but they concluded that rf heating could at best serve as a subsidiary power source. The primary heat source, they agreed, should come from a 75-megawatt neutral beam of 175-keV deuterium atoms. This is going to require a considerable neutral-beam development program, Rutherford pointed out. Radio-frequency heating at the electron cyclotron frequency (130 to 140 GHz at INTOR's 5.5-tesla field) would become particularly interesting if one could develop gyrotrons capable of operating above a hundred gigahertz.

Objectives. The four delegations found themselves in reasonable accord as to the objectives of the first two stages of INTOR operation (roughly the first seven years after construction is completed). During this period one would want to achieve ignition for 100-second pulses, and learn to control a burning plasma. One would also attempt to demonstrate electricity production and tritium breeding at a modest level.

In a tokamak reactor the plasma would be surrounded by a metallic heat-exchange blanket, with water or helium coolant and some ceramic compound of lithium on its inner surface. The coolant would conduct the heat liberated in the D–T fusion reaction to an external generator of electricity. The 14-MeV fusion neutrons that provide most of the heat at the blanket would serve a second function; they would react with the lithium in the blanket to breed tritium, thus replenishing the plasma fuel. During these first seven years it is planned to test small blanket modules of various designs and materials, generating electricity at a level of about ten megawatts (compared to an input of hundreds of megawatts), and breeding some tritium.

Differences between the delegations arise when it comes to the objectives of the third stage of INTOR operation, which would begin in 1997 at the earliest. The US would like to run INTOR at the highest possible neutron-flux "wall loading" level—1.6 megawatts/cm^2, roughly half of what the walls would suffer in a practical tokamak reactor. The Americans and the Russians want to use the final stage of INTOR primarily to test candidate reactor materials—to see how they would stand up to this horrendous flux of 14-MeV neutrons.

The Japanese particularly, and also the Europeans, would prefer to use stage three to achieve substantial electricity production (100 megawatts) and tritium breeding (70% of the consumption rate). The Japanese are particularly concerned that tokamak reactors be made self-sufficient in tritium, because Japan (and similarly Germany) does not have a thermonuclear weapons industry to serve as a domestic source of tritium. To this end they would like INTOR to have a full blanket in the third stage, rather than the smaller blanket modules favored by the US and USSR, which would be more compatible with high-flux materials testing.

The design parameters suggested by the INTOR Workshop represent a compromise between these positions, with both options left open for the time being. The US has agreed to a more modest wall loading than it would have liked, and Japan has retreated from its advocacy of a full blanket. The size (and hence the projected cost) of the compromise INTOR is closer to the original American recommendation ($1 billion) than to the somewhat larger device previously favored by the Japanese and Europeans.

At the end of the conceptual-design phase (mid-1981) the participating countries will have to decide whether to proceed to the next phase—detailed design and construction. Even if, as some have suggested, the participating countries eventually decide not to follow through to the actual realization of an international tokamak, it is generally agreed that the INTOR project will have been enormously useful—generating, collecting and assessing world tokamak data at a level not at present possible for any one country.

The Engineering Test Facility currently under study at Oak Ridge is a parallel national effort with roughly the same objectives as INTOR. In addition to its tokamak design studies, the ETF group is also looking at alternative magnetic-confinement schemes. According to Rutherford, the international fusion-research community takes it for granted that the first magnetic-confinement reactors will be tokamaks. In America however, doubts have been expressed on this score. The Ad Hoc Experts Group on Fusion, headed by John Foster of TRW, has warned against excessive reliance on the tokamak concept. (See PHYSICS TODAY, September 1978, page 85.) The Foster group pointed out that among its many physics and engineering complexities may lurk an obstacle that would make it impossible to realize a practical tokamak reactor in the foreseeable future. The $94-million Mirror Fusion Test Facility now under construction at Livermore, and scheduled for completion in 1982, will be the world's largest experimental mirror-fusion facility. Last year DOE chose the Elmo Bumpy Torus from among several magnetic-confinement alternatives to tokamaks and mirrors to be supported for a proof-of-principle test (PHYSICS TODAY, October 1979, page 18). —BMS

Texas tokamak is ready for proposals

The Texas Experimental Tokamak is expected to begin operating on the University of Texas campus at Austin this spring. By next January, it is expected to be available for experiments by off-site visitors. The tokamak is suitable for experiments in atomic processes, impurity transport, rf heating, plasma/surface interaction, plasma formation studies, plasma edge effects, disruptive instabilities and diagnostic development.

The machine has a major radius of 100 cm, minor radius of 28 cm, centerline magnetic field of 3 T, plasma current (nominal) of 400 kA and flat-top pulse length of 0.3 sec.

Proposals for machine time to do experiments on the Texas tokamak will be considered by an advisory committee. Inquiries should be directed to: Kenneth W. Gentle, Director, TEXT, Fusion Research Center, Department of Physics, University of Texas, Austin, Texas 78712.

in brief

General Electric has received a three-year, $1.7-million contract from EPRI to study fluidized-bed combustion, an advanced coal-burning process that may provide cleaner, more efficient energy from power plants. In this process, a stream of air is blown up through a bed of hot coal and limestone, giving the bed some characteristics of a fluid. Boiler tubes run directly through the fluidized bed, promising more efficient heat transfer. Operating about 1500 F degrees cooler than conventional coal burners, the new system would produce less pollution from oxides of nitrogen.

The installation of a second Cray-1 computer at Los Alamos recently began. The $10-million computer, manufactured by Cray Research, is described as the world's fastest, with a vector-computing capacity that makes it about four times as fast as LASL's CDC 7600. It has a million-word memory, but miniaturization makes it physically smaller than the 7600. The new system will increase LASL's computing capacity by about 35 percent.

McDonnell Douglas Corp. has added $1.85 million to the over $5.6 million in gifts it has donated to Washington University since 1974 in support of the McDonnell Center for Space Sciences. This most recent gift will fund the continuation of ten graduate fellowships, a distinguished visitors and postdoctoral associates program and the Earth and Planetary Science Department, as well as the purchase of new equipment.

The Fleischmann Foundation has donated $1.55 million for construction of a Geosciences Research Center at the Quissett Campus of the Woods Hole Oceanographic Institution. The building will house deep-sea samples and laboratories for their analysis. □