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France to Be Site of World's First Nuclear Fusion Reactor

By [CRAIG S. SMITH](#)

PARIS, June 28 - France won an international competition today to be the site of the world's first nuclear fusion reactor, an estimated \$12 billion project that many scientists see as essential to solving the world's future energy needs.

"It is a great success for France, for Europe and for all the partners" in the reactor project, President Jacques Chirac of France said in a statement after an international consortium chose the country as the site for the International Thermonuclear Experimental Reactor.

Japan, which had lobbied hard for the project, just dropped out of the bidding. The six-member consortium, which includes the United States, Russia, China, Japan, South Korea and the European Union, agreed in Moscow to build the reactor in the southern French city of Cadarache.

Nuclear fusion is the process by which the atomic nuclei are forced together, releasing huge amounts of energy, as with the sun and stars or, in manmade form, the hydrogen bomb. The process has long been studied as a potential energy source that would be far cleaner than burning fossil fuels or even nuclear fission, which is used in nuclear reactors today but produces dangerous radioactive waste.

While the physics of nuclear fusion have long been understood, the engineering required to control the process remains difficult and the logistics of coordinating construction among a six-member consortium presents an even bigger challenge.

The reactor project was started in 1988 but quickly bogged down in bickering over where the reactor's design team would be based. A compromise split the team between Japan, Germany and the United States, but the inability to decide on a single site foreshadowed the consortium's struggle over agreeing where the reactor would be built.

Canada, Spain, France and Japan were originally in contention to host the reactor, but a December 2003 meeting to pick a winner ended in a deadlock, with the United States, Japan and South Korea backing the Japanese site and the other three consortium members pushing for the site in France.

Japan finally agreed to relinquish its bid in return for the consortium's commitment to build a \$1 billion materials testing facility in that country.

The consortium also promised Japan that any subsequent fusion reactor would be built there, a significant concession as the first reactor is a development project meant to solve the various technical problems involved and prove that fusion can be harnessed as an economically viable energy source. A second reactor would likely be a prototype meant for commercial power generation.

The standoff put the project on hold. With today's agreement, the consortium can proceed with the drafting of an agreement on the construction and operation of the reactor. Officials involved in the reactor project said they hoped the agreement would be signed by the end of the year, allowing work on the reactor to begin next year and ground to be broken at the Cadarache site in 2008.

Current plans foresee the reactor operating in 2015.

Construction of the reactor is expected to cost \$5 billion with its operation is expected to cost another \$5 billion over twenty years, according to officials of the reactor project. Those numbers are based on present-day dollars, however, meaning the actual cost of the reactor will be much higher by the time it is completed.

Many experts also predict that construction could take much longer than currently foreseen, given the difficulty of coordinating multiple suppliers of costly and highly technical components in many countries. Today's agreement leaves open the possibility that still more countries may participate in the project. India, for example, has expressed interest in getting involved.

The final agreement on the International Thermonuclear Experimental Reactor is expected to include provisions that would require consortium members that cause delays to pay compensation.

The fusion project has stirred controversy since it was first considered in the 1980's, with many scientists arguing that "big science" projects like the multibillion-dollar experimental reactor would divert money from the "little science" of individual researchers who have often produced the most striking scientific breakthroughs.

But such criticism has been drowned out by the growing recognition of fusion's potential as a solution to the world's growing energy needs.

"We all know oil and gas depletion will start in 2030 or 2035," said Peter Haug, secretary general of the European Nuclear Society.

He said most experts agree that because of technical difficulties, renewable energy sources like wind or solar power are unlikely to provide more than 15 or 20 percent of the world's energy needs. There is enough coal in the earth to keep the world running for centuries, but at an unacceptable environmental cost because of air pollution. As the world's oil and gas fields become exhausted, the world is expect to increase

its reliance on nuclear energy.

"We don't think fusion will remove fission from the production scheme," Mr. Haug said. "But it will probably be used along with fission because of the growing energy needs of man."

Still, few scientists expect a fusion reactor to generate commercially viable electricity before the middle of the century, if by then.

In the meantime, the fusion project means money for the industries and scientific communities that will contribute to it.

"It's brings great joy and great pride," said Pascale Amenc Antoni, director of the Cadarache Center, which is run by France's Atomic Energy Commission.. She said it also recognizes the work on nuclear fusion at its research facility.

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