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#4-75 From Prototype to Production: Industrialization and Application of the Libera MONACO 3 Neutron Flux Monitoring System

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From 2020 to 2023, CEA Cadarache and Instrumentation Technologies collaborated on the industrialization of the Libera MONACO 3 (Multichannel Online Neutron Acquisition in Campbell mOde) neutron flux measurement system for research reactors. This instrument provides four independent input channels, enabling data processing across a broad operational range, and can be used with Fission Chamber (FC) detectors. The signal from the FC detector is initially processed by the frontend, which includes: a transimpedance preamplifier unit that converts current pulses from the detector into voltage pulses; a high voltage unit that can polarize the detector with either positive or negative voltage up to ±900 V; and a current meter unit capable to measure up to ±1 mA. The signal is digitized by ADCs and further processed within the FPGA, where additional functionalities such as Pulse Height Analysis and signal statistics are computed. A graphical user interface on a local PC provides real-time system monitoring and control. Neutron flux monitoring can be performed in pulse, Campbell, and current modes in parallel, covering the full reactor dynamic range.

The outcome of the collaboration between CEA Cadarache and Instrumentation Technologies were two prototypes. During the tests and validation of the two prototypes, several hardware, software, and GUI improvements were identified. For this reason, and industrialization phase started in June 2023 to get to an industrial design that can be produced in series. A first series of instruments was produced in 2024, with the first five instruments delivered to CEA Cadarache. An additional instrument was produced as an internal unit, dedicated to conducting measurements at various research reactors, foreseen at IJS in Slovenia and SCK-CEN in Belgium.

Some preliminary tests with the industrial version of the instrument were performed at the TRIGA reactor at IJS and confirmed the system's ability to measure neutron flux across the full operating range in counting mode. Some additional tests were also performed using CVD diamond and SiC detectors, broadening the applicability of the instrument to fusion reactors.
In this paper, an overview of the industrialized system is provided, including the improvements introduced before the series production. Additionally, the measurement results from the above-mentioned campaigns are presented.

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