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#4-177 Report on TESCA irradiation of optical sensors and tests of glasses

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Thanks to their remote sensing capabilities and compact size, Fibre Optic (FO) sensors are exceptionally well-suited for in-pile experiments in Materials Testing Reactors (MTRs) where space is limited. Their lightweight design reduces gamma heating, minimizing thermal effects. These sensors can measure a large range of physical parameters—including strain, displacement, vibration, pressure, and temperature—using various optical measurement principles. Testing under irradiation and representative conditions is essential for qualifying sensor prototypes. The TESCA irradiation campaign, conducted from November 16 to December 17, 2023 (one reactor operating cycle) in the SCK.CEN BR2 reactor, enabled testing of optical sensors at different development stages under intense radiation: fast neutron fluence (E > 1 MeV) of 1 to 2 x 10^{19} neutrons/cm² and gamma doses of about 5 GGy. Our sensors and experiments were situated in the in-pile sections of three needles, constrained by a reduced diameter (9 mm) due to auxiliary electrical heating arrangements surrounding the dedicated volume, used to regulate temperature despite reactor power and gamma heating fluctuations. TESCA facilitated on-line testing of Fabry-Perot extensometers, and miniature, non-contact, high-temperature optical pyrometry sensors. We also conducted tests on glasses to collect data on physical parameters—such as dimensional changes, optical attenuation, and refractive index shifts under irradiation—critical for developing a chromatic confocal measurement sensor. These tests required the development of specialized sensors for glass measurements. We will present the effective irradiation and temperature conditions (ranging between 250℃ and 500℃). Because all sensors are temperature-sensitive, it was crucial to either maintain stable temperatures or accurately monitor them to assess the impact of radiation on sensor response stability at constant load or on glass parameters. Brief temperature jumps were also applied to vary the load and test sensor accuracy.
An overview of results from monitoring the various sensors and experiments throughout the irradiation cycle will be provided. Additionally, glass samples irradiated in one of the three needles were retrieved for post-irradiation measurements to complement the online data.

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