

## Brexit brings nuclear (con)fusion

The world's biggest active nuclear fusion project could lose EU funding just as it gears up for its grand finale.



The €13 billion International Thermonuclear Experimental Reactor (ITER) is under construction in France | ITER

CULHAM, England — Just as European scientists here gear up to put decades of experiments to the test and try to bottle up the nuclear reaction that powers every star in the universe, *Brexit* is throwing the future of their work into doubt.

The 34-year-old *Joint European Torus* (JET), which sits in the *Culham Centre for Fusion Energy's* retro 1960s laboratory, is a crucial part of an international research push on nuclear fusion that hopes to, one day, fuel homes and cities with energy free of greenhouse gases and waste.

Despite its location in the Oxfordshire meadows, JET is an EU venture through and through. The hundreds of scientists, engineers and technicians who visit the center to conduct experiments, as well as the parts used to assemble the world's biggest nuclear fusion reactor so far, come from all around the Union.

Crucially, so does the €283 million that underpins the JET program for the five years through 2018. New European Commission funding, at least for 2019 and 2020, looked pretty certain — until Britain's referendum, and London's *announcement* in January that it would *leave the European atomic energy community*, *Euratom*, once the U.K. leaves the block in two years.

Talks to renew JET's funding are now on hold, according to Culham center officials. What happens after 2018 depends largely on the outcome of *Brexit* negotiations.

The uncertainty could delay or even derail the JET program's grand finale: Heating two hydrogen isotopes — heavy hydrogen (deuterium), which comes from water, and super-heavy hydrogen (tritium), from lithium — to temperatures hotter than the center of the sun.

JET was the first fusion reactor in the world to *achieve fusion this way in 1991*, and scientists have since worked to refine their control of the reaction and design better materials for the reactor's core.

Now it's time to put those changes to the test.

Tritium is radioactive, and JET is currently the only reactor in the world that can handle it. While China, Germany and others are also experimenting with fusion, building a new reactor to test the mix somewhere else would be costly and time-consuming, with far stricter regulations nowadays, according to Lorne Horton, JET's exploitation manager.

*“Not going ahead is madness,” said Horton, who was seconded by the European Commission. “What we’ve been told is to proceed as normal,” he added. “But we’re hoping something happens soon because we’re running out of time.”*

### *‘For me, it is a concern’*

The work needed to get *JET* ready for the tritium experiments in late 2018 starts in January when 300-400 workers are due to arrive in Culham. Once they’ve seen how the machine handles tritium, they will test it with tritium and deuterium together in late 2019.

The walls of the reactors now match the materials that will go into the much bigger €13 billion *International Thermonuclear Experimental Reactor* (*ITER*) under construction in Southern France, which is waiting to see *JET*’s results. As a venture between EU members, the U.S., China, Russia, Japan, South Korea and India, *ITER* is among the largest international projects on the planet — second only to the *International Space Station*.

*ITER* is expected to produce its first plasma — the super-heated exotic state of matter in which fusion occurs — in 2025, and then mix tritium and deuterium to generate energy in 2035. Once it begins experimenting, the “little *ITER*” in Culham will cease to be useful. But between now and then, it’s an important learning ground.

*“If *JET* ends after 2018 in a way that is not coordinated with another global strategy for fusion development, clearly it will hurt *ITER*’s development,” said Bernard Bigot, *ITER*’s director general, adding that he would like to see *JET* extended to 2022 or 2023. “For me it is a concern.”*

*JET* is also seen as valuable training base for the legion of fusion experts *ITER* will need, Bigot and others stressed.

“If *JET* closed at the end of 2018, and *ITER* doesn’t operate for seven years thereafter, there’s an extremely high probability that a large fraction of that resource in terms of know-how and capability could be lost,” said Ian Chapman, chief executive of the U.K. Atomic Energy Authority, which oversees the Culham center.

### *As hot as the sun*

From the outside, *JET* looks more like an engine room than a nuclear reactor. At the center is a doughnut-shaped magnetic chamber called a “tokamak” — the place where the “star in a jar” is made.

To make this happen, atomic nuclei are heated to around 200 million degrees Celsius to create a hot pink plasma that wisps around the chamber and lights up like a disco.

But the day when homes will be powered by fusion is still a long way off. The joke among experts is that fusion is 30 years away and has been for 30 years. It almost certainly is still 30 years away — at least — but *ITER* should show whether fusion energy is viable.

The worst that could happen in an accident is that the heat switches off and the plant shuts down, leaving only radioactive traces inside the sealed tokamak.

If ITER fails, fusion will likely be dead.

But if it works, the prize is an unlimited and predictable clean energy source — and the key to helping the world meet difficult goals for limiting global warming.

*“With fusion, we still could get there,” said Tony Donn  from EUROfusion, a network of EU fusion research programs.*

It would also be much safer than conventional nuclear power. The worst that could happen in an accident is that the heat switches off and the plant shuts down, leaving only radioactive traces inside the sealed tokamak.

## Brexit wrench

Nuclear fusion officials are now focused on containing the fallout of the U.K.’s departure from Euratom by trying to raise awareness about the damage it could do to their program.

That’s taken up the bulk of Chapman’s job since he took over at Culham little more than a month after the *Brexit* vote.

*“It’s really defined my tenure thus far, and I’ve spent a lot of my efforts working with government and informing government about all of the ramifications of the fusion program and leaving the European Union and Euratom,” Chapman said. “We have to develop a strategy which maintains a strong U.K. fusion program and maintains a strong international fusion program.”*

Jo Johnson, Britain’s science, research and innovation minister, tried to quell concerns in February, saying that the government does not intend to compromise the Culham fusion center’s “world-class” position. But it has not yet addressed JET’s most pressing uncertainty — whether it will get funding for 2019 and 2020, at least. Beyond that, the divorce raises questions about the U.K.’s participation in ITER, since EU countries fund the project through Euratom.



The Joint European Torus, resides in the U.K. and is seen as an important stepping stone for ITER’s future - U.K. Atomic Energy Authority/ EUROfusion

Johnson shared concerns about JET when he met the EU’s research, science and innovation commissioner, Carlos Moedas, last week. Moedas told POLITICO he explained that future EU funding is part of the *Brexit* talks. The Commission intends to propose extending the Euratom program to 2020, he added in the statement. But Moedas did not say if JET would be part of that and

noted that JET's continued operation is now subject to a broader independent evaluation. A U.K. government spokesperson did not respond to a request for comment.

There is a range of options for redesigning Britain's relationship with Euratom, Chapman said, from becoming a partner country in research, training and ITER programs, like Switzerland, to breaking away and funding the fusion projects on its own.

*"If the U.K. says in the negotiations, 'We will take a huge chunk of JET,' that could allow us to continue this operation," said Donné.*