

Overview of Current High-Temperature Fission Chamber Activities

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

*Created for the National Organization of Test, Research, and Traning Reactors Conference 2025

A LEGACY OF KNOW-HOW...





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...

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

 $0.01 - 0.1 \, \text{cps/nv}$ Ø 18 mm

FC167

0.14 cps/nv Ø 25.4mm

CFUC

0.6 - 1 cps/nvØ 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

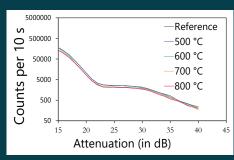
Tight-Seal Parts

- Metal-to-Ceramic Improved Designs
- >>> Prevent Discharges

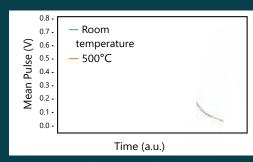
Connectors

- Design Adaptation
- Material Change
- >>> Preserves Pin/Socket Connection

RESULTS



Fully operating FC132 processed up to 850°C



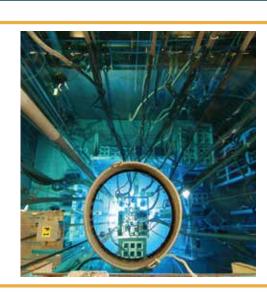
Improved CFUE design tested at 550 °C, with a 800 °C target



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



- ¹ M.Hodgson et al., "Revalidation of mature high temperature fission chamber detectors", Proc. Int. Conf. 5th G4SR, Canada (2024)
- ² J.P. Trapp et al., "High temperature fission chambers: state-of-the-art", OECD, (1996)