under this situation, the leak rate for the reactor hall should be verified for its safely within the predefined limit. [1]

The principle of the existing test is that the time gaps of the regular pressure drop are used to measure. At first, with all isolation damper closed, using a supply fan, it is necessary to increase the internal pressure to higher than 30mmWG. As the pressure is become getting higher than this point, the supply fan should stop. That is to measure the time gaps correspondent to the decrease of pressure drop.

The weakness of this measurement result from a narrow gap of the range of concern, is that, a small variation in the atmospheric pressure can cause a big deviation in the leak rate calculation. It was found as a systematic problem that the unavoidable fluctuation by the atmospheric change had adversely affected the accuracy and reliability of the measurement. In addition, the measurement error of the temperature signal also resulted in a spurious deviation of the leak rate calculation. [2]

2.2 The Proposed Measurement Type

In order to solve this problem, the new concept of a measurement type that takes an advantage of an independent flow control system was suggested. The best alternative to the leak rate measurement is to eliminate the effect of a atmospheric pressure, and to measure the absolute pressure of the internal reactor hall. But, on account of the resolution limit of a pressure device, this method is difficult to implement.

Instead, it is developed so that the supplied flow maintaining the positive pressure inside can be converted to the leak rate of the internal reactor hall. An independent flow generating system consists of a fan, volume damper, inverter, flow measuring devices. This configuration is shown for Figure 2. [3]

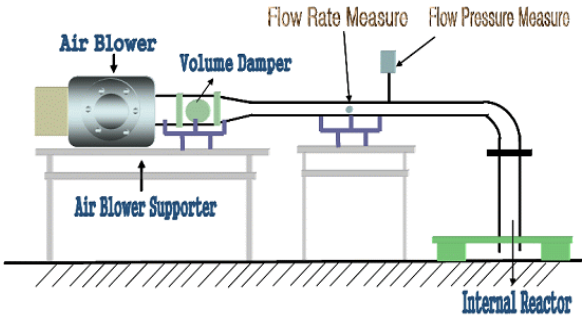

Figure 2 Architecture of the flow control system

After the stabilization of the internal pressure at 25mmWG, the supply flow rate is adjusted to make it equivalent to the volume of the leak rate through the building. If the supply flow rate is more than the leak rate, the internal pressure become high and in the contrary case, the internal pressure will decrease. So this system is based on the theory that the proportional relation between the flow rat and leak rate exists. [4]

2.3 Data Analysis

The test results, obtained from the new concept indicate that the atmospheric pressure change and calculation error did not cause any trouble and the measured leak rate by the new method satisfy the design condition conservatively. Table 1 stands for the improvement of the leak rate trend by the data produced at 2006 and 2007. SPT(standard pitot tube) value means the average of each measurement at five points in the flow duct. As seen, despite the variation of the atmospheric press(0.2mbar), the leak rate measurements all satisfy the design requirements(570 m^3/h).

Table 1 Improved leak rate data at 2005, 2006

Try	SPT	Air Pr	Temp	Cal	Leak rate	Try	SPT	Air Pr	Temp	Cal	Leak Rate
	[inch H20]	[mbar]	[deg]	SPT	SPT		[inch H20]	[mbar]	[deg]	SPT	SPT
1	0,133	1013	26,09	7,49	476,13	1	0,126	1005,30	18,73	7,23	459,5
2	0,152	1013	26,10	8,00	508,99	2	0,126	1005,30	18,84	7,23	459,6
3	0,152	1013	26,09	8,00	508,98	3	0,125	1005,30	18,84	7,20	457,8
4	0,154	1013	26,09	8,06	512,32	4	0,123	1005,30	18,75	7,14	454,0
5	0,148	1013	26,03	7,90	502,22	5	0,129	1005,30	18,77	7,31	465,0
6	0,156	1013	26,00	8,11	515,56	6	0,130	1005,40	18,93	7,34	466,9
7	0,154	1013	25,99	8,06	512,23	7	0,140	1005,50	18,77	7,62	484,3
8	0,146	1014	25,58	7,84	498,34	8	0,133	1005,50	18,76	7,42	472,1
Avg	0,146	1013,4	25,97	7,83	498,11	Avg	0,129	1005,36	18,80	7,311	464,9

Through the new type of leak rate measurement, also a new security door that controls the entrance of the reactor hall by an automatic system can be verified. It can be also seen a Figure 3 that the leak rate value is improved by this method.

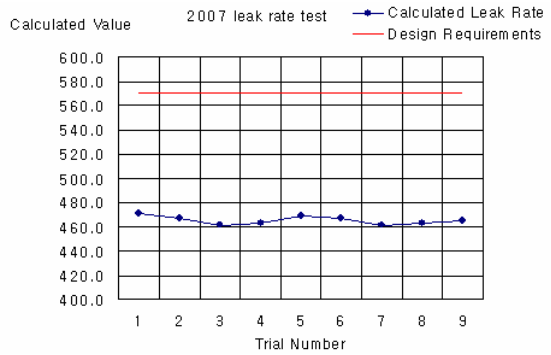

Figure 3 Leak rate measurement value at 2007

3. Conclusion

According to the improved leak rate test, it can be confirmed that the suggested method is more accurate and reliable than the previous method.

In the near future, the way to adjust the flow rate by using a feedback system will be studied and also an alternative that is robust against the unexpected atmospheric fluctuation will be investigated.

REFERENCES

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