IAEA/OECD (NEA) INTERNATIONAL SYMPOSIUM, JÜLICH, 13–17 OCTOBER 1975

The meeting on "Gas-Cooled Reactors with Emphasis on Advanced Systems" was attended by 388 participants and observers from 21 countries and 5 international organizations.

Gas-Cooled Reactors with Emphasis on Advanced Systems

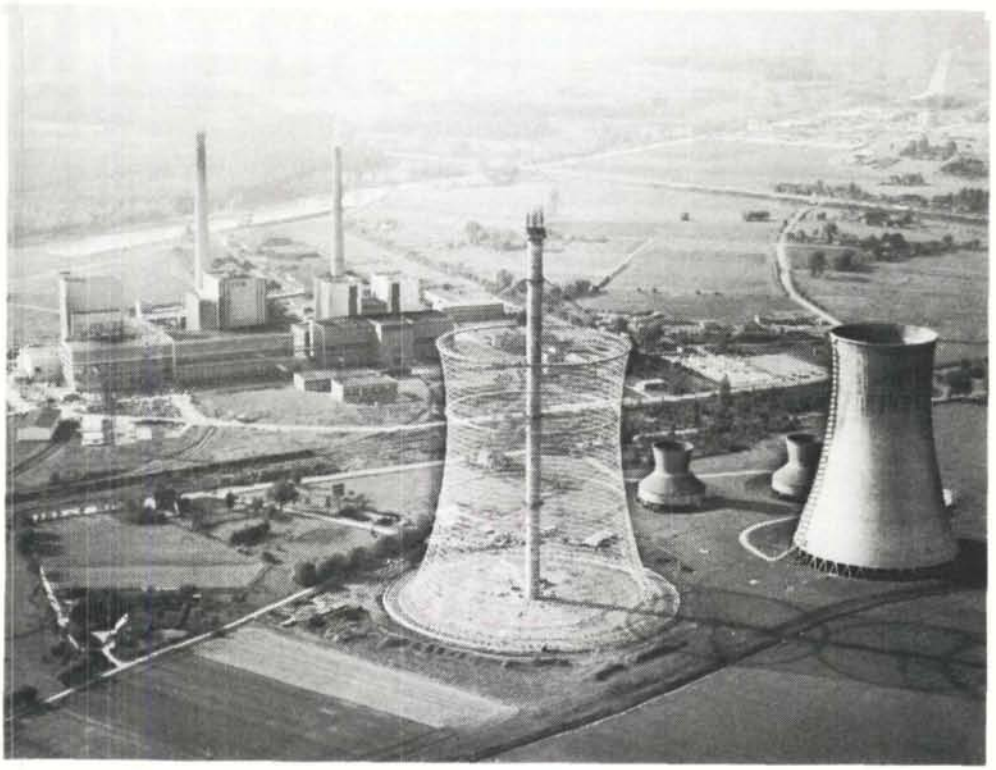
Present forecasts indicate that by the turn of the century more than half the global production of electrical energy will be derived from nuclear fuel. However, since the total electrical share of the overall primary energy requirements is at present only about one-fourth, increasing to perhaps one-half during the next two-and-a-half decades, nuclear power can only assume a substantially greater role in meeting world energy needs if a broader scope of application can be developed for the nuclear heat produced in reactors.

The potential utility of the helium-cooled graphite-moderated high-temperature reactor (HTR) for both electric power generation and as a source of high temperature heat for industrial processes or production of synthetic fuels has provided motivation for extensive development programmes of the concept going back to the early 1950's and leading up to the construction and operation of experimental power systems and the threshold for the commercial introduction of large HTR power stations.

The IAEA, in co-operation with the Nuclear Energy Agency of OECD, sponsored this symposium at Jülich, Federal Republic of Germany, site of one of the main centres in the world for development of the HTR. The programme included reviews of national programmes and operation experience, as well as a number of technological problem areas, such as fission product behaviour, materials and plant components, relating to the steam cycle HTR plant as well as the more advanced concepts of the gas turbine HTR, the gas-cooled fast breeder (GCFR) and very high temperature reactor (VHTR) for nuclear heat applications.

In the various national programmes on HTR technology, the main effort to date has been on the design and development of two types of steam-cycle HTR power systems: one based on the prismatic fuel block design, and the other on the pebble bed design. In the Federal Republic of Germany, France and Japan studies are underway for the possible construction of large scale (800–1160 MWe) HTR plants of the prismatic fuel block type (HTGR), but the present HTGR situation, as reflected in the remarks given by some of the speakers at the start of the symposium, is somewhat clouded because of the recent cancellation or suspension of work in the USA on nearly all the large-scale HTGR units ordered by utilities. These cancellations were attributed primarily to the shortage of financing for utilities in the USA and to the slowdown in electrical power demand. Additional considerations, however, relate to the long delayed start-up of the Fort St. Vrain HTGR prototype, which is intended to demonstrate the operational capability of the HTGR steam cycle system for electricity generation. In the Federal Republic of Germany, construction of the 300 MWe pebble bed THTR prototype is also facing some slippage in schedule, primarily due to licensing problems.

As pointed out by one author, the pace of development of advanced HTR concepts, in particular the gas turbine HTR and the VHTR, is strongly linked to the progress made in introducing the steam cycle HTR.



The thorium high temperature reactor under construction at Uentrup, Fed.Rep. of Germany, is connected with currently operating fossil power plants. In the foreground a dry cooling tower under construction. Photo: VEW

HTR's yielding high-temperature nuclear heat for industrial processes are of special interest in the development programmes of F.R. Germany, Japan and USA. In Germany the availability of large deposits of lignite and hard coal, plus the motivation to develop synthetic fuels as a substitute for the depleting natural gas and oil resources that currently supply two-thirds of the domestic energy consumption, has given special emphasis to the development of coal gasification techniques using nuclear heat. In the USA, coal liquefaction studies have been made, showing the VHTR to be economically competitive with fossil fired units with coal prices at up to $56/ton and oil at up to $17 per barrel. In Japan, the research and development work on the VHTR is primarily motivated by the potential application in steel making.

An additional aspect discussed at the symposium concerned the need to "close" the HTR fuel cycle; specifically, the development of technology for the commercial reprocessing of graphite fuel elements and for refabrication of the recovered fuel into new fuel elements.

The review of the progress in HTR technology showed the favourable experience being obtained from the experimental reactors still in operation, and that present information continued to support the earlier assessments of the special advantages of the HTR system with regard to resource utilization, environmental effects and operational safety, and the potential of the HTR for multipurpose application.