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## #06-66 The VINON-LOCA test facility: exploring the LOCA phenomenology through an out-of-pile thermal sequence on irradiated pressurized fuel rod

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Since the Halden loss-of-coolant accident (LOCA) test series IFA-650, a major safety interest has raised for Fuel Fragmentation, Relocation and Dispersal (FFRD) during a LOCA sequence. Besides the characteristics and the behavior of the fuel ejected from the rod after the clad burst, the occurrence of the ballooning, of the fuel fragmentation and of the possible fuel relocation within the rod before the clad rupture is still to be investigated. For this purpose, the VINON-LOCA program is devoted to perform Out-Of-Pile heating tests on irradiated repressurized fuel rod, in the framework of a trilateral agreement between EDF, Framatome and CEA.

The experimental set-up is implemented in a hot cell of the LECA-STAR facility of the IRESNE Institute of CEA, at the Cadarache research center. After a thermal reconditioning phase at 300°C, the thermal transient sequence consists in a ramp test (typically 5°C/s from 300°C to 1000°C) performed in an induction furnace under an inert gas circulation. The tested rodlet is initially pressurized at around 50 bar (ambient conditions) and equipped with thermocouples attached to cladding (rather than welded) for monitoring the clad surface temperature.

One of the specificity of the VINON-LOCA experiment is the online gamma measurement systems: the expected ballooned region is examined both with a classical collimated gamma spectrometry station and with an innovative 2D fast gamma imaging system to have on-line measurement of fission product activity (specifically developed for this application with CEA/DRT). Another gamma spectrometry station targets the experimental rodlet plenum region in order to estimate Fission Gas Release (FGR). In this region, the gas composition is also measured online with an acoustic sensor (developed by the IES Electronic Institute at Montpellier) coupled to pressure and temperature on-line measurements. . In addition, FGR after clad failure is addressed thanks to both online and post-test gas analyses (microchromatography, online gamma spectrometry, gas sampling). Pre and post-test characterizations of the rod include in situ gamma scanning (i.e. with the rod still in the furnace) using the capabilities of the collimated spectrometry gamma station. Additional measurements are performed on a dedicated instrumented bench: gamma scanning performed with a better accuracy, possibly gamma emission tomography, and laser diameter measurement. The fuel fragments ejected from the rod are collected, weighted and sieved after the test in order to evaluate their size distribution.

An extensive and substantial qualification campaign has been performed for validating the test protocol and conditions and for qualifying the instrumentation. It has included tests on an out-of-cell twin mockup, tests on dummy inactive rods in the hot cell, and was completed by some preliminary modellings and calculations. This allowed achieving successfully the first experimental qualification test of the program end of 2019 on irradiated UO<sub>2</sub>. A second qualification test is planned in 2021.

This contribution will highlight the experimental set-up and its associated instrumentation, illustrated by some results issued from the qualification campaign and preliminary tests.

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