USSR Position Paper for the Specialists' Meeting
on
Thermal Stratification in Sodium

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High values of temperature and a high rise of coolant temperature in a core, as well as physical properties of sodium require much attention to be paid to the problem of coolant mixing to ensure uniform temperature within mixing chambers and other components of a liquid metal circuit. A presence of a considerable thermal stratification of coolant may affect, in a certain way, the working capabilities of structures and components which contact with the coolant. Temperature pulsations may arise at the interface of coolant flows with different temperatures which would result in additional cyclic loads on the structures. The thermal stratification of sodium could also hamper development of natural circulation under decay heat conditions. On the other hand, it is possible to use the thermal stratification phenomenon in a positive way, for example, to reduce the temperature drop at the walls separating "cold" and "hot" coolant in a reactor vessel.

The problem of adequate coolant mixing and flow pattern optimisation becomes more significant while considering pool type fast reactors. Within a vessel of this reactor type there are considerable bulks of coolant at different temperatures. Because of many-sided design requirements certain difficulties exist in the problem of ensuring sufficient mixing of the coolant at the outlet of the core, radial blanket, in-pile fuel storage and in-pile neutron shielding. For the BN-600 reactor this problem is considered in a separate paper to be presented at this specialists' meeting.

In the framework of the R and D activities carried out to justify fast reactor design solutions a proper attention is given to investigations of the coolant flow pattern within plena and in those sections of pool type reactor, where the coolant flow takes place. In this connection it should be noted that, up to now, we did not obtain any clear evidence of the presence of a pronounced thermal stratification of sodium within reactor mixing chambers under normal operating conditions. The conclusion may be drawn on the basis of our experiments and design experience that there are certain gradients of temperature and inefficient mixing of coolant flows with different temperatures within the chambers (both "hot" and "cold" ones). All these factors to a certain degree complicate a reactor operation. However, from our point of view, the main point in the problem of arranging an "optimum" coolant flow pattern within the chambers is to insure the stability of coolant motion in the chambers (including flows with different temperatures) by means of special design solutions based on results of experimental and calculational studies. We believe it is a possible instability of coolant flow that is the most important factor influencing on temperature distribution within structures and components. In this connection, coolant flow in all reactor chambers and cavities should be well arranged and stable, including natural convection flows. We begin to pay more attention to investigation of these problems, and a certain understanding has been reached. By means of rather simple design changes the flow pattern can be arranged in a desirable fashion. Different kinds of fins, baffles, which limit flow, and natural convection against the general background of forced circulation could be used for this purpose. Analyses of such type have been performed. The experience of operating the BN-600 reactor has shown that in some cases temperature instability in sodium flow can be eliminated if the regime of establishing circulation is chosen appropriately. The Soviet delegation believes that the subject of this meeting is very important, the topics suggested for discussion are of great interest. Some of the problems to be discussed are dealt with in our special paper to be presented at the meeting.