



SWISS BREEDER RESEARCH PROGRAMME

A new initiative for a 'Swiss Fast Breeder Research Programme' has been started during 1991. This was partly the consequence of a vote in Fall 1990, when the Swiss public voted for maintaining nuclear reactors in operation, but also for a moratorium of 10 years, within which period no new reactor project should be proposed. On the other hand the Swiss government decided to keep the option 'atomic reactors' open and therefore it was essential to have programmes which guaranteed that the knowledge of reactor technology could be maintained in the industry and the relevant research organisations.

There is also motivation to support a 'Swiss Breeder Research Programme' on the part of the utilities, the licensing authorities and the Paul Scherrer Institute (PSI). Although these organisations have different expectations and priorities with respect to the ultimate goals, it was possible to reconcile the interests, and the mutual understanding led to a common programme, which is entirely safety-oriented.

The utilities recognise the breeder reactor as an advanced reactor system which has to be developed further and might be a candidate, somewhere in the future, for electricity production. In so far they have great interest that a know-how base is maintained in our country, with easy access for technical questions and close attention to the development of this reactor type.

The licensing authorities have a legitimate interest that an adequate knowledge of the breeder reactor type and its functions is kept at their disposal. The legitimisation is justified due to the fact that the French 1000 MWe fast breeder reactor in Creys-Malville is situated approximately 100 km west of the Swiss frontier. Any incident in this reactor will have direct or indirect influence on our population in that region.

PSI and the former EIR have had for many years a very successful basic research programme concerning breeder reactors, and were in close cooperation with EFR. The activities within this programme had to be terminated owing to limitations in personnel and financial resources.

The new PSI research programme is based upon two main areas, reactor physics and reactor thermal hydraulics. In both areas relatively small but valuable basic research tasks, the results of which are of interest to the breeder community, will be carried out. It is obvious that a new research programme, started within a very short time and with activities which are accepted by EFR, based on existing experimental facilities, experimental techniques and know-how. Some activities which were already carried out at a very low priority could be rescheduled. Because of

these activities we are already in a position to show first results from the different tasks.

The lack of support of the former Breeder Programme led to capacity problems and finally to a total termination. Therefore one of the problems which had to be solved first was to find a sound base for the financial support. Furthermore it is essential to finance the programme over a reasonable period of time to ensure an efficient use of the investments and to guarantee the continuity of the experiments. The financial support which was decided upon, is shared between the three interested parties, utilities, licensing authorities and PSI, over the next 5 years and amounts to a total of 5.5 Mio sFr.

For the reactor physics research two almost parallel activities were considered. During the first period mainly existing know-how will be applied and a step by step familiarisation with the *significance of fast breeder reactor physics is foreseen*. New *pointwise and groupwise cross section libraries based on ENDF/B-VI and JEF 1.1* have been prepared. A large (1250 MWe) sodium-cooled fast breeder reactor benchmark problem was calculated and the eigenvalues, isothermal core fuel Doppler-reactivities, effective delayed neutron fraction and reactivity worths were compared with a great number of solutions obtained in the past.

During the following periods new methods and models to calculate burnup-cycles of large breeder reactors should be developed and tested. Data libraries for shielding problems to be used in the ECCO code will be prepared and shielding problems calculated. Furthermore activities specified through the R&D programme of the EFR will be initiated.

The thermal hydraulics research is conducted to investigate the flow structures produced by two parallel layers of liquid at different velocities and temperatures. This problem arises particularly on occasions where natural circulation is prevailing and hot and cold streams of liquid come together. Although some investigations on similar phenomena have been published in the open literature, more research is needed to cover all aspects for the breeder reactor.

At present, tests are carried out with water in an horizontal glass channel (WAMIX). Two flow visualization techniques are being used: laser-sheet induced luminescence and image-analysis of videopictures taken with ink injection marking. Based on the image analysis a determination of the frequency of appearance of vortices (time-dependence) could be made. The preparations to put the sodium loop (NALO II) into operation were continued. In this loop an analogous experiment to WAMIX, but with liquid sodium (NAMIX), will be carried out.

In the analytical area the computational thermal hydraulics code ASTEC was further validated by participation in an international benchmark calculation exercise. This code is also used to calculate the velocity profiles in the boundary layer of the inlet segment of the WAMIX test section.

It is intended to directly participate in the European and the French R&D programmes for sodium-cooled fast breeder reactors. Necessary steps to achieve this cooperation have already been made.

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