METHOD OF HIGH-TEMPERATURE TESTS OF MATERIALS IN THE CONDITIONS OF MODELING A SEVERE NUCLEAR REACTOR ACCIDENT

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Currently, the further development of the nuclear industry is directly related to the introduction of new promising materials. In this regard, specialists are faced with the task of providing promising nuclear installations under development with new materials. One of the most relevant studies today is the influence of intermetallic inclusions in zirconium alloys on their radiation and corrosion resistance, as well as studies of various types of oxide ceramics for their use in promising reactor installations.

At the same time, new promising materials should also be tested in the case of a severe accident with the melting of the reactor core and the formation of corium. The purpose of such tests is to study the interaction of new candidate materials with corium for the subsequent development of recommendations for the management of a severe accident at a nuclear power plant.

At the same time, experiments were conducted to study the interaction of corium with low-melting metals. A method of high-temperature material testing has been developed. Thus, this paper describes a method for conducting high-temperature tests to study the interaction between corium and low-melting metals in condition of modeling a severe accident. Experiments were conducted on a small-scale condition at the VCG-135 test bench [1] and on large-scale conditions at the «Lava-B» facility [2].

The feature of conducting experiments with low-melting metals was that in the process of preparing for the experiments it was necessary to ensure the conditions of a severe accident with the core melting by liquid corium obtaining and to organize the interaction of the studied metal with liquid corium. This means the interaction between the materials under study was unacceptable before liquid corium obtaining.

The liquid corium obtaining on two facilities is implemented by induction heating. At the same time, the special devices for metal discharging into liquid corium were designed and manufactured to organize the interaction of the studied metal with liquid corium. The design of these devices and the scheme of metal discharging into liquid corium distinguishes due to the different scale of experiments and consequently, the different design of the VCG-135 test bench and the Lava-B facility.

VCG-135 test bench

«Lava-B» facility

Fig.1. Appearance of the VCG-135 test bench and «Lava-B» facility

Thus, the developed method can be used to study the interaction of corium with various structural materials in a severe accident. This method can become an effective tool for selecting candidate materials for the possibility of their application in promising reactor installations.

REFERENCES

[1] K. Plevacova, C. Journeau, P. Piluso and et.al., "Zirconium carbide coating for corium experiments related to water-cooled and sodium-cooled reactors,". Journal of Nuclear Materials. vol. 414, no. 1, pp. 23-31, July 2011, doi: 10.1016/j.jnucmat.2011.04.055

[2] Y. Maruyama, Y. Kojima, M. Tahara and et.al., "A study on concrete degradation during molten core/concrete interactions," Nuclear Engineering and Design. vol. 236, no. 19-21, pp. 2237-2244, October 2006, doi: 10.1016/j.nucengdes.2006.03.055