

## French-Japanese experimental collaboration on fuel-coolant interactions in sodium-cooled fast reactors

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Fuel-coolant interactions (FCI) are important phenomena occurring in the event of core disruptive accidents in sodium-cooled fast reactors (SFR). A new phase of experimental research into FCIs has been launched through a collaboration between French and Japanese organisations. Bespoke high-speed, high-resolution X-ray imaging at the JAEA MELT facility has enabled successful visualisation, in the highest resolution achieved to date, of the quenching of a jet of molten steel in a pool of molten sodium. The FCI experimental program is accompanied by calibration tests undertaken using “phantom” models, which are necessary for detecting imaging artefacts, such as vignetting and optical distortion, and assisting in the development of algorithms to reconstruct melt fragments in 3D from X-ray attenuation data. The CEA have developed SPECTRA (Software for Phase Extraction and Corium TRacking) for processing the images acquired at the MELT facility, enabling the segmentation of melt and vapour phases from the raw images and the tracking of discrete melt fragments traversing the imaging window. The first experiment at the MELT facility under this collaboration revealed evidence of extensive crust formation at the interface between the melt and sodium. Rapid vaporization of entrained sodium appeared to lead to fracturing of the crust during a thermal fragmentation event, resulting in a debris population containing both fine fragments and large frozen jet shells. JAEA have now commissioned a new MELT test section, roughly 10-times greater in sodium capacity, to observe the interaction at increased scale. In parallel, the SERUA (Sodium boiling Experimental Ring for Understanding of fuel-coolant interAction) facility is currently being developed by the CEA to investigate film-boiling heat transfer at the interface between corium droplets and molten sodium, in support of computational research into FCIs in sodium.

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