the political problems.

INTOR stands for International Tokamak Reactor. The objective so far has been to define the design parameters of a 620 MW (thermal) tokamak which would test engineering systems required in a commercial fusion reactor. The objectives of INTOR are to produce a token amount of electricity and to demonstrate tritium breeding and 25-50 per cent availability. Decisions on the future of the project will be taken by members of the design team only when the final report is ready.

For the time being, the team is innocent of politics. The first difficult step will come when the design study is complete and it is necessary to set up a full-time design group.

If ever built, INTOR will be a net consumer of electricity and tritium. The reactor would use a charge of 3 kg of tritium which would have to be replaced every six months. Average electrical power consumption would be 200 MW. Capital costs would be of the order of the cost of the American Engineering Test Facility, about \$1,000 million. **Robert Walgate**

US fusion

Middle course?

Washington

Magnetic fusion research in the United States will be further encouraged by a new report prepared for the Department of Energy. The report concludes that research is now sufficiently encouraging to justify a new stage of engineering experimentation.

Even so, the report falls short of endorsing the Engineering Test Facility being promoted by some members of the fusion research community. It says that the proposed high neutron flux and heavy usage, as well as the role of the ETF as a direct stepping-stone to commercial fusion, are "too ambitious" and "inappropriate at this stage".

The report recommends instead that the department should construct, at an estimated cost of less than \$1,000 million over ten years, a more modest Fusion Engineering Device (FED) based on the tokamak design. This device, the report says, should be sited at a new Center for Fusion Engineering (CFE).

The proposals come from a subcommittee of the department's Energy Research Advisory Board, chaired by Dr Solomon Buchsbaum of Bell Laboratories. Officially they are still in draft form; but they are likely to form the backbone of the Administration's response to critics who claim it has been dragging its feet on the commercial application of fusion.

The Buchsbaum committee in passing attacks a previous report prepared two years ago by a similar committee chaired by Dr John Foster of TRW Industries. That argued that it would be unwise to pursue an ambitious programme based on the tokamak design, urging that research

support should be spread more widely.

The Administration has responded by increasing support for alternative designs, in particular for the Elmo Bumpy Torus being developed at the Oak Ridge National Laboratories (*Nature*, 1 May), to the chagrin of the potential commercial sponsors of fusion technology, who have felt that the Foster committee was too cautious.

Leading the attack has been Mr Mike McCormack, chairman of the energy subcommittee of the House Science and Technology Committee. Mr McCormack has been pushing hard for an accelerated fusion research and development programme. Last year his subcommittee appointed a 12-member Fusion Advisory Panel which recommended that the ETF, being designed at Oak Ridge, should be built in 1987.

The Buchsbaum committee is the response to the McCormack initiative by Dr Edward Frieman, director of the Office of Energy Research. It justifies its shift of view by citing recent "rapid scientific progress" and says that the US is now ready to embark on the exploration of the engineering feasibility of fusion.

Among recent successes are:

- validation of empirical predictions of achievable electron energy confinement times;
- demonstration in experiments with neutral beam currents that the heating of plasma to ignition temperature is feasible;
- the absence of evidence that impurities will tend to accumulate in the centre of high density plasmas; and
- the existence of several promising schemes for steady-state current drive using radio-frequency or particle-injection techniques.

These and other developments, the committee says, make it appropriate to move on to the study of ignited plasmas — where fusion reactions proceed without external energy being supplied. This would be one of the principal goals of the FED, which would also be used to explore reactor technology and to study safety questions. But the new report, like that of the Foster committee, asks that attention should continue to be given to alternative designs in case the tokamak configuration disappoints.

The committee therefore supports the proposal for a large tandem mirror machine, if only to prove the principle that open-confinement systems may be feasible; this may be included in the 1982 budget request. The committee also asks that work on the Elmo Bumpy Torus should be strengthened to clarify some immediate physics issues, but adds that the proposed \$75 million investment is "too large, given the existing uncertainties in the physics of the EBT configuration".

The appearance of the committee's draft report aptly coincided with a debate in the House of Representatives on the Department of Energy's proposed 1981

budget. As part of a general attempt to trim long-range energy research, the House Appropriations Committee had proposed that the magnetic fusion budget be reduced by \$23 million from the Administration's request for \$396 million (an 11.5 per cent increase over this year).

Waving copies of the Buchsbaum report, House members were able to restore the money by an amendment which also reduced some of the proposed cuts in high-energy and nuclear physics research programmes. But Mr McCormack is not satisfied. He is now talking of introducing a supplementary budget request later in the year to bring the fusion budget more into line with the Buchsbaum proposals, which recommend that the total budget be almost doubled over the next five to seven years.

Not unexpectedly, the Buchsbaum report is less bullish than Mr McCormack. It says that heavy spending on the engineering aspects of fusion will not be necessary until 1983-84. By then, results from the Tokamak Fusion Test Reactor at Princeton will be available, and should help to decide the design details of the proposed Fusion Engineering Device.

David Dickson

New NSF director

Dr John B. Slaughter (below) was nominated to take over from Richard C. Atkinson as director of the National Science Foundation last week. Slaughter, an engineer by training, has been persuaded to return to the NSF after leaving only a year ago to become academic vice-president and provost of Washington State University. He had previously been assistant director of NSF for astronomical, atmospheric, earth and ocean sciences. Atkinson, a psychologist, has already taken up an appointment at the University of California.