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Possibility of Simulating Natural Circulation in Fast Neutron Reactors Using a Light Water Test Facility

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The paper evaluates the possibility of modeling the heat transfer phenomena in a liquid-metal coolant using a light water test facility. It considers the natural circulation of the coolant in the upper plenum of the fast-neutron reactor. A large nuclear power reactor (like the BN-1200 project) was selected as a reactor installation to be modeled. As the referent one was accepted the IPPE B-200 facility.
To validate the model, the similarity theory and the "black box"method were used. The paper uses the experience of a number of researchers in this field, in particular, the accepted assumptions which do not result in serious loss in modeling accuracy. The governing criteria of similarity were estimated based on the fundamental differential equations of convective heat transfer, so were the conditions under which it is possible to model sodium coolant by using light water with adequate accuracy. The paper presents the scales of the parameters used for the model-reactor comparison.
The introduction presents the paper purpose, considers the relevance of this topic, the utilized approaches – the similarity theory and the "black box"method, their limits to applicability. The general restrictions of the water test facility structural features are provided.
The first section provides the governing criteria derivation from the fundamental equations.
The second section includes obtaining the scales of the parameters.
The third section presents estimating the water test facility characteristics depending on its geometric scale.
The conclusion about the possibility of the water-based modeling the liquid-metal coolant behavior is presented.
The paper includes 2 pictures, 2 tables, 23 references.

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