

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...

EXCSENS 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

CFUF

0.001 - 0.01 cps/ns Ø 7 mm CFUX

0.01 - 0.1 cps/ns Ø 18 mm FC167

0.14 cps/ns Ø 25.4mm CFUC

0.6 - 1 cps/ns Ø 48 mm



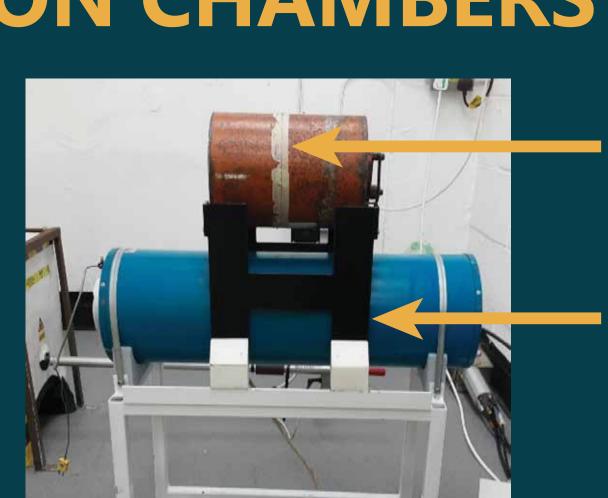


TOWARDS VERY HIGH TEMPERATURE FISSION CHAMBERS ABOVE 600°C

Ovens up to 950°C

In-House Testing
Capabilities

- Fixed and mobile neutron source
- Wide range of electronics to fully characterize the fission chamber



Mobile neutron

source

set-up

Oven

<u>Combined neutrons</u>

<u>& temperature</u>

ENGINEERING ACTIVITIES

Thermal Treatments

- Uranium DepositActive Volume
- >>> Outgassing Limitation

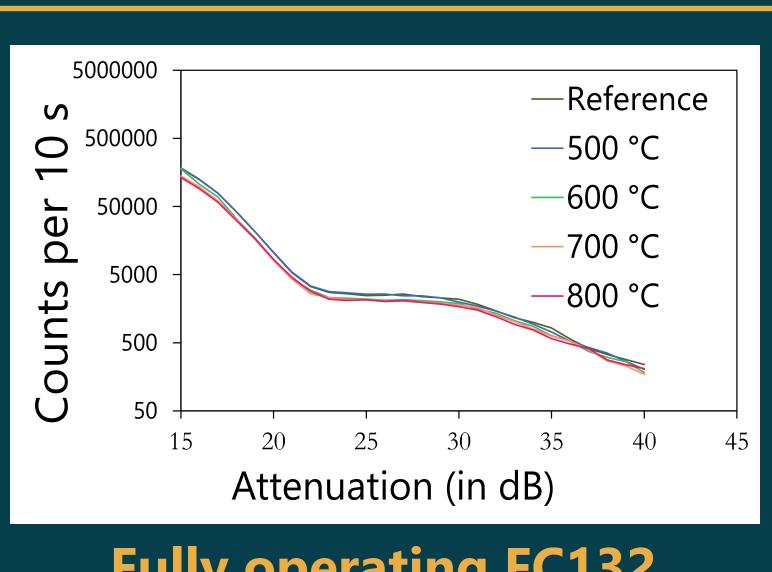
Tight-Seal Parts

- Metal-to-CeramicImproved Designs
- >>>> Prevent Discharges

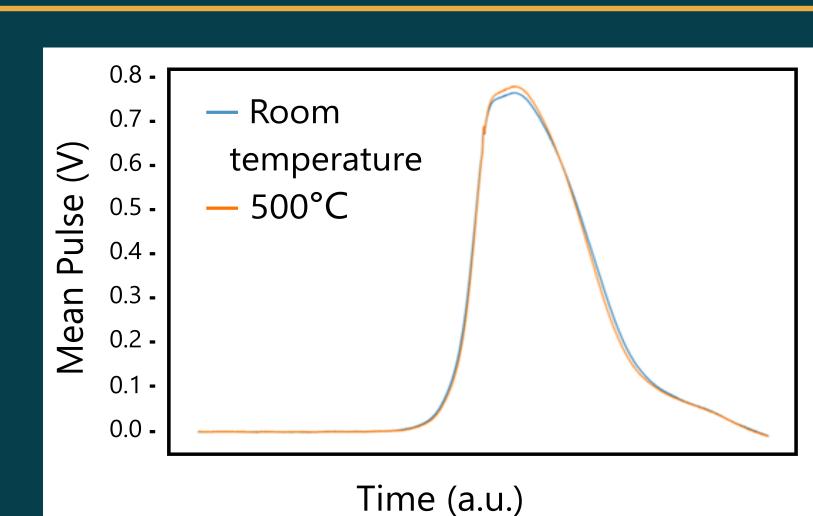
Connectors

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

RESULTS



Fully operating FC132 processed up to 850°C



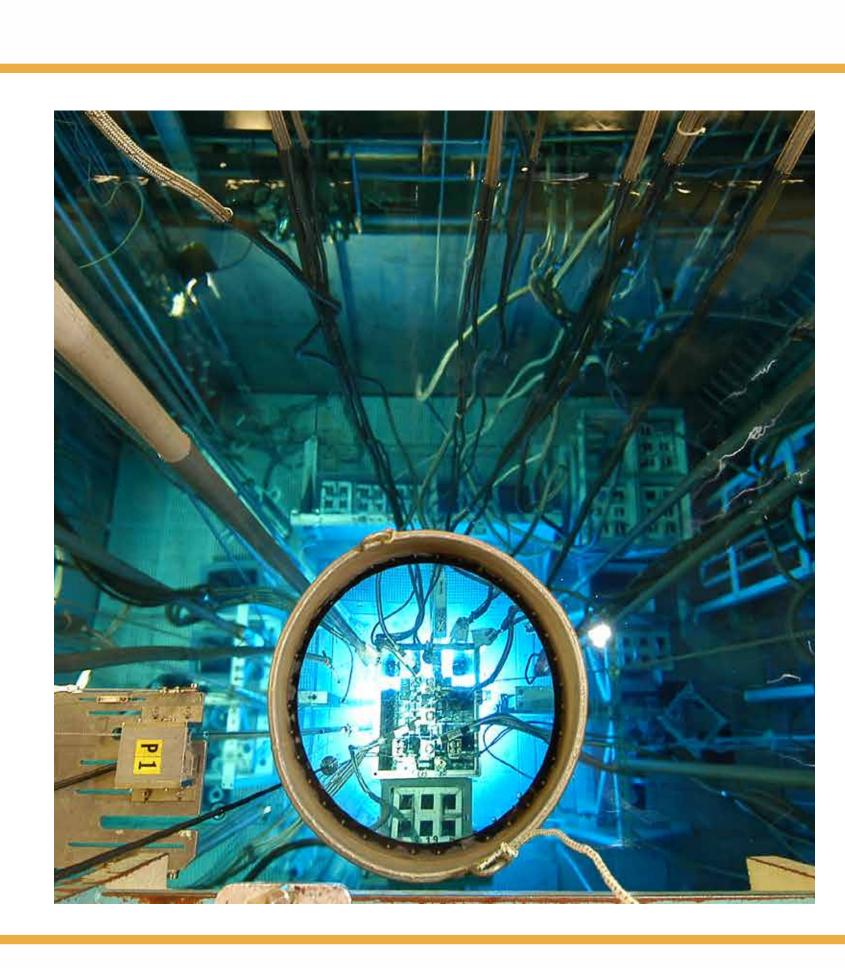
Improved CFUE design tested at 550 °C, with a 800 °C target



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)