Analysis of MSGTR Events for APR1400 by Means of Best Estimate Thermal-Hydraulic System Code

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Abstract

A multiple steam generator tube rupture (MSGTR) event has never occurred in the history of commercial nuclear reactor operation while single steam generator tube rupture (SGTR) event is reported to occur every two years. As there is no history of MSGTR event, the understandings of transients and consequences of this event are not so much. In this study, a postulated MSGTR event in advanced power reactor 1400 (APR1400) is analyzed using thermal-hydraulic system code. The APR1400 is a two-loop, 1000 MWe, PWR supposed to be built in 2009. MARS1.4 is used in this study. The present study aims to understand the effects of rupture location in heat transfer tubes and selection of affected steam generator following a MSGTR event.

The effects of five tube rupture locations are compared with each other. The comparison shows that the response of APR1400 is to allow shortest time for operator action following a tubes rupture in the vicinity of hot-leg side tube sheet and to allow longest time following a tube ruptures at the tube top. The MSSV lift time for rupture at tube-top is evaluated as 24.5% larger than that for rupture at hot-leg side tube sheet. Also, the MSSV lift time for four cases are compared in order to examine how long operator response time is allowed depending on which steam generator is affected. The comparison shows that the cases for both of two steam generators are affected allow longer time for operator action compared with the cases that a single steam generator is affected. Further more, the tube ruptures in the steam generator where a pressurizer is linked leads to the shortest operator response time.