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CIRCE-ICE EXPERIMENTAL ACTIVITY IN SUPPORT OF LMFR DESIGN

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The CIRCE-ICE experimental facility, designed and hosted at ENEA Brasimone R.C., is a large pool multi-purpose integral test facility devoted to support the Thermal-Hydraulic design of Gen IV Liquid Metal Fast Reactor.

Thermal stratification phenomena in HLM pool may induce significant thermal loads on the structure in addition to existing mechanical loads. Moreover, vertical temperature gradient in accidental scenario conditions could opposes to the establishment of natural circulation which is a fundamental aspect for the achievements of safety goals required in the GEN-IV roadmap.

In this work the LBE temperature field of the pool is investigated during a series of experiment aimed at simulating a protected loss of heat sink with loss of flow. Obtained results are here presented and discussed.

The other important aspect here considered is the chemistry of the coolant. This topic is deeply connected with thermal-hydraulic behaviour of the pool in fact, the oxygen distribution in the coolant is strongly affected by the thermal stratification, posing relevant issues related to the coolant chemistry control and corrosion of structural materials in the pool.

Concurrently with the thermal hydraulic experimental activity, the calibration of various potentiometric oxygen sensor was performed in the chemical laboratory of ENEA Brasimone R.C. in oxygen-saturated liquid LBE and Lead. In particular, different oxygen sensor with various reference systems (Pt-air (gas), Bi/Bi₂O₃ (liquid) and Cu/Cu₂O (solid)) were manufactured and their performances investigated in a wide range of temperature. Finally, different zirconia electrolytes: Yttria Partially Stabilized Zirconia (YPSZ, with ≈ 5 mol. % of Yttria) and Yttria Totally Stabilized Zirconia (YTSZ, with ≈ 8 mol. % of Yttria) were tested. In this work experimental measurements in the temperature range 160-550 °C are reported and collected data compared with the theoretical expected values.

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