NEW WORLD

Fusion Power Changes Gear

by our Washington Correspondent

THE past year has been a very good one for fusion research in the United States. So good, in fact, that officials in charge of the programme at the Atomic Energy Commission are predicting that a demonstration commercial fusion power reactor will be operating by the mid-1990s—a five year improvement on their previous predictions. The factors which have led to such a rosy outlook are a run of successes in the research programme which have led to a recent reorientation in planning, and most important, the possibility of a huge increase in the AEC's budget for such research in the next few years.

That, in any case, was the line taken last week by a string of witnesses before the Joint Committee on Atomic Energy, which held its second set of hearings in two years on the AEC's fusion research programme. In the previous hearings, AEC witnesses were optimistic about the future for fusion power (see *Nature*, **234**, 120; 1971); this time they were positively enthusiastic, and their enthusiasm has been translated into plans to burn a fusion fuel of deuterium and tritium much earlier than they were estimating just a year ago.

Dr Roy L. Hirsch, Director of the AEC's Division of Controlled Thermonuclear Research, told the Joint Committee last week of a meeting of leaders of the programme held in mid-July, at which the outlines of the accelerated programme were agreed to. The chief change from previous plans is to push ahead with the design of equipment and experiments to burn a fusion fuel without first waiting for a demonstration that the physical conditions necessary to achieve a fusion reaction are scientifically feasible.

The ultimate goal of fusion research is to produce energy by imitating the processes that take place on the surface of the Sun. The idea is to heat a mixture of heavy isotopes of hydrogen—initially deuterium and tritium—to about 100 million degrees, and to contain the hot plasma out of contact with solid surfaces long enough for hydrogen ions to fuse together to form helium nuclei. The reaction would release energy and neutrons.

The previous plans called for a four-stage research and development programme to reach that goal. Phase one—the present phase—is physical research on methods of heating plasmas and confining them. The next stage is to build experiments to demonstrate that it is scientifically feasible to reach the physical conditions of temperature, density and confinement time necessary to get net energy out of fusion reactions. This stage would involve research on hydrogen, which would not actually undergo fusion. The third step is to build a test reactor in which deuterium and tritium would be allowed to react to produce net energy output. And the final stage is the construction of a prototype commercial reactor. The new plan is to combine the second and third stages, a move which Hirsch said last week "reflects our growing belief that our successes indicate that scientific feasibility is not the milestone technical issue it was once thought to be".

Among the successes to which Hirsch referred are considerable advances in the past two years in the field of magnetically confining plasmas, but perhaps the most exciting breakthrough came early in July at Princeton's Adiabatic Toroidal Compressor (ATC), a tokamak machine. Last year, a series of successful experiments on the ATC machine produced good results in heating a plasma by compression, and in addition the density was increased to the minimum thought to be necessary to operate a fusion reactor. More recently, however, the Princeton machine has been used to demonstrate a second heating method known as neutral beam heating.

First developed with the linear mirror machines at the Livermore Laboratory, neutral beam heating consists of injecting a high-energy beam of deuterium ions into the hot plasma. In the Princeton experiment, a plasma was heated to about 2 million degrees in the tokamak by resistance heating, compressed to raise the temperature to about 6 million degrees and then a beam of deuterium ions was fired into it. The trick is first to fire the deuterium ions through a gas so that they pick up electrons to neutralize the charge, which enables the beam to pass unhindered through the magnetic field that contains the plasma. The ATC experiments increased the ion temperature by between 20 and 25 per cent, even though the injected beam was at relatively low energy. "This early result", Dr Melvin Gottlieb, Director of the Princeton Plasma Physics Laboratory, said last week, "is indeed encouraging".

It is perhaps no coincidence that the reorientation of the fusion research programme was agreed to at a meeting which took place less than three weeks after President Nixon's statement on energy. In that statement, Mr Nixon announced that an extra $100 million

NSF

David's Doubts

by our Washington Correspondent

DR EDWARD E. DAVID JUN., who resigned in January as Science Adviser to the President, expressed some reservations last week about the federal government's new science policy machinery which, he said, has "downgraded in my view, the direct influence of scientists on societal affairs". The new arrangements, announced two weeks after David left the government to become Executive Vice-President of Gould Inc., involve the abolition of the Office of Science and Technology and the transfer of its functions to the director of the National Science Foundation.

Testifying before the House Committee on Science and Astronautics, David suggested that the transfer of science policy responsibilities from the White House to the National Science Foundation has resulted in an "unstable" arrangement because "NSF's history is deeply rooted in the academic style which rightly demands single-minded concentration on scientific excellence to the exclusion of other factors. This characteristic is difficult to leaven with other, less science-based realities".

He suggested that there are two possible resolutions of the instability, the first of which is for NSF to "follow its cultural past and thereby revert to the narrower concerns of science and academic research.... In this role, NSF would be no more than it is now". Alternatively, the foundation "may succeed in transcending its past, and actually achieve the national stature necessary" to carry out its coordinating and advisory functions. That, of course, would mean that the foundation would rise in the Executive hierarchy, since it would have to influence other government agencies concerning programmes which cut across their operating boundaries. "It would also mean", David suggested, "that NSF would serve as the technological beacon for other agencies. It must act as a surrogate for the President to exert these influences". David offered no predictions about which course the NSF will follow.