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Regulatory Research Activity on Safety Analysis Methodology for Passive Safety Systems in Korea

Recently, Small Modular Reactors (SMRs) have been actively being developed around the world and many of SMRs adopt passive safety feature as their safety systems. The nuclear industry in Korea is also developing a unique SMR called innovative SMR (iSMR) fully equipped with Passive Safety Systems. (PSSs) In light of these circumstances, KINS has launched a regulatory research project in order to develop a new safety analysis methodology given the PSS characteristics such as weak driving forces and a possibility of the functional failure. In the present paper, we would like to share our research results achieved so far, and potential improvement and its application of the safety analysis on PSS.

As for the achievement, we've developed the reliability informed safety analysis methodology for the PSS. First, several potential factors affecting the performance and may lead to the functional failure of the PSS were identified. Then, the potential factors were incorporated into the REPAS (Reliability Evaluation of Passive Safety System) method as its "critical parameters". Next, the REPAS method with proper failure criteria was applied and the functional failure rate of the PSS was quantified. After that, the REPAS statistical sampling sets highly contributing to the functional failure rate were single out. Finally, the REPAS critical parameters (i.e. some potential factors) included in the REPAS statistical sampling sets are identified as additional parameters for the safety analysis of the PSS.

As for further improvement and possible applications of our safety analysis methodology, items such as identification of additional failure criteria of the PSS in relation to FMEA and stable long-term cooling, a minimum safety margin to avoid the cliff-edge effect, and decision of optimal pre-service/in-service tests condition including appropriate reliability level to support the use of the PSS over the active system is scheduled to be investigated.

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