Complex modeling of VVER-1000 using MCU-ATHLET-FLOWVISION.

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Nowadays modelling of physical processes is very spread in all fields of physics. It is possible because of high capacity of computing powers and capability of parallel computing. We can observe a trend to more detailed description of simulated systems and growth of calculation schemes complexity. Scientists understand that the feedback of related physical processes occurring simultaneously could have significant impact on the results of modelling and should be solved in the scope of multiphysics.

That kind of problems exists in reactor physics. It is vital to perform complex modelling of processes occurring in a fuel core of a nuclear reactor, especially during the design of the next generation nuclear power plants. It is not possible to justify safety of the power reactor without complex calculations.

In this paper, we proposed a test case for precise coupled neutronics-thermal hydraulics calculation of VVER-1000 reactor using MCU, ATHLET and FLOWVISION codes. MCU is a general-purpose stochastic neutron-physical code based on the Monte-Carlo method and characterized by large time of calculation, as well as CFD codes. Because of that system code ATHLET was used as a thermal hydraulic code in iterative scheme. In the end of the calculation we used CFD code FLOWVISION in order to enhance the precision and verify CFD model for the further complication of geometry. The dependency of thermal hydraulic characteristics on different neutron parameters, geometrical simplifications, etc. was analyzed. We showed the possibility of a reasonable combination of neutron Monte-Carlo codes and thermal-hydraulic system and CFD codes on the example of VVER-1000 reactor.

It is assumed that the test case will be used for simulation of VVER-1000 reactor in accident-related regimes and for codes cross-verification. The obtained experience and developed coupling program (PERL script) will be used to create coupled schemes for complex modelling of generation IV nuclear reactors.

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