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PROGRESS IN PEACEFUL APPLICATIONS OF NUCLEAR ENERGY DURING THE YEAR 1969/70

Statement by Belgium received on 24 September 1970

BELGIUM

RESEARCH PROGRAMMES

1. The activities during 1969-70 were essentially a continuation of the work initiated in 1968 under Belgium's five-year (1968-72) nuclear energy plan.

Fast reactors

Belgian participation in work on the German-Dutch-Belgian sodium-cooled fast reactor (SNR).

2. At the end of 1969, the international consortium Interatom-Neratoom-BelgoNucléaire submitted to the authorities of the three countries and to the electricity producers' enterprise PSB (Projekt Gesellschaft Schneller Brüter) an offer, specifications and a safety report for the SNR.

3. Fuel research was concentrated to a very considerable extent on irradiation experiments. Fuel pins irradiated in the Dounreay reactor (DFR) were withdrawn after successfully withstanding a burn-up rate of 50 000 MWd/t and some of these are to be re-irradiated and taken to even higher burn-ups. Other experiments were carried out in the BR-2 reactor (MFBS loops and FAFNIR capsules). Two assemblies have also been designed and built for irradiation at the end of 1970 in the French reactor Rapsodie.

4. Work on the design and development of core and blanket assemblies has continued; preliminary specifications have been drafted, and theoretical and experimental studies of the thermohydraulic and mechanical behaviour of the assemblies have been made. Industry, the Centre d'études de l'énergie nucléaire (CEN) at Mol, and the Universities of Brussels and Louvain have been collaborating in this work.

5. The question of control systems and instrumentation for the SNR fuel-handling equipment has been studied and specifications have been prepared. Work has continued on the design of the in-pile instrumentation and on the development of various kinds of equipment, including a pressure regulator for the blanket assemblies and a machine for manipulating the core instrumentation.

6. In the safety field, experiments involving trial explosions on mock-ups have been performed at the Ispra Joint Research Centre. In addition, theoretical studies of transient conditions and particular aspects of accidents have been initiated.

7. Problems of inspecting irradiated fuel assemblies have been investigated by Belgian and Luxembourg industry, and a facility for the treatment and disposal of radioactive effluents - of the type that will be used for the SNR - is currently under construction at Mol.

8. An out-of-pile sodium loop (Na-2) has been used for a series of corrosion tests on austenitic steels in the temperature range 600-700°C. These tests are of interest both to the CEN and to Belgian and German industry.

9. In reactor physics, the CEN has compiled multigroup cross-section libraries so as to be able, in due course, to provide industry with the data required for reactor core calculations.

Belgian participation in the European association for the development of gas-cooled fast reactors

10. Although this activity does not appear in the five-year plan, Belgian industry has decided to participate in the European association for the development of gas-cooled fast reactors, whose immediate aim is to study the concept and assess the economic and technical prospects of this reactor type.

General programme of study and implementation

11. The work performed in 1969-70 related mainly to fuel, cladding, sodium technology, the development of new irradiation devices, and supporting activities. In particular, a 3-MW out-of-pile loop (Na-3) for testing control assemblies and rods went into service at the CEN, while new capsules were designed for irradiation studies to be carried out in the BR-2 reactor.

Reprocessing

12. The CEN, in collaboration with industry, has prepared a file on the principal aspects of the reprocessing of irradiated fuel by fluoridation. This programme will gradually be directed towards the development of peripheral techniques for wet and dry reprocessing of fuel: head-end treatment, gas scrubbing, treatment of residues.

Proven reactors

13. As regards equipment for light-water reactors, Belgian industry has been working on the adaptation of pumps for operation at 50 c/s and on the development of equipment for handling core components under water. In addition, the development of a system for regulating control assemblies has reached the prototype stage.

14. Considerable effort has also been devoted to the construction and introduction into service of a loop for testing the static and dynamic stability of internal reactor components. A 1:3 scale model reproducing the internal structure of the Doel reactors has been subjected to a series of vibration tests. This model was instrumented with the help of the CEN, and loop tests simulating the hydraulic flow conditions of the reactor are to begin before the end of 1970.

15. In its efforts to improve calculation methods, industry has continued its work on the development of codes. In particular, the influence of high power densities on the validity of models and on reactor safety has been investigated.

16. Work on fabrication methods and the control of PWR fuel for large power stations took the form of the construction of large, complete prototypes. These activities, carried out in support of fabrication equipment studies, are being supplemented by industrial trials and a programme for the development of new fabrication methods.

17. The work on plutonium recycling in light-water reactors being carried out jointly by the CEN and industry is a continuation of earlier theoretical and experimental studies undertaken as part of a programme of core fuel management calculations. Moreover, efforts have been made to improve the techniques for producing mixed oxides (UO_2-PuO_2) in pellet and vibro-compacted form. Irradiation tests on such fuels have been carried out in the BR-2 and BR-3 reactors and in the Swiss reactor DIORIT.

High-temperature gas-cooled reactors

18. The programme for 1969-70 has been devoted essentially to the fabrication of coated particles with a view to eventual construction of a pilot plant capable of producing 20 000 tons of fuel a year. Various samples have been irradiated in the BR-2, BR-3 and DRAGON reactors as well as in the DIDO reactor at Jülich.

