sibility for supporting civil technology.

The department's new responsibilities were written into last year's trade bill. The legislation provided a framework for private companies and the federal government to work together through joint ventures or industrial consortia to develop technologies likely to be important to the civilian economy. Japan and European countries have made such arrangements a centerpiece of their technology policies.

The trade bill resulted in a bureaucratic reshuffle that raised the political status of the department's existing technology programs, bringing them together into a Technology Administration headed by an Undersecretary for Technology. The venerable National Bureau of Standards was given a new name (and a more euphonious acronym), the National Institute of Standards and Technology (NIST), and new authority to enter into joint research ventures with industry.

The changes had the enthusiastic backing of then Commerce Secretary William Verity. He gave Ernest Ambler, the director of the bureau of standards, the job of getting the new Technology Administration up and running during the transition to the Bush Administration. Ambler, who had already announced plans to retire, agreed to stay on until 1 April, by which time President Bush should have picked his own man or woman to lead the effort.

True to his word, Ambler left last week. But nobody has yet been nominated as Undersecretary for Technology. NIST, too, has been operating under an acting director for 3 months, ever since Ambler took on the Technology Administration job, and no replacement has been named. Moreover, not only did Reagan's lame-duck budget contain no money to carry out the new programs but NIST's budget for its existing programs was also trimmed.

Ambler says that, given the pressure to reduce the federal deficit, the lack of funding for the new initiatives is not surprising. He views as far more serious the slowness in making appointments, especially the President's science adviser. "You have to question whether there is any thought being given to how we are going to deploy technology in this competitiveness game," he says.

Representative Brown and others who have championed the cause of technology policy concede that it will be very difficult to break loose substantial new funding next year for the Commerce Department programs, given the pressure to cut the deficit, but they will nevertheless keep up the pressure. Says a committee aide, "it is difficult to believe that having authorized and supported the program, the committee will not fund it." ■ COLIN NORMAN

Budget Squeeze Causes Fission in Fusion Labs

Divisions have appeared among fusion researchers over the nation's fusion strategy; the timing of the next major machine and its potential impact on other research are at issue

STEVEN COWLEY'S DREAM is to replicate the hydrogen fusion process of the sun. For 8 years, dating back to the day he graduated from the University of Oxford, Cowley has pursued this goal at the Princeton Plasma Physics Laboratory, and he says he's ready to spend his entire professional life on it. But Cowley—and many of his peers working on other, smaller-scale fusion projects across the United States—are getting a bit nervous about their future.

For 5 years running, Congress has refused to increase funding for the $350-million-a-year magnetic confinement fusion program. This has already caused a number of research programs to be stretched out, and a reshuffling of research priorities. The result: layoffs at some laboratories. "Budgets are down to a level now where every time it shrinks it cuts into the core of people who have dedicated their careers to this program," observes Bruce Montgomery, associate director of the Massachusetts Institute of Technology's Plasma Fusion Center.

Yet more worrisome to many physicists and engineers is fusion's version of the big-science dilemma: what will happen to many smaller research programs in physics, engineering, and nuclear science if Cowley's colleagues at Princeton are able to convince Congress to provide the funding to move ahead quickly with construction of the Compact Ignition Tokamak (CIT)—the fusion experiment of the 1990s that could cost $700 million to build?

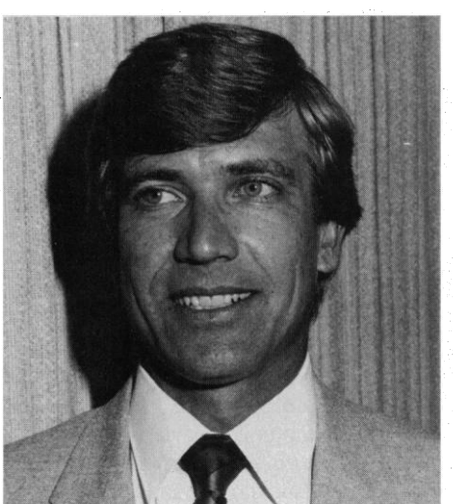
Project managers at institutions around the country have told *Science* they fear that ongoing research projects will be in jeopardy if the Department of Energy (DOE) tries to shoehorn the machine into the fusion budget without more funding to accommodate it. But nobody expects the overall fusion budget to grow much in the current climate. And with the federal budget under pressure, it will be increasingly difficult to persuade Congress to pump more resources into a program that is not expected to make significant contributions to the nation's electrical grid before the middle of the next century.

