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Development of Sensors for High-Temperature High-Pressure Liquid Pb/ Pb-16Li Applications

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Liquid Lead Lithium (Pb-16Li) is of primary interest as one of the candidate materials for coolant fluid and tritium breeder in liquid metal blanket concepts relevant to fusion power plants. For effective and reliable operation of such high temperature liquid metal coolant systems, monitoring and control of critical process parameters like pressure, level, temperature and flow is essential. However, high temperature operating conditions coupled with the corrosive nature of Pb-16Li severely limits the application of commercially available diagnostic tools. This paper illustrates indigenous test facility designs and experimental methods used to develop non-contact configuration radar level sensor and wetted configuration diaphragm seal pressure sensors for high temperature, high pressure liquid Pb and Pb-16Li. Calibration of these sensors at high temperature between 380C-400C and high pressure upto 10 bar was performed. Reliability and performance validation were achieved by continuous long duration testing of sensors in liquid Pb and liquid Pb-16Li environment for over 1000 hour. Estimated error for radar level sensor lies within ± 10 mm and estimated error for pressure sensors lies within 1.1% of calibrated span over the entire test duration. Results obtained and critical observations from these tests are presented in this paper.

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