

The Reactor BR2 traditionally provides irradiation services for its internal (within [SCK·CEN](#)) and external clients. The services supplied range from the neutron and gamma irradiations of materials and fuels within the framework of scientific programs belonging to the internal and external customers, to commercial productions in the field of radioisotopes for medical and industrial uses and NTD-Silicon for the microelectronic industry. These commercial activities are exclusively directed to external customers and are of prime importance to provide financial support for the operating costs of the reactor.

For some years we try to exploit our know-how gained from the operation of the reactor by promoting services specifically oriented to the safety and operation of existing research reactors and the development of new ones. These efforts were fully realized for the first time in 2002 and 2003 by two contracts related to the behavior under irradiation of structural materials and the development of new fuels. A third program was launched end of 2004 aiming at the in-pile qualification of a replacement fuel for a future research reactor. We started and finalized in 2005 the conceptual design of a half-open loop, called EVITA. It will be loaded in the central 200 mm channel of the reactor and will allow the irradiation of a full size 94 mm diameter fuel element in representative conditions of heat flux, water velocity and surface temperature. The expected irradiation program will extend over three years starting in 2008.

Also the synergy between our knowledge in irradiation technology and the scientific collaboration with external partners led to the development and the successful irradiation of new and first of its kind irradiation rigs for the in-situ testing of materials. After a previous successful demonstration with in-situ uniaxial testing, we built in 2004 a new device and the required out-pile equipment to investigate in-situ the dynamic effects of cyclically applied stresses on fusion materials. The first two in-situ creep fatigue experiments were successfully performed in 2005.

Development work on a new concept for ramping fuels was continued in 2005. It combines a variable neutron screen on one hand and the strong flux gradient across a peripheral 200 mm channel on the other hand. The detailed design is expected to be finalized in 2006.

In the frame of an EC funded project, metallurgical samples will be irradiated under Pb-Bi. Specially designed capsules were built for loading in the Callisto loop and a new gas capsule is still being designed for a later irradiation at higher temperatures. The irradiation program is now planned to start in the Callisto loop early in 2006 for two years.

In 2005 the OMICO (Oxide fuels: Microstructure and COmposition Variations)-MIMAS-PV (MIMAS Process Variation) program was continued. A twin bundle consisting of 8 instrumented- and 8 non-instrumented fuel pins is being tested in the high-pressure high-temperature loop CALLISTO under typical PWR-conditions. The program is expected to be finalized late in 2006.

Nowadays the irradiation programs require a very specific description of the irradiation conditions that they will be subjected to. For this reason, we have developed an in-house competence for reactor physics at BR2 which has involved the implementation of the required computational tools. These tools are now being systematically used for prediction and evaluation of irradiation conditions of all experiments. Major evaluations conducted concern new fuel and material irradiation programs in Callisto, preparation of an irradiation program of advanced MTR fuel in the central H1 channel, the optimization of irradiation devices containing Pb-Bi and of a new pool-side facility for irradiation of 6 and 8 inches diameter Silicon ingots. In 2006, beside the evaluations needed for new programs, a number of evaluations will be needed in the framework of the 2006 decennial safety reassessment of the BR2 facility.

Advanced irradiations in research reactors require the on-line monitoring of crucial parameters like neutron fluxes, gamma dose rates, central fuel rod temperatures, fission gas release pressures and small geometry

changes. Our activities in this field aim at a detailed understanding of the sensor behavior in the irradiation conditions in order to extract reliable real-time information. Major work performed in 2005 concerned the testing in various conditions of new miniaturized fission chambers in collaboration with [CEA](#) and the assessment of radiation-induced electromotive forces in mineral-insulated cables. Future work will concern the development of in-pile instrumentation, with emphasis on the research in the framework of the SCK•CEN-CEA Joint Instrumentation Laboratory (fast neutron detection system, gamma selective self-powered detector,).

These activities in reactor physics and in-core instrumentation are part of a global program that allows us to fully exploit the exceptional capabilities of the reactor facility. This program also deals with the development of data/acquisition systems and of new multipurpose reusable irradiation devices. All instrumented irradiation devices are now connected to an in-house built data acquisition system allowing the scientific researchers and the project engineers to follow their experiments on-line using their office PC's.

The CALLISTO loop is still our most important irradiation facility for materials and fuel experiments. It comprises three in-pile sections that are connected to a common out-pile equipment. The principal purpose of this device is to simulate the irradiation conditions representative of PWR reactors. One of the in-pile sections is completely inserted within the reactor core to maximize the fast flux conditions. We foresee in 2006 the further utilization of the CALLISTO loop for testing of materials and fuels.

The exploitation of the reactor was again successful in 2005. The availability of the plant reached 93.59 %, no incident was recorded and the commercial revenues reached a new record. In collaboration with the SCK•CEN Physical Control, we obtained the approval of our Licensing Authority for a detailed action plan in the frame of the 2006 decennial safety re-evaluation: the main objective is to guarantee the operational safety and the reliability of the facility until at least 2016 as decided by the board of governors of the SCK•CEN. The planning of execution of the inspections, upgrading and studies is now spread over several years starting in 2006.

In 2005 the board of governors of the SCK•CEN decided to allow an extension of the annual operating regime of the reactor with a sixth cycle for the benefit of all present and future scientific and commercial users of the facility.

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