Abstract

ITER putting the sun in a box

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When he was asked how long it would take to build the first fusion power plant, the Soviet physicist Lev Artsimovich – one of the pioneers of tokamak research – replied that "fusion will be there when society needs it". Although it can be argued that we do indeed require it now, the route has been more arduous and the road longer than might have been imagined when those comments were made. But with the ITER machine, now well under construction in the South of France, the world Fusion Community is finally taking a key and bold step required to show the way towards feasibility of a demonstration reactor based on the tokamak (magnetic confinement) concept. This multi-national project, with partner countries (including the European Union) whose populations together represent more than half the world's population, is one of the most challenging and largest scientific endeavours ever attempted by mankind.

Starting with an introduction to the basics of the terrestrial fusion reaction between the light hydrogen isotopes and the tokamak principle, I will try to explain why the ITER device must be as large as it is and describe the main physics and technology goals of the project which, despite being a forerunner to any possible next step reactor, remains fundamentally an experiment. It will produce no electricity for the grid and will operate only in comparatively short pulses (around 10 minutes in the first years of exploitation and ultimately up to about one hour), but will bring together in a single machine all that we have learned in more than 70 years of R&D on the tokamak concept, both from the physics and engineering perspectives. I will describe the current status of plant construction and machine assembly and outline the research plan which takes the device from first plasma to achievement of the principal fusion power objectives.

In comparison with previous decades, the fusion world is experiencing a minor avalanche of new generation devices either coming on line now or expected to be in operation in the relatively near future, both in the public and private research domains. In the case of private enterprise, the claim is sometimes one of "faster, better" than the route the mainstream has chosen with the ITER device. The presentation will conclude with some brief thoughts on the prospects for fusion power generation.

Disclaimer: The views and opinions expressed herein do not necessarily reflect those of the ITER Organization.

Bio Richard Pitts

Richard Pitts, earned his Phd in 1991 from the University of London, UK, in collaboration with UKAEA Culham Laboratories, for experimental research with electrostatic probes in the plasma boundary of the DITE (UK), TEXTOR (Germany) and COMPASS (UK) tokamaks. Following a year working on a task agreement at the JET tokamak (UK), he moved to a postdoctoral position at the CRPP Lausanne, Switzerland (now SPC) and established a plasma boundary research programme on the then new tokamak TCV, which began operation in 1993. A two year postdoc turned into a 16 year stay, but included a 7 year period between 1999 – 2007 with regular short term secondments back to JET, acting first as Deputy, then Leader of the Exhaust Physics Task Force under the European Fusion Development Agreement. In 2008 Richard moved to the ITER Organization (IO) in Cadarache, France, to lead the Plasma-Wall Interactions Section and then, from 2019 the Experiments and Plasma Operation Section within the IO Science Division. He is the author/co-author of over 400 peer reviewed journal papers and, since arriving at the IO, has collaborated with experimental and modelling teams in almost all of the ITER Member fusion institutes worldwide, including with KTH scientists. He holds an Adjunct Professorship at the MEPhI University, Moscow and is a Fellow of the Institute of Physics.