And now along comes "cold fusion." The recent media hoopla surrounding claims that fusion has been achieved by an entirely different approach (see page 143) may focus more attention on the huge costs of the magnetic fusion program.

"Some folks are getting a little disinterested in [magnetic] fusion," concedes Harold Forsen of the Bechtel Group, Inc., a Department of Energy contractor. Indeed, fusion program leaders in the national laboratories across the country already are bracing for a possible $20-million reduction in the 1990 fusion research budget by Congress.

All this is carving deep divisions in the fusion research community over not merely the pace and timing of the CIT but over the nation's fusion strategy in general.

Tensions within the fusion community have been heightened since Robert O. Hunter took over last fall as head of the Department of Energy's Office of Energy Research, which funds the magnetic fusion program. Late last year, Hunter reordered some research priorities by shifting funds into basic studies of the mechanisms governing the transfer of heat and particles across magnetically confined plasmas. Although there is general agreement that increased attention to these areas is warranted, core



David O. Overskei: *Recommended a 2-year delay in constructing the CIT.*

research activities at Princeton, Oak Ridge National Laboratory, and Los Alamos National Laboratory had to be trimmed and some layoffs resulted (*Science*, 20 January, p. 303).

At Princeton, for example, a long-delayed plan for operating the Tokamak Fusion Test Reactor (TFTR) with deuterium and tritium has been postponed for three more years. Using deuterium alone, physicists have pushed plasma temperatures in TFTR well above the 100-million-degree-Celsius level needed for fusion, but they have not been able to confine a sufficiently dense plasma long enough to generate more energy than is required to create the fusion reaction. Adding tritium may enable them to exceed the energy break-even threshold.

The CIT would allow researchers to take magnetic fusion a step further by producing the necessary conditions for the plasma to ignite, and it is considered the forerunner of an energy test reactor that would burn plasmas for extended periods. Further, there is general agreement that the CIT would lead to major advances in the fusion program. The general quarrel is over its timing and location.

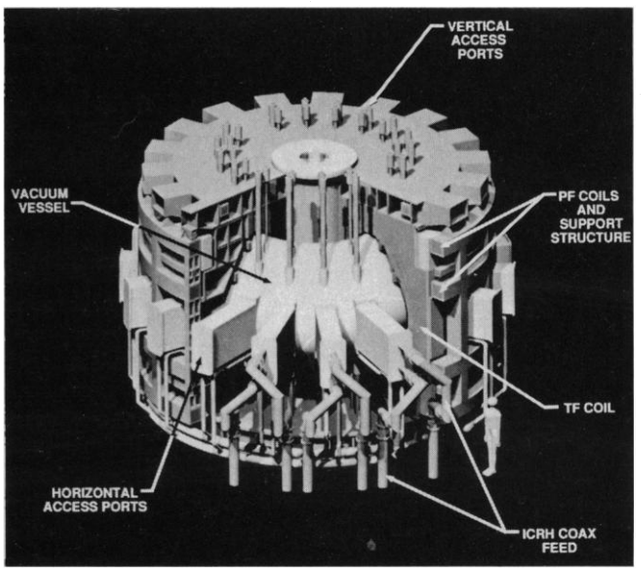
The Administration has requested $5.5 million to initiate the construction phase in 1990, and DOE's Magnetic Fusion Advisory Committee last month urged Hunter to proceed with the $700-million project, which is currently scheduled to be completed in 1996.

Even though Hunter has said that construction should proceed slowly in the next few years to avoid severe impacts on other projects, researchers fear that alternative fusion reactor concepts, materials research, and other programs may be raided to scrape together funds to build the device. Harold Furth, director of Princeton's fusion program and a supporter of the project, puts the dilemma succinctly: "When there is not enough money, the only way to build [CIT] is to cut out research programs."

Grant Logan, deputy administrator for planning at Lawrence Livermore National Laboratory, says that, faced with such a choice, the research community may conclude that running ongoing experiments for a few years longer may be more productive than gutting much of the research base to build CIT. Princeton's Cowley predicts, however, that most leaders in fusion research are not about to give up the decade-long fight to construct a successor to TFTR.

The directors of two fusion research programs have already recommended postponing construction of CIT for at least a year. David O. Overskei, senior vice president for the fusion division of General Atomics, and Ron Parker, director of MIT's fusion effort, testified recently before the House subcommittee on energy research and development that such a delay was necessary to optimize the CIT's design.

While a postponement would ostensibly allow the CIT's designers to take advantage of findings from the new plasma physics studies instituted by Hunter, more is at stake than tweaking the machine's performance. Overskei, Parker, and a number of other fusion scientists are questioning whether Princeton should have management control of the ignition experiment.



The CIT's core: *The forerunner of an energy test reactor, it might produce conditions to ignite a hydrogen plasma.*

For more than a decade, Princeton has been the dominant fusion laboratory in the country, principally because TFTR is located there. Princeton's star billing has become a source of friction in the fusion community as the overall budget has shrunk, however. This year the laboratory will get $96 million for its fusion program, the largest single chunk of the budget. Comments one Princeton scientist, "everybody else hates Princeton because we have got all the money."

Building CIT at Princeton while cutting programs elsewhere would exacerbate the disparities. "The way the CIT has been structured to date," says Overskei, "it is difficult for a number of players to see how they will continue to participate in the fusion program. We think this is a big issue that needs to be resolved."

Overskei and Parker are pushing DOE to consider establishing an independent management group similar to Universities Research Association, which manages Fermi National Accelerator Laboratory. Such an approach could ensure that "everybody has long-term useful roles," contends Overskei. Whether such a structure will ultimately be acceptable to Princeton and the Department of Energy is not clear, but laboratory officials recognize that some new management arrangement may have to be created. Princeton's problems, however, may not end there.

MIT's Parker also is challenging the soundness of building the CIT at Princeton's TFTR site because of potential protests from the surrounding community over the use of radioactive tritium in the machine. Although the amounts of tritium are not deemed to pose a major health threat, Parker says there is no guarantee that logic and truth will carry the day when it comes time to operate CIT around 1997. He has advised DOE officials that it might be wiser to build the machine in another, presumably more remote, part of the country, even though project construction costs would rise by $240 million.

Gerald Kulcinski, director of the Fusion Technology Institute at the University of Wisconsin, notes, however, that Princeton has gone out of its way to assess the safety issues. Furthermore, he points out that relocating the project to another site will not necessarily insulate it from protests.

With so much dissension within the ranks, Bechtel's Forsen wonders what the future holds for magnetic fusion research. "We must find a way," he says, "to bring people back together." Charles Baker, director of Argonne National Laboratory's fusion program, thinks that CIT may be the answer, if his colleagues can make some compromises and sacrifices. Forsen agrees: "We must get on with building this machine," he says, or risk falling further behind Europe in fusion research.

And there is another argument for moving forward—one that arises from a potentially bitter irony that faces the fusion community. Congressional and public interest in fusion is flagging in part because of the lack of headline-grabbing advances, but major strides are only likely to come with increased funding and new machines. "We face a dilemma," says Baker. "To progress, the program needs to move ahead and build the next series of research facilities. But, without additional funds, we are unable to do that."

Until the sniping stops, there will be little prospect of rallying congressional support for Baker's point of view.

■ MARK CRAWFORD