

# Overview of Current High-Temperature Fission Chamber Activities

Providing Safe and Reliable Detectors for In-Core & Ex-Core Instrumentation of SMR / AMR

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A LEGACY OF KNOW-HOW...

PHOTONIS

CENTRONIC

Photonis and Centronic Ltd have been historically manufacturing and supplying high quality neutron detectors for research and power reactors worldwide.

In particular, AGR fleet in the UK 1 and SFR reactors 2 Phénix Superphénix) in France required fission chambers for severe irradiation conditions, up to 1100°F (600°C) Some designs where even tested up to 1550°F (850°C).

TO FACE TODAY'S CHALLENGES...

EXOSENS

REVEAL THE INVISIBLE

The global drive toward decarbonization has significantly accelerated interest in AMR and SMR in recent decades, often involving core and coolant temperature reaching or surpassing 600°C.

As the requirements evolve, EXOSENS is advancing its development roadmap to extend its current portfolio of solutions to very high temperature - namely above 600°C.

FROM STANDARD 600°C-RATED HIGH-TEMPERATURE FISSION CHAMBERS

CFUE

0.001 - 0.01 cps/nv

Ø 7 mm

CFUX

0.01 - 0.1 cps/nv

Ø 18 mm

FC167

0.14 cps/nv

Ø 25.4mm

CFUC

0.6 - 1 cps/nv

Ø 48 mm

TOWARDS VERY HIGH TEMPERATURE FISSION CHAMBERS ABOVE 600°C

In-House Testing Capabilities

- ♦ Ovens up to 950°C
- ♦ Fixed and mobile neutron source
- ♦ Wide range of electronics to fully characterize the fission chamber

Mobile neutron source

Oven

Combined neutrons & temperature set-up

ENGINEERING ACTIVITIES

Thermal Treatments

- ♦ Uranium Deposit
- ♦ Active Volume

» Outgassing Limitation

Tight-Seal Parts

- ♦ Metal-to-Ceramic Improved Designs

» Prevent Discharges

Connectors

- ♦ Design Adaptation
- ♦ Material Change

» Preserves Pin/Socket Connection

RESULTS

Fully operating FC132 processed up to 850°C

Improved CFUE design tested at 550 °C, with a 800 °C target

Prototype 2

Prototype 1

Reference

Radiation & temperature resistant HN connector up to 600 °C

THE PATH REMAINING

- ♦ In-house neutron + temperature tests on current / improved designs
- ♦ Experimental reactors combined neutron + temperature tests on current / improved designs

<sup>1</sup> – M.Hodgson et al., “Revalidation of mature high temperature fission chamber detectors”, Proc. Int. Conf. 5th G4SR, Canada (2024)

<sup>2</sup> – J.P. Trapp et al., “High temperature fission chambers: state-of-the-art”, OECD, (1996)