High temperature fission chambers – an overview of EXOSENS legacy and development activities

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In recent decades, the global drive toward decarbonization has significantly accelerated interest in next-generation nuclear technologies, particularly Advanced Modular Reactors (AMRs) and Small Modular Reactors (SMRs). Whilst these reactor designs promise enhanced safety, flexibility, and economic viability, they also introduce new technical challenges, especially regarding their instrumentation. Many AMR / SMR designs involve core and / or coolant temperatures exceeding those of traditional reactors, often reaching or surpassing 600 °C. These increased operational demands have created a critical need for sensors capable of withstanding high-temperature environments, specifically in the range of 350 °C to 600 °C (662 °F to 1112 °F), and extending into very high-temperature, exceeding 600 °C (1112 °F). Among these, neutron flux detectors are of critical importance, with their implementation essential for reliable reactor monitoring and control; directly contributing to the safety, stability, and efficiency of reactor operation.

Exosens—bringing together the heritage and expertise of Photonis and Centronic under a single entity—stands at the forefront of this challenge. With a combined legacy of over 70 years in neutron detection and radiation instrumentation, both entities have long delivered high-reliability sensors, including high temperature fission chambers, qualified for operation at temperatures up to 600 °C, and more – with some designs having been tested up to 850 °C. These detectors have served in various reactor platforms globally, including the Advanced Gas-cooled Reactor (AGR) fleet in the UK and Phénix and Superphénix Sodium Fast Reactors (SFR) in France.

As the requirements for AMRs and SMRs evolve, Exosens is advancing its development roadmap with two main goals: extending its current portfolio to provide in-core and ex-core solutions for high temperature applications on one hand, and secondly, producing detectors capable of withstanding the harshest operating temperatures current reactor designs pose. In this presentation, we will review the

progress of current programs within Exosens, and highlight how the combined expertise of Photonis and Centronic uniquely position us to support the evolving needs of the nuclear energy sector.