PASSIVE DESIGN FEATURES FOR APPLICATION TO KOREAN NEXT GENERATION REACTOR

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ABSTRACT

The Korea Next Generation Reactor (KNGR), an advanced light water reactor (ALWR) of 1,350Mwe class, is now being developed by KOPEC and KEPCO to launch into commercial operation in 2007. Future nuclear power plants must be safer, easier to operate and maintain, and cheaper than the current generation reactors and other type electricity production facilities, and these requirements had been reflected in KEPCO's KNGR Utility Requirements Document (URD). A lot of advanced design features (ADF) have been adopted to fully meet the KNGR URD. The ADFs include larger pressurizer, steam generators, four train safety systems (SIS, CSS, EFWS) and their supporting systems, In-containment Refueling Water Storage Tank (IRWST) and Safety Depressurization System (SDS), double containment, severe accident mitigation features (reactor cavity design, hydrogen igniters), and so on. One of these key features is the IRWST in conjunction with SDS. This feature is a major contributor to the reduced core damage frequency and improved severe accident performance of the KNGR, and has not yet been used in any existing nuclear power plants in Korea.

In the events of transients or small break LOCAs with S/G secondary heat removal unavailable, the SDS with the IRWST provides a means of feed and bleed operation to cool the reactor core.

When the SDS valves and pressurizer safety valves (PSVs) open, the high pressure reactor coolant from the pressurizer goes into IRWST. And the discharged flow of air, steam, and water imposes significant hydrodynamic forces on IRWST structures. Therefore the IRWST structures should be designed to withstand this hydrodynamic loads for maintaining the structural integrity and the safety functions of the ESF systems. Thermal hydraulic phenomena imposing the relevant hydrodynamic forces on IRWST structures, such as water jet, air clearing, and steam condensation, has been reviewed. The methodologies and computer programs have been developed to predict the loads due to thermal hydraulic phenomena. The results of preliminary analysis show that water clearing loads are negligible and the maximum air clearing load is 22 psid on the inner wall and the bottom slab near the sparger. Normalized loads on the IRWST submerged boundaries and drag loads on a circular pipe are calculated and the temperatures distribution IRWST is analysed to confirm the cooling capability. Based on the preliminary analysis performed, the transients or small break LOCAs with S/G secondary

hat removal unavailable are estimated, and the adequacy of IRWST system and structure design are evaluated. The analysis results is reflected in the KNGR designs such as the detail design of sparger configurations.