INVESTIGATION OF NATURAL CIRCULATION IN EXPERIMENTAL HELIUM LOOP

SLAVOMÍR BEBJAK[1,*], BORIS KVIZDA[1], VLADIMÍR SLUGEŇ[2]

[1]VUJE, a.s., Okružná 5, Trnava, 918 64, Slovak Republic
[2]Institute of Nuclear and Physical Engineering FEI STU, Ilkovičova 3, Bratislava, 81219, Slovak Republic

** Corresponding author email: slavomir.bebjak@vuje.sk*

Among the six reactor concepts of generation IV., the article is focused on the Gas-cooled Fast Reactor (GFR) technology. An essential part of the GFR research is a solution of its safety concept and establishment of heat removal from the core. As an experimental support for evaluation of natural circulation in decay heat removal (DHR) system, the experimental helium loop facility has been built. The helium loop consists of the heat source, represented by vertical electrically heated rods, that assure heating of the helium in the loop up to 520 °C. For the heat removal, a horizontal gas water recuperation heat exchanger with U-tubes is installed. The entire facility is designed for a pressure up to 7 MPa. A set of experimental measurements containing steady state and various transients, such as increase/decrease of the DHR cooling power or simulation of helium leakage from the loop, was performed with the aim to collect a data from real operation. Consequently, a simplified thermo-hydraulic model of the natural circulation helium loop was built up with the purpose to observe the helium flow under various initial and boundary conditions and to predict expected physical phenomena, mainly establishing of natural circulation of helium in a loop and verification of helium velocity and mass flow behaviour. After proving the ability of the thermohydraulic model to represent the steady state qualitatively at the reference parameters of the helium loop (7 MPa, 520 °C), the qualification of the computational model was performed, including validation at the steady state using the measured data on the experimental device of the helium loop. Created and validated computational model of the helium loop, which serves to verify the natural circulation of helium and the ability to remove heat from the GFR in the natural circulation mode contributes to the deepening of knowledge of thermodynamic and hydraulic properties of gas cooled fast reactor technology.

028_abstract_final