Gaseous Tritium Release Reduction by Evaporation at Fuel Building

Minchul Kim

Korea Hydro & Nuclear Power Co., Ltd.
Email: kim.minchul@khnp.co.kr

Background

Hanul unit 1&2 have difficulties with gaseous release of tritium to environment since their amount of gaseous tritium release has been continuously increased. It has been almost reached and once over to their total annual expected gaseous release of tritium. Korea Hydro & Nuclear Power Co., Ltd has conducted a research how to reduce gaseous tritium effluents and what factors should be considered.

Analysis of operation data

Hanul unit 1&2, framatome typed NPPs, have 2 main gaseous effluents pathways, exhaust of reactor buildings and a common stack where gaseous radioactive materials are mixed from reactor buildings, auxiliary buildings and fuel buildings. A common stack plays a main role of releasing gaseous tritium, however, tritium production rate of each individual building has not been informed of. Thus, operation data of Hanul unit 3&4 was analysed to review tritium production rate by respective buildings with the assumption of similar operation conditions. Over the span of 10 years (2003~2012), gaseous tritium was generated by 42.3 % of unit 3 and 35.2% of unit 4 averagely in the fuel buildings. According to USA PWRs' operation experiences of tritium releases, NUREG-0017[1], source of gaseous tritium release was reported 50% refuelling area, 32% auxiliary building and 18% containment building. Although the 77.5% tritium production portion of Hanul unit 3&4 is somewhat higher than USA experiences, it is clear that fuel building is a major source of gaseous tritium. Over the last decade, averaged monthly gaseous tritium release of Hanul unit 1&2 shows highly dependence on season. During summer, tritium release was high, but low for a winter on the contrary. It implies that evaporation control may be the way of gaseous tritium release control in the fuel building and chillers of spent fuel pools(SFP) have not good enough capacity to make the SFP temperature stable regardless of ocean temperature.

In 2005, Electric Power Research Institute proposed an empirical evaporation formula in the fuel building on its technical report [2]. For the application based on operation data, tritiated water from both SFPs were collected on 18 Feb. and 8 May respectively and assayed their specific activities. In addition, temperatures of both SFP and each fuel buildings, and relative humidity of respective fuel buildings were checked. With this information, theoretic tritium release by evaporation was calculated as 1.41E+10 Bq for the 3rd week of Feb. and 1.45E+10 for the 2nd week of May. In the same period, the actual release through the common stack was

2.76E+10 Bq and 3.60E+10. Therefore, theoretic release activities are 51.7% and 40.2% of the actual release, meaning that the empirical formula corresponds with the NUREG-0017 and gaseous tritium release can be reduced by controlling temperature and humidity of SPF and fuel buildings.

Future works

Hanul unit 1&2 has been preparing a gaseous tritium reduction plan which includes replacement of large chillers to make the SFP temperature low especially during summer season, and installation of humidistat to increase humidity of fuel building with careful consideration of effects on the components and equipment in the fuel buildings.

References

[1] US Nuclear Regulatory Commission, Calculation of Release of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWR-Gale Code), NUREG-0017, Rev.1, 1985

[2] EPRI Tritium Management Model, TR-1009903, 2005