

Components Effects for the Performance of the Passive Residual Heat Removal System of an Advanced Integral Type Reactor

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Abstract

A set of experiments have been performed on the components effects for the performance of the passive residual heat removal system (PRHRS) for an advanced integral type reactor, SMART-P, by using a high temperature and high pressure thermal-hydraulic test facility, the VISTA facility. In this paper the effects of the gas cylinder system, PRHRS compensation tank, initial filling of PRHRS and the heat loss compensation are investigated.

When the PRHRS is triggered by the accident conditions, during the reference test a two-phase natural circulation flow is properly achieved in the PRHRS loop, which is composed of a steam generator secondary side, a secondary system, and a PRHRS, to remove the decay heat from the primary system.

For the PRHRS tests without a gas cylinder system, the gas space allocated to the primary loop is very limited to three pressurizers and the system pressure in the primary loop decreases very rapidly when compared with the reference test. However, the temperatures in the primary loop decrease more slowly than those of the reference test. It is because the pressure and temperatures are higher in the secondary system than those of the reference test, which is due to a lower natural circulation flow rate and heat removal capacity. One interesting phenomena is that the unsteady flow instability, which occurred during the reference test, does not occur in the present test.

For the PRHRS tests without a PRHRS compensation tank, the gas space allocated to the secondary loop is smaller than that of the reference test. The natural circulation flow rate is similar at the initial stages but its decreasing rate is higher than the reference test at the later stages. The decrease of the pressure and temperatures in the secondary loop

is faster in the present test and the decreases of the pressure and temperatures in the primary loop are also slightly faster.

For the PRHRS tests without an initial filling of the PRHRS lines, the gas space allocated to the secondary loop is larger than that of the reference test. The natural circulation flow rate is similar to the reference test throughout the tests. The peak pressure and the initial temperature drop in the secondary loop are lower and higher, respectively, than those of the reference test.

For the PRHRS tests without a heat loss compensation, the overall PRHRS performance is better than the reference test. The decreases of the pressure and temperatures in the secondary loop are faster than those of the reference test.

The experimental results show that the overall performance of PRHRS is enhanced without PRHRS compensation tank, without initial filling of PRHRS loop, and without heat loss compensation.