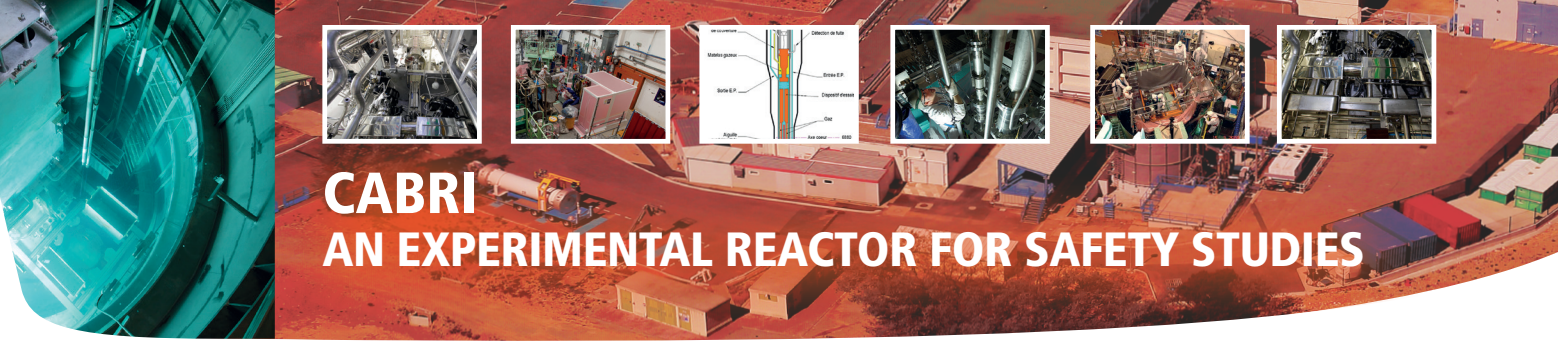


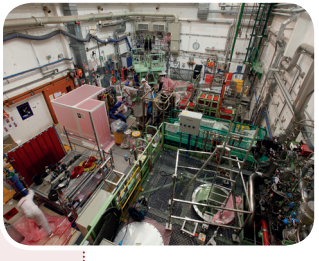
CABRI
AN EXPERIMENTAL REACTOR FOR SAFETY STUDIES

Comparing computer modelling with actual experimentation is essential to improving the prediction of the consequences of a severe accident in a nuclear power plant. Within the Reactor Studies Department (DER) at the CEA Cadarache Research Centre, the SRES is in charge of the operation of the experimental reactor, CABRI.

Commissioned in December 1963, **Cabri is designed to study the behaviour of nuclear fuel undergoing a «reactivity accident», i.e. a sudden and rapid local increase in the neutron flux**, resulting in an increase in nuclear power due to fission rising above the normal level of operation.

At the beginning of its operation, Cabri was equipped with a liquid sodium test loop intended for safety studies in fast reactors (RNR) such as Phénix and Superphénix.

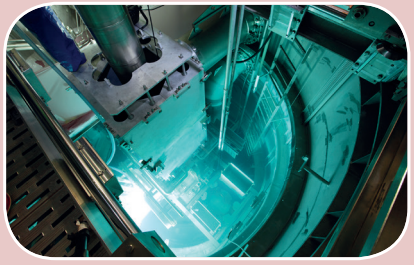
In 2003, the facility was shut down for extensive renovation within the framework of the Cabri International Program (CIP), a research programme associating multiple national and international partners from more than a dozen different countries. **The goal of this programme is to study the behaviour of nuclear fuel rods and their cladding at the time of a reactivity injection accident in pressurised water reactors (PWR).** Regulatory upgrades were then carried out and the initial sodium loop was replaced by a pressurised water loop simulating the thermal-hydraulic conditions of a PWR-type nuclear power plant. **Cabri achieved criticality again in October 2015. The first test is scheduled for 2017.**



THE REACTOR DESIGN | Technical characteristics of a power transient:

- Core of UO_2 rods
- Initial reactor power: 0 to 100 kW
- Duration of the power transient: 10 to 100 ms
- Maximum transient power: 20 GW
- Injected energy: up to 200 MJ
- Characteristics of the water loop: 280 °C, 155 bar, flowrate up to 6 m_3/h

Cabri is a «pool type» reactor with a maximum power of 25 MW in steady state operating conditions. It is cooled by natural convection to below 100 kW and by forced convection beyond.

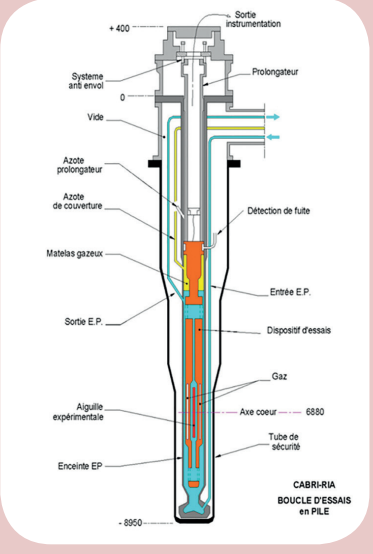


The reactor consists of a driver core of reduced dimensions (65 cm. on the side by 80 cm. in height) composed of 40 fuel assemblies based on enriched uranium dioxide at 6% in ^{235}U, quite similar to the fuel used in French power plants. These rods are specifically designed to withstand the increased neutron flux produced during testing.

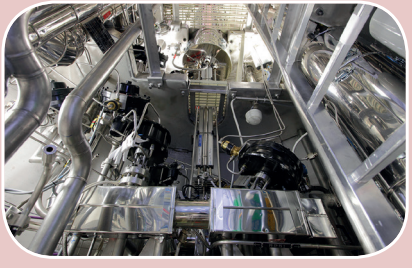
The core of the research reactor is equipped with:

- A central cavity receiving the part of the test loop in which the device containing the tested fuel sample is implanted. Cabri is equipped with a test loop that obtains the same conditions of temperature, pressure and flowrate velocity in the fluid surrounding the test fuel as those of a coolant used to remove the heat released in a real nuclear power plant.

- A channel equipped with a hodoscope that measures the deformations and movements of the tested fuel in real time.



The Cabri International Program (CIP)



The CIP experimental program, led by the IRSN under the aegis of the OECD, includes a total of 10 tests. It consists of exposing fuel sections irradiated in the reactor to thermal-hydraulic conditions and the neutron power encountered during a reactivity injection accident.

Power transients are produced by depressurization of helium-3 (neutron gas) within the core of the Cabri reactor and at its centre where the rod to be tested is positioned. During a test, power can be increased from 100 kilowatts to 20 gigawatts in a few milliseconds.

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