Antibiotics' natural role

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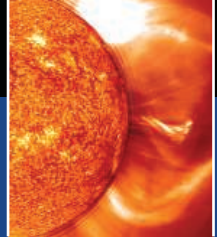

Predicting solar storms

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FUSION RESEARCH

ITER Gets the Nod for Slower, Step-by-Step Approach

The managers of the ITER fusion project are still scrambling to draw up a final design, schedule, and cost estimate for the massive reactor. But the international partners behind the effort agreed last week to build the project in stages so engineers can make corrections if something goes awry early on.

First, a simple stripped-down reactor will start producing a superhot hydrogen plasma in 2018; then components will gradually be added to prepare it for a power-producing plasma of deuterium and tritium by the end of 2026, some 18 months to 2 years later than previously planned. Member countries agreed to the new plan, known as scenario 1, at the half-yearly meeting of the ITER council in Mito, Japan, contingent on their accepting the full revised design, costing, and schedule, known as the baseline, at their next meeting in November. "We're learning as we go," says David Campbell, deputy head of ITER's fusion science and technology department. "There is some delay, but it's the first time we've done this."

ITER, originally called the International Thermonuclear Experimental Reactor, aims to prove that nuclear fusion, the process that powers the sun and other stars, could provide Earth-bound energy. Researchers spent about 15 years drawing up a design for ITER, and the ground is now prepared at Cadarache in southern France to begin construction this year. But when the ITER organization was officially created in October 2007, staff were working from a baseline drawn up in 2001. Researchers spent the next year working on a redesign incorporating the latest results from plasma physics.

But the physicists' wish list inevitably pushed up the price tag. The governments of the seven members—China, the European Union, India, Japan, South Korea, Russia, and the United States—were alarmed by early cost estimates, which insiders say ranged as high as twice the original €5 billion construction estimate (*Science*, 27 June 2008, p. 1707). "There's no question that costs have gone up," says Steven Cowley, director of the Culham Science Centre near Oxford, the U.K.'s fusion research lab, adding: "I'm pretty optimistic that we'll see a number of measures to bring down those costs."

Ready, set, ... The ground is prepared at Cadarache in southern France. Construction of ITER will begin this year.

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ITER managers proposed scenario 1 mainly to reduce technical risk, says Campbell. "We'll be able to shake down the core system, demonstrate first plasma, then integrate other systems," he says. "If something goes wrong, it's easier to get at it and fix it." Earlier fusion reactors, including JET at Culham, currently the world's largest, adopted a similar staged approach. The machine that researchers will fire up in 2018 will pretty much just comprise the vacuum vessel, superconducting magnets to hold the plasma in place, and a cryogenic system to cool the magnet coils. Researchers will first run the reactor with normal hydrogen inside to learn how to control the plasma, and there won't be any fusion reactions.

In following years, engineers will install diagnostic instruments, microwave and particle beam heating systems to raise the plasma's temperature, a metal blanket on the inside wall of the vessel to absorb neutrons from the fusion reactions, and a diverter to extract spent fuel. Only when all of those components are working properly will researchers fire up a plasma of deuterium and tritium and attempt to generate energy. Once they start, the vessel will be radioactive and harder to modify. Campbell says scenario 1 will delay the start of deuterium-tritium operation from early 2025 to late 2026. "Scenario 1 has a lot of attractions for a machine builder," says Cowley. "It's a better idea than the original idea."

Estimating ITER's cost remains a thorny issue and may be impossible to do accurately, project scientists say. In the 2001 baseline, researchers had calculated a value for ITER's various components so that they could be parceled out fairly to the partners to build and deliver to the site. Each partner decides for itself how much to spend on their components, depending on local market conditions and commodity prices. The ITER organization in Cadarache is in charge of only about 10% of spending. "We're trying to make the best estimate of the costs we're responsible for," says Campbell.

As part of that effort, after ITER staff presented the first results of the redesign at a council meeting in June 2008, the council ordered JET's former operations director, Frank Briscoe, to carry out an independent review of costs. As of last week's meeting, that review was still going on, and the council requested that a final revised baseline be presented at its next meeting in November.

Cowley thinks the council would not even consider scaling down the reactor to cut costs. "You would never get to fusion with anything less," he says. "ITER [as it stands] is the minimum possible." In the end, Cowley believes, the members are less concerned about the overall cost than about keeping annual expenditure steady. The phased construction plan has the added benefit that it avoids a huge peak in construction activity and spending during about 2015–16. **–DANIEL CLERY**

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