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#8-286 Experimental study of boron nitride thermowell geometry effect on temperature measurements at high temperature of liquid metal oxide corium.

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The Severe accident experimental lab of CEA IRESNE in Cadarache (LEAG) is a laboratory whose main mission is to increase the knowledge of corium behavior and thermophysical properties and performs experiments on its PLINIUS platform. "Corium"refers to melted core materials and by extension, to other melted materials gradually included all along the severe accident in the nuclear power plant. In this objective, LEAG realizes experiments at high temperature (1500℃-3000℃) with prototypical corium, composed of depleted uranium dioxide and other oxides from the basement but also metals from the vessel. At these very high temperatures, we use type C thermocouple that are able to measure up to 2300℃. However, we need to use a sheath to protect it from the corium melt otherwise it will be rapidly damaged or melt. For corium mostly composed of oxides, tungsten thermowell is a good way to protect the thermocouple. However, when there is a significant fraction of metal in the corium, it is not possible to use tungsten because of a low melting point eutectic between metal and tungsten. That is why LEAG has selected a new material for thermowell: boron nitride, chosen for its compatibility with metal at high temperatures. In this paper, we will present the study of the impact of the geometries of the boron nitride thermowell, including thickness and immersion length, on measurement accuracy. In the first series of experiments, a type K thermocouple was covered with a boron nitride thermowell and placed inside a tube furnace. It was heated up to 500℃ and we varied the length (25 mm and 50 mm) and the thickness (2 mm, 3.5 mm and 5 mm) of the thermowell. In the second series of experiments, the parameters were the same, except that we used a bared type C thermocouple and carried out some experiments with a tin load in the crucible. The third series of experiments was carried out with type K thermocouple in the VITI advanced facility of the PLINIUS platform with three configurations: without crucibles, with no load in the crucibles and with tin load in the same crucibles. The fourth series of experiments was also carried out with the crucible in the VITI advanced facility but with type C thermocouple allowing to study new metal: copper with melting point at 1085℃. The study underscores the necessity of considering thermowell geometries in the measurement of temperature. The finding on the VITI experiment highlights that the immersion length has a greater impact than the thickness.

Primary author: DENOIX, Arthur (CEA Cadarache)

Co-authors: Ms TISSOT, Solène (CEA Cadarache); Dr DELACROIX, Jules (CEA Cadarache); Dr BOUYER, Viviane (CEA Cadarache)

Presenter: DENOIX, Arthur (CEA Cadarache)

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