Virtually all currently used nuclear reactors are cooled usually by different liquid substances or gases flowing around the reactor core and in turn removing heat generated inside reactor. The heat generated in the reactors, is used in order to generate steam that drives the turbines, which are generating electricity. The most commonly used reactor coolant is water, but there are also technologies using liquid metals or gases. The coolant - regardless of its type - does not flow smoothly through the space inside the core. The actual flow is full of disturbances in the form of local turbulence or oscillations. We know the phenomenon well from everyday life: when turbulence occurs in the pipes of the home water supply network, usually we hear characteristic, often unpleasant sounds. They are taken from the vibrations of the pipe material, which are induced by swirls. In nuclear reactors, first of all, very important aspect is an unevenness caused by turbulence in cooling the fuel elements and walls of the reactor vessel. Their appearance may lead to large local temperature and pressure differences, and, as a result, to stresses leading to faster material fatigue, which may result, for example, in the appearance of undesirable micro-cracks. The material from which the installation is made must be resistant to such phenomena. One should also strive for the scale of unfavorable processes to be as small as possible.

Nowadays, a good prediction of mentioned by means of turbulences complex three-dimensional phenomena is a challenge for the researcher. The models which they are using need to be validated and improved accordingly. It is important in order to properly describe flow and heat transfer inside fuel rod bundles with the use of complicated numerical simulations.

The main objective of the research proposed in this project is to validate and/or calibrate the available and commonly used turbulence models. Implementation of this project will allow us to determine how good are the available low order turbulent models in order to simulate flow behaviour and heat transfer in a tightly spaced bare rod bundles. In consequence, the rules for “good practices” will be set up in respect to the numerical prediction of flow and heat transfer in such flow configurations. Thank to this a scientific community and nuclear engineers will get an improved tool enabling to provide more reliable results.