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ABSTRACT

Molten Salt Technology for Reactor Applications

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Molten fluoride salts have been studied as fuel as well as coolant of nuclear reactor systems in the past, and a considerable development program has been performed at Oak Ridge National Laboratory (ORNL). In addition, clean molten salts are a candidate to transfer heat from a VHTR to a thermochemical hydrogen production plant. In the U.S., the VHTR and hydrogen production are high-priority activities. Finally, the fusion community also considers molten fluorides an important option for use as coolants and tritium breeding media for fusion power chambers. At ORNL, the present research activities include the operating molten-salt corrosion test loop to develop clean molten salts for heat transfer, such as between a VHTR and a hydrogen production plant, and the development of a conceptual design of a modern MSR as part of the GenIV.

Presently there is a growing interest in these and other applications of molten salts. The renewed interest in U.S., Europe, and Japan in molten salt coolants and the MSR concept in the frame of GenIV and the P&T studies has led to new research programs in several institutes, among which the Institute for Transuranium Elements (ITU) of the JRC. ITU's research activities on molten salts for reactor technology are emerging and focus on the assessment of the physico-chemical properties and the calculation and measurement of phase diagrams of fluoride salts. Fuel salts for Th/U fuel cycles and transuranium transmutation cycles are studied as well as coolant salts.

The objective of the present project is to enhance the collaboration between ORNL and ITU through a common work program. The activities will be supported by the institutional funds of both organizations. Moreover, both organizations are involved in the MOST project, a Shared Cost Action of the 5th Framework program of the European Union. The extent and scope of efforts described here will also depend on an eventual follow-up project to MOST.

A total of six tasks have been identified, of which four represent activities that will strengthen the scientific basis for molten salt technology (tasks 1, 3, 4 and 5) and one (tasks 2) addresses the important technological issue of salt cleaning. A firm scientific basis is essential for molten salt technology, as recent developments indicate higher demands due to the higher operating temperatures and larger temperature gradients, which have an impact on behaviour of the salt itself and the structural materials of the reactor primarily as a result of corrosion, one of the key issues.