Abstract

The thesis presents a new approach to the modeling of thermal-hydraulic phenomena in passive safety systems of an innovative generation III+ Boiling Water Rector. The main idea, which the proposed approach is based upon is the hybrid modeling method. This approach combines the standard modeling methods with the current trends and best practices in the computer modeling; that is with the integration of different codes and data bases. Furthermore, a new model of the thermal-hydraulic phenomena in reactor pressure vessel after a loss of coolant accident was presented in the thesis. This model was developed by the implementation of the object-oriented modeling, which constitutes a part of the proposed hybrid method.

The intention of this work was to propose an alternative method for solving of the thermal-hydraulic issues, which would both, facilitate and optimize the utilization of the current developments in this scope and would address the issues encountered during the modeling with the currently used methods. Both of these aspects as well as other significant benefits of using this method were demonstrated in the thesis.

The objective of the elaboration of the new model of the thermal-hydraulic phenomena in a reactor pressure vessel after a loss of coolant accident was a development of a more accurate and faster model of the phenomena which are important from the viewpoint of the operation of the passive safety systems of a Boiling Water Reactor.

Particularly important outcome of the work are also the synergistic effects of one of the aspects of the hybrid modeling method. Specifically, it was demonstrated that the integration of different models developed with different languages and characterized with different advantages and disadvantages allows for an enhancement of the capabilities of both models. This constitutes an important aspect in the context of the further development in the scope of computer modeling.

All results presented in the thesis were verified experimentally or by their comparison with the calculations of other codes recognized as the current state-of-the-art in their scope. The empirical data for the validation of the models were obtained during the cooperation with Framatome GmbH in Erlangen, Germany which owns the INKA test facility which represents the KERENA reactor.