Fundamental research

19. In low-energy physics, the isochronous cyclotron purchased by the University of Louvain is to be installed at Ottignies and will go into service at the end of 1971. This research programme is being carried out on an inter-university basis and in co-operation with the CERN laboratories and foreign research teams.

20. Belgian research workers have also continued to take an interest in studies related to particles of intermediate and high energy. One team, for example, is performing experiments with muons and pions in co-operation with CERN, and the high-energy laboratory has continued to specialize in the analysis of films taken during bubble chamber experiments. This laboratory also participated in the CERN experiments for which the 70-GeV accelerator at Serpukhov (USSR) was used.

21. The activation analysis techniques developed at the University of Ghent now seem likely to be of value in routine work in biology, metallurgy and geochemistry as well as in studies of the pollution of the environment.

22. The fundamental research carried out at CEN has continued to be devoted to solid state physics, nuclear physics and radiobiology. In all those fields, the general orientation of the work has remained the same as in past years.

Production and use of radioisotopes

23. The production of radioisotopes at CEN has continued at the same rate as previously. In 1969 the total activity of the radionuclides distributed by CEN was 290 000 Ci-236 000 Ci in cobalt-60 sources and 44 000 in iridium-192 sources. The gamma irradiation programmes were devoted to the preservation of foodstuffs and the improvement of certain textiles. An irradiation installation employing 100 000 Ci of cobalt-60 has now been constructed and put into service at CEN.

Operation of BR-2

24. In 1969 some 230 unites were irradiated in the reactor, apart from routine production of radioisotopes. Fifty-two irradiation channels were occupied, on average, and the reactor remained in service at nominal power for 225 days. The loops at present in operation allow burn-ups of 50 000 MWd/t in the fissile fuel pins for fast reactors and enable these to be subjected to several hundred power cycles.

25. As regards improvements in the performance and conditions of operation of the installations and reactor, special mention should be made of the tests carried out on new fuel elements; new heat exchangers have been ordered, and studies on the use of hot cells for post-irradiation examination have been extended.

Actinium programme

26. The irradiation equipment and hot facilities for chemical treatment of actinium, earlier developed by CEN, were sufficiently advanced to allow regular production to begin at the end of 1969. Studies were continued on the treatment of fuel for the isotope generator which has been developed jointly by German and Belgian industry.

Budgetary questions

27. The nuclear budget of the State for 1970 shows a net increase: 1700 million Belgian Francs as against 1400 million in 1969. An increasingly large part of this total is to be devoted to national activities, which will absorb nearly 73% of aggregate resources, while Belgian participation in international organizations will drop from 31 to 27%.

28. The distribution of funds between fundamental research, technological research and public service activites is to remain virtually unchanged, as are the shares allocated to CEN and industry respectively.

29. As in previous years, expenditure associated with technological nuclear research is in the aggregate considerably higher than the contribution of the State, since the receipts of CEN itself and the financial contribution of industry cover about 20% of the cost of the programmes entrusted to CEN.

INDUSTRIAL PRODUCTION OF PLUTONIUM

30. After ten years of experience in fabricating and studying plutonium fuels, Belgian industry has decided to build a factory for the production of this type of fuel at Dessel, for use in both thermal and fast reactors. This factory is to go into operation during the second half of 1972.

POWER STATIONS

BR-3 power station

31. The year 1969 saw the commencement of operation of the BR-3 station at Mol, with a newly-designed second core. This BR-3/2 bis core consists of 39 assemblies

already irradiated in the previous core and 34 new assemblies mostly clad in Zircaloy. The layout and internals of the BR-3/2 bis reactor are identical with those of the BR-3/2 reactor, but light water serves as both coolant and moderator while radioactivity is controlled by additions of borated water.

32. The provisional operating power of BR-3/2 bis has been set at 8 MW(e), and the question when the reactor should be taken to its rated power of 11.6 MW(e) is at present under study.

33. Belgian industry has, in the meantime, gone ahead with preliminary studies for the third and fourth BR-3 cores. The order for the third core should be given to industry by CEN some time during 1970, and certain materials and equipment have already been supplied for the construction of this core. The third core is designed to give fuel manufacturers experience with the behaviour, at high burn-ups, of a Zircaloy-clad core. The purpose of the fourth core is to assist studies on methods of improving the flexibility of the station's operation.

Ardennes Nuclear Power Station at Chooz

34. The condition of the internals of the reactor at the Ardennes (SENA) station was checked in November 1969 by a series of tests which showed the material to be in good shape. Beginning on 13 March 1970 the station was gradually returned to service, and industrial operation began on 19 May 1970. Since that date the SENA station has been operated at full power.

Doel and Tihange Stations

35. From mid-1969 to mid-1970, work on the Belgian nuclear stations at Doel and Tihange went ahead in accordance with the established programme. As regards the Doel station, most of the requisite studies have been completed; the production of equipment and the civil engineering work are already well advanced on the first nuclear unit of the station, installation of which is to begin during 1971. Studies for the Tihange station began in September 1969; structural materials have now been obtained so that the production of equipment can begin in the second half of 1970. Groundwork has also been started on the site.