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ITER.NL: Dutch technology paving the way for nuclear fusion

Some two hundred Dutch companies have the kind of technology that can, in principle, be used in the construction and operation of the ITER test reactor. Their prospects are enhanced by ITER-NL.

Photo: Witho Worms

Nuclear fusion generates energy by fusing the nuclei of two different atoms. This fusion requires two isotopes of hydrogen: deuterium and tritium. The fusion produces helium. The non-radioactive deuterium can be found on Earth in large quantities while the radioactive tritium is made in the reactor chamber by bombarding the metal lithium with neutrons. And there is also plenty of lithium about. One kilogram of deuterium and lithium contains as much energy as ten million kilos of coal. The fