Experience on Safety Review of Liquid and Gaseous Effluent Monitoring System for Nuclear Power Plants in Korea – 16237

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ABSTRACT

The liquid and gaseous effluent monitoring systems are important components in order to evaluate and minimize the radiation environmental impacts from Nuclear Power Plants (NPPs). Therefore, licensee should install liquid and gaseous effluent monitoring systems and these systems should be reviewed by regulatory body. In Korea, the criteria of liquid and gaseous effluent monitoring systems for NPPs are stipulated in Nuclear Safety Act (NSA) and subordinate statute, and it is stated in 'Regulation on Technical Standards for Nuclear Reactor Facilities, etc.' that 'Instrumentation shall be provided to monitor related variables, including the following, and systems over their anticipated ranges of normal operations, anticipated operational occurrences, and accident conditions'.

RG-1.97(Rev. 3, 1983) of US Nuclear Regulatory Commission (NRC) was used as criterion for accident monitoring instrumentations for NPPs in Korea. Licensee, however, started to apply RG-1.97(Rev. 4, 2006) as new criterion for accident monitoring instrumentation of the Construction Permit (CP) of new NPPs (Shin-kori Unit 5 and 6). Licensee submitted the report for type selection criteria and this report shows selection criteria of from 'Type A variables' to 'Type E variables'. Licensee of Korea has plans to submit the validation report regarding the criteria for accident monitoring instrumentation during Operation License (OL) and regulatory body of Korea also will conduct safety review of these reports.

A graded approach to establishing a sampling program is required in ANSI/HPS N13.1-1999. Because deaerator release pipe of Shin-kori unit 5, 6 was integrated into condenser vacuum system release pipe, regulatory body reviewed application of a graded approach on this integration. Output of PWR GALE shows that iodine released from turbine building is 0.12% of total iodine release amount and this value is potential impact categories (PICs) 3 in ANSI/HPS N13.1-1999. So, periodic sampler installed in condenser vacuum system release pipe in Shin-kori unit 5, 6 is suitable.

INTRODUCTION

The liquid and gaseous effluent monitoring systems are important components in order to evaluate and minimize the radiation environmental impacts from Nuclear Power Plants (NPPs). Therefore, licensee should install liquid and gaseous effluent monitoring system and these systems should be reviewed by regulatory body.

This paper shows experience on the safety review of the liquid and gaseous effluent monitoring system for NPPs and consists of 2 main parts; (1) nuclear regulation on liquid and gaseous effluent monitoring system in Korea, (2) review of application on

graded approach to sampling and monitoring following American National Standards Institute / Health Physics Society (ANSI/HPS) N13.1-1999.

Nuclear Regulation on Liquid and Gaseous Effluent Monitoring System in Korea

The criteria for liquid and gaseous effluent monitoring system of NPPs are stipulated in Nuclear Safety Act (NSA) and subordinate statute. In Article 11 (Standards for Permit) of NSA, it is stipulated that 'The construction of a nuclear power reactor and related facilities shall conform to the standards as prescribed by the Presidential Decree in order to prevent any harm to public health and the environment caused by the radioactive materials, etc.'. In Article 20 (Instrumentation and Control System) of the 'Regulation on Technical Standards for Nuclear Reactor Facilities, etc.'., which is one of the regulations of the Nuclear Safety and Security Commission (NSSC), it is stated that 'instrumentation shall be provided to monitor related variables, including the following, and systems over their anticipated ranges of normal operations, anticipated operational occurrences, and accident conditions'.

For both Construct Permit (CP) and Operation License (OL) of the NPPs, NPP licensee in Korea should be reviewed by regulatory body, the NSSC and Korea Institute of Nuclear Safety (KINS). In these processes, regulatory body conducts safety review and pre-operational inspection regarding safety system of NPPs including liquid and gaseous effluent monitoring system.

Review of Application on Regulatory Guide-1.97(Rev. 4, 2006)

RG-1.97(Rev. 3, 1983) of US NRC was used as criteria for accident monitoring instrumentation for NPPs in Korea. Licensee, however, started to apply RG-1.97(Rev. 4, 2006) as new criteria for accident monitoring instrumentation of the CP of new NPPs (Shin-kori Unit 5 and 6).

RG-1.97(Rev. 3) describes specific criteria regarding instrumentation for light water cooled reactors. For example, RG-1.97(Rev. 3) provides design and qualification criteria for Category Ⅰ, Ⅱ and Ⅲ, such as equipment qualification, redundancy, quality assurance and etc. And this RG-1.97(Rev. 3) also shows variable, range and purpose for Type A~E. IEEE Std. 497-2002, which is endorsed by RG-1.97(Rev. 4), doesn't provide the specific criteria for design, qualification and performance and it is stipulated in IEEE Std. 497-2002 that licensee shall demonstrations of selection of type, design, qualification and performance of liquid and gaseous effluent monitoring system. Therefore, licensee shall show selection criteria, qualification criteria and performance criteria (range / accuracy / response time / required instrumentation duration / reliability / performance assessment documentation) and design criteria (single failure / common cause failure / independence and separation / isolation / information ambiguity / power supply / calibration / testability / direct measurement / control of access / maintenance and repair / minimizing measurements / auxiliary supporting features / portable instruments / documentation)

Licensee submitted report for type selection criteria and this report shows selection criteria of Type A variables to E variables, safety critical function and reason of selection. According to this report, it is selected that the liquid and gaseous effluent monitoring system for MCR, liquid and gaseous effluent monitoring system from containment building, auxiliary building, Spent Nuclear Fuel (SNF) pool and the other buildings are Type E variables. This selection coincides with definition of Type E variables in IEEE Std. 497-2002. Definition of Type E variables is variables required for use in determining the magnitude of the release of radioactive materials and continually assessing such releases. Licensee of Korea has plans to submit the validation report regarding criteria for accident monitoring instrumentation, such as report for performance assessment, report for design criteria and report for qualification criteria during OL. Regulatory body also will conduct safety review of these reports.

Review of Application on Graded Approach to Sampling and Monitoring following ANSI/HPS N13.1-1999.

ANSI/HPS N13.1-1999 describes the necessity of a graded approach to establishing a sampling and monitoring program. This approach means that sampling method is decided based on the potential that the effluent from a given facility has for contributing to offsite dose. And it is stated in ANSI/HPS N13.1-1999 that 'this approach employs potential impact categories (PICs) that represent dose consequences (e.g., potential effective dose) that may occur assuming effluent attenuation or filtration devices present in the effluent stream have no effect.' Table I shows a Graded Approach to Sampling and Monitoring of ANSI/HPS N13.1-1999.

TABLE I. Graded Approach to Sampling and Monitoring

Potential Impact Category	Monitoring and Sample Analysis Procedures	Potential Fraction of Allowable Limit
1	Continuous sampling for a record of emissions and in-line, real time monitoring with alarm capability; consideration of separate accident monitoring system	> 0.5
2	Continuous sampling for record of emissions, with retrospective, off-line periodic analysis	> 0.01 and ≤ 0.5
3	Periodic confirmatory sampling and off-line analysis	> 0.0001 and ≤ 0.01
4	Annual administrative review of facility uses to confirm absence of radioactive materials in forms and quantities not conforming to prescribed specifications and limits	≤ 0.0001

Deaerator release pipe of Shin-kori unit 5, 6 was integrated into condenser vacuum system release pipe. This integration of both deaerator release pipe and condenser vacuum system release pipe may cause replacement of sampling device, because monitoring and sample analysis procedures are settled based on potential fraction of allowable limit. Output of PWR GALE shows that iodine released from turbine building is 0.12% and this value is PIC 3 in ANSI/HPS N13.1-1999. Because it is stipulated in ANSI/HPS N13.1-1999 that monitoring and sample analysis procedure for PICs 3 is 'Periodic confirmatory sampling and off-line analysis', periodic sampler is just installed for Shin-kori unit 5, 6.

CONCLUSION

Because the liquid and gaseous effluent monitoring system is important components, criteria for this system is stipulated in NSA and this system is reviewed by regulatory body. For more safety, RG-1.97(Rev. 4) and IEEE Std. 497-2002 are used as criteria for accident monitoring instrumentation for NPPs in Korea. Shin-kori Unit 5, 6 will be first unit to apply RG-1.97(Rev. 4). A graded approach to establishing a sampling program following ANSI/HPS N13.1-1999 also is reviewed and periodic sampler installed in condenser vacuum system release pipe in Shin-kori unit 5, 6 is suitable.

REFERENCES

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