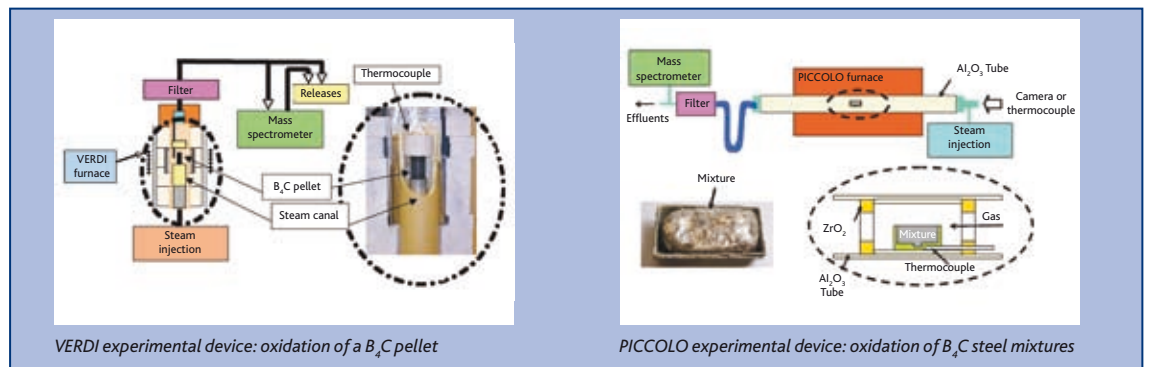


# Research Programme BECARRE

## [BORON CARBIDE ROD DEGRADATION TEST AND ASSOCIATED RELEASES]

The experimental programme BECARRE (2001-2010) belongs to the international "source term" programme. The BECARRE programme Objectives involve better understanding the degradation phenomena occurring in boron carbide ( $B_4C$ ) control rods during a core meltdown accident and determining the laws governing steam oxidation of  $B_4C$  pellets and relocated mixtures. These laws will be used to both quantify the gases produced during oxidation, and estimate their potential effect upon iodine releases into the environment. The programme results will help improve the ICARE2 code which is being developed by IRSN.



### [3 TYPES OF TESTS]

#### [VERDI]

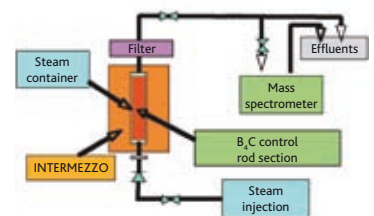
Steam oxidation tests on a  $B_4C$  pellet in the VERDI furnace. These tests consist in heating a  $B_4C$  pellet at different temperatures (between 1200°C and 1800°C) and in different steam flow rates. The effect of these parameters on the  $B_4C$  oxidation rate can therefore be determined and an oxidation law can be established for  $B_4C$ , which is then integrated into the ICARE2 code. This law is used to predict associated gas releases.

#### [PICCOLO]

Steam oxidation tests on  $B_4C$ -steel mixtures in the PICCOLO furnace. These tests are performed on different mixture compositions at various steam flow rates and temperatures (between 1200°C and 1600°C) to establish a law of the oxidation rate of mixtures taking into account the effect of the different parameters. This law will be integrated into the ICARE2 code and used to calculate the heat and gaseous releases generated by this oxidation.

#### [INTERMEZZO]

Degradation tests on a  $B_4C$  control rod section in the INTERMEZZO furnace. A section of a  $B_4C$  control rod enveloped in its Zircaloy guide tube is submitted to heating representative of a core meltdown accident sequence in a representative flow of steam.



INTERMEZZO experimental device : degradation of a  $B_4C$  control rod

#### Characterisation methods

Gaseous releases are continuously measured by a mass spectrometer connected to the furnace outlet. After each test, the different samples are subject to metallographic examination to determine the degradation mechanism : interactions between materials, formation and liquefaction of mixtures, and formation of oxide layers. These examinations are performed with an electron microprobe. As part of tests conducted in the Intermezzo furnace, non-destructive examinations (radiography and tomography) are also performed on control rod sections to characterise their state of degradation.

#### Budget

The total cost of this programme – jointly financed by IRSN, the CEA, EDF, the European Community, USNRC (USA), PSI (Switzerland), and the AECL (Canada) – is about €3 million, including €1.75 million in investments.