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BACKGROUND NOTE

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CULHAM IS SITE FOR EUROPEAN COMMUNITY JET

The European Research Council's decision this week to build the Joint European Torus at Culham, England, restores the impetus to a $174 million nuclear fusion research project that is believed still to be slightly ahead of similar projects in the United States and the Soviet Union.

Construction of the torus -- a doughnut-shaped vacuum vessel in which scientists believe cheap, clean energy can be created by the fusion of hydrogen atoms, as on the surface of the sun -- had been delayed since 1975 pending a decision by the European Community governments on the site for the project.

In the intervening years the problem was tackled without resolution by five meetings of the European research ministers, three discussions by the foreign ministers and a European Council meeting. In recent months, the delay had been caused by disagreement among member governments of the Nine over whether the experimental device should be constructed at Culham, where a JET project team has been working since 1973, or at Garching, in the German state of Bavaria.

Belgian Foreign Minister Henri Simonet, who chaired the Research Council meeting in Luxembourg Tuesday, said that despite the long and difficult process of getting confirmation, "in the end it was possible to get a decision on this essentially Community enterprise." The size and cost of the five-year project would have prohibited a single nation's attempt to carry out fusion research. The Council also agreed to allocate about $174 million for exploitation of the JET device over another five to seven years, making the total project allocation about $350 million.

Simonet said that a consensus favoring Culham had emerged after individual and joint meetings with the ministers of the Nine. Initially, five ministers had voted for the British site and two for Garching.

The blueprint for JET, Energy Commissioner Guido Brunner told journalists after the council meeting, is more advanced than similar projects in the United States and the Soviet Union, but he acknowledged that time lost by the governments' indecision was a setback.

Brunner said he expected construction of the experimental reactor to begin in about four months, after statutes for the joint project had been agreed upon. JET is the first joint enterprise of this type to be established under the European Atomic Energy Community (Euratom). Brunner said that additional scientists will be hired at Culham to bring the current 34-person research team up to the necessary level of 320. He added that all member states would have a chance to participate in the fusion research, and that about 150 persons from Euratom would be involved in the project.

Most experts believe it will take decades before fusion energy can be used to operate commercial power stations. But if it can be made to work, fears about future fuel availability (as with fossil fuels such as oil, coal and natural gas), environmental hazards and nuclear proliferation (as with fission energy) can be laid to rest. Fusion energy is created through the smelting together of hydrogen, deuterium and lithium elements that are abundantly available in water and in rocks. Neither deuterium nor lithium are radioactive, so hazards of radioactive pollution through a reactor breakdown or disposal of waste are practically nonexistent. At one stage of its fuel cycle, a fusion reactor will use a poisonous radioactive gas called tritium, but scientists believe safeguards against this gas will be easier to develop than in the fission reactor's fuel cycle. In addition, the tritium in a fusion reactor -- which conceivably could be used to produce a fusion weapon -- is created and consumed within the reactor itself.

The first problem of fusion, which JET scientists will now attempt to overcome is that the pairs of nuclei in the fuel elements of hydrogen, deuterium and lithium naturally repel each other. Fusion only occurs if the nuclei are hurled together at great speeds when heated to temperatures of 100 million degrees Celcius or more. Scientists in Europe, the United States, Japan and the Soviet Union have been experimenting for several years on containing this high-temperature energy within a closed configuration vessel called a Torus. Smaller Torus devices have not had a magnetic field large enough to contain the gaseous plasma and the energy it creates at high temperatures.

The purpose of JET, therefore, is to build an experimental vessel large enough to produce and to study a plasma in conditions simulating those in a thermonuclear reactor.

The JET device will be an 80-ton vacuum vessel (torus) made of eight stainless steel sections welded together. It will have 32 toroidal field coils made of copper and cooled by circulating water -- total weight 380 tons. The poloidal field coils are also constructed of water-cooled copper -- total weight 80 tons. An eight-limbed iron core -- weight 1,500 tons -- will improve the transformer efficiency.

The JET power supplies will combine power from the network and motor-generator-flywheel units. The maximum power drawn from the supplies is expected to exceed 500 mega watts. Additional heating will be provided by injecting energetic neutral atoms into the plasma, by radio frequency heating and by adiabatic (thermically isolated) compression of the plasma obtained by increasing the magnetic field.

The JET device will be operated by a centralized control system. Temperature plasma density and other characteristics of the plasma will be measured by special diagnostic techniques. The control circuit and "diagnostics" will be linked by computers to provide fast control of the plasma and apparatus and to aid in analysis and measurement of the experimental results.

The JET experiments will be conducted at first with plasma that lacks some of the elements necessary to produce fusion reactions. Scientists believe they will be able to determine how a fusionable plasma can be expected to behave within the magnetic walls of the container and what methods should be used to heat the plasma. If these experiments are successful, a fusionable plasma will be produced and thermonuclear fusion reactions will be observed.

The Joint European Torus is similar to but smaller than a Soviet project called the Soviet T-20, but it has a larger volume than the JT-60 in Japan or the Two-Component Torus (TFTR) being designed by the Princeton Plasma Physics Laboratory and Westinghouse in Princeton, New Jersey. The four fusion projects are considered complementary rather than competitive, however, since each is approaching fusion research from a slightly different aspect.

At their meeting in Luxembourg,the European research ministers also agreed that a JET II project, to be constructed if the research at Culham proves fruitful, would not be built in England but in another European Community country. Funding for JET I at Culham, the ministers agreed, will be shared among the eight other member states, except for Britain, the host country, which will contribute 25 per cent of the cost.

The European Community is cooperating with the International Energy Agency on other elements of fusion research. Energy Commissioner Brunner recently signed two agreements for research into reducing the effects of the plasma on the magnetic walls of a torus and for research and development on superconducting magnets for fusion power. Under the latter agreement, each of the participants will provide at least a single superconducting magnetic coil for a testing unit of four to six coils. The European Community will provide one of these coils, at a cost of between $4 to $5 million. The United States, another participant in the research, will provide a coil and the Large Coil Test Facility, which is expected to cost about $25 million.

Total Community expenditures on fusion research amount to $116 million yearly. Total Community-funded research -- in energy, nuclear safety and environment -- amounts to $870 million per year.