

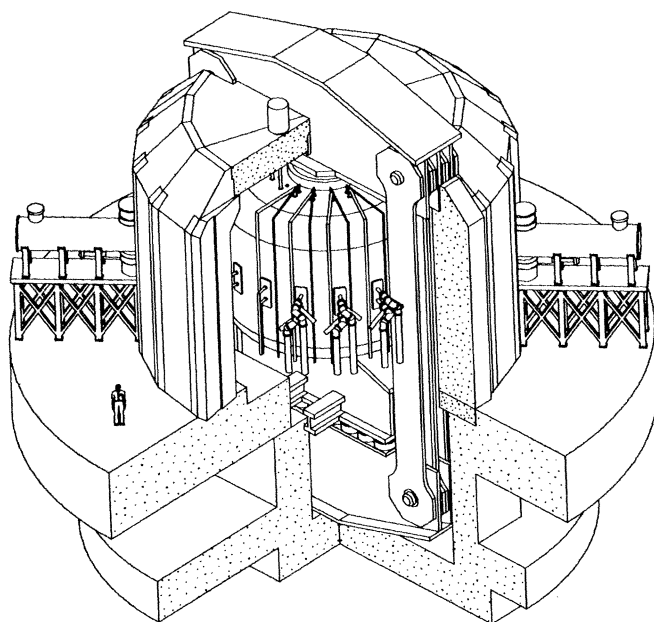
U.S.S.R. Eyes Role in U.S. Compact Tokamak Ignition Experiment

Physicists working on nuclear fusion in the Soviet Union want to participate in America's next experiment, the Compact Ignition Tokamak (CIT). Soviet scientists first mentioned the idea to Department of Energy (DOE) officials last spring but have not put forth any formal proposal. Department officials, however, say the Soviets are serious about working with the United States on the project.

"The Soviets think this is an important experiment," says John Clarke, director of DOE's fusion program. "They think it will produce essential information about a burning plasma that is needed before we can move on to an energy test reactor." And, working with the United States on the hydrogen-fueled CIT would allow them to avoid much of the cost and risk of building a device themselves.

Compact tokamak

The CIT would burn two hydrogen isotopes, deuterium and tritium, for a few seconds at temperatures exceeding 100 million degrees Celsius.



The opportunity for broader collaboration with Soviet researchers on fusion materialized at the fall 1985 summit meeting in Geneva. President Ronald Reagan and General Secretary Mikhail Gorbachev agreed then that international collaboration on magnetic confinement fusion should be expanded. From the outset, however, efforts to work more closely with the Soviets on fusion research have been stifled by concerns within the Administration that sensitive Western technology will be transferred to the Soviet Union's military establishment (*Science*, 23 May 1986, p. 925).

The Soviet Union has had a large fusion R&D program in place for decades. Its scientists also have pioneered the use of the

tokamak reactor concept and cyclotron heating. In recent years, however, the country's experimental programs have suffered from inadequate resources and construction delays. Despite these problems, Soviet scientists remain at the forefront of some areas of plasma physics. "They have managed to get very far with clever researchers and wonderful ingenuity," comments Ronald Prater, of GA Technologies, a San Diego-based R&D company that has conducted fusion research for several decades.

DOE officials contend that Soviet physicists could bring some valuable analytical skills to the CIT program. "They have some of the finest plasma physicists the world over," says John Willis, head of confinement systems for DOE's Office of Fusion Energy.

Soviet scientists already have agreed to participate in a design review of the CIT

project. This has been arranged as part of a formal fusion information exchange agreement with the United States that has existed since 1958. If funded by Congress, the \$350-million compact tokamak would be built next to the existing Tokamak Fusion Test Reactor (TFTR) complex at the Princeton Plasma Physics Laboratory.

Although smaller than TFTR, the compact tokamak would be capable of igniting and burning a plasma for short periods—about 3.7 seconds. This would provide physicists with valuable information on alpha particle heating of the hydrogen plasma, plasma instabilities, and other phenomena that could affect the design and operation of a more ambitious, multinational fusion ex-

periment. This International Thermonuclear Experimental Reactor (ITER) is meant to provide the necessary data for ascertaining the economic viability of magnetic confinement fusion power.

The key to Soviet participation in CIT may depend on what they can contribute materially, as well as intellectually to the U.S. project. Soviet scientists are currently defining how their country might contribute to the CIT, and they could submit a proposal to the United States within a year.

Soviet industry, for example, could build the hydraulic press that CIT will require to prestress the massive 10-tesla magnets used to confine the plasma. They conceivably might also provide electron cyclotron or ion cyclotron radio frequency devices for heating the plasma. But, Clarke cautions that the Soviets may not go that far. "Their military is as conservative as ours when it comes to technology transfer," he notes.

Indeed, the technology transfer issue has made DOE and State Department officials reluctant to discuss the possibility of the Soviet Union taking a role in the CIT. They fear that the concept will be rejected on ideological grounds before the merits of a Soviet proposal can be considered. The Reagan Administration already has limited U.S. involvement (*Science*, 7 November 1986, p. 666) with the Soviets in ITER to the completion of a design study—not the construction of the energy test reactor. This was a response to concerns raised by the National Security Council and the Department of Defense (DOD) about the transfer of technology to the Soviet Union. Although compact tokamak is far less advanced than the proposed multibillion dollar ITER device, the Pentagon still may object to Soviet physicists getting deeply involved.

Some members of Congress also are a little jittery about working more closely with the Soviet science community. Representative Ralph M. Hall (D-TX), chairman of the House subcommittee on international scientific cooperation, plans to hold hearings on the matter early next year. Representative Marilyn Lloyd (D-TN), chairman of the subcommittee on energy research and development, says she also is concerned about the potential for unauthorized transfers of technology to the Soviet Union.

DOE's Clarke, however, insists that such problems are manageable. He notes that if the Soviet's conduct in negotiations for setting up the more ambitious ITER is any indication, ways can be found to safeguard sensitive technologies. Clarke adds that since the United States is building CIT, it can easily control the extent of the Soviet Union's participation in the experiment. ■

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