Performance Evaluation of NAA Irradiation Holes in Hybrid-Low Power Research Reactor (H-LPRR)

Kyung-O Kim, Gyuhong Roh, and Byungchul Lee

Research Reactor Design Division, Korea Atomic Energy Research Institute, Daejeon, Republic of Korea
E-mail: k5kim@kaeri.re.kr

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Korea Atomic Energy Research Institute (KAERI) has designed the Hybrid-Low Power Research Reactor (H-LPRR) which can be used as a critical assembly and conventional research reactor as well. It is an open tank-in-pool type, of 50 kW thermal power (see Figure 1), and the Neutron Activation Analysis (NAA) is one of the most important applications of H-LPRR. For this, there are eight irradiation holes on the edge of the core, classified into two types: IR (6 holes for RI production) and NA (2 holes for NAA) holes. In order to quantify elemental contents in analytical samples by Instrumental Neutron Activation Analysis (INAA) with $k_0$-standarization method, it is necessary to measure neutron spectrum parameters such as thermal neutron flux, the deviation of the ideal $1/E$ epithermal neutron flux distribution defined as a $(1/E)^{1+\alpha}$ Shape ($\alpha$), and thermal-to-epithermal neutron flux ratio ($f$) for the irradiation holes. In this study, MCNP6 code and MATLAB are used to determine neutron spectrum parameters for the elemental analysis using INAA at two irradiation holes in H-LPRR, and $\alpha$ and $f$ parameters are compared with ones of other research reactors. As a result, it is confirmed that $\alpha$ and $f$ parameters of H-LPRR are 0.107 and 22.1, respectively, and these values are similar with ones of Vietnam (500 kW) & Malaysia (1 MW) TRIGA MARK II and Belgium Thetis (150 kW).

Fig. 1. Conceptual Design of H-LPRR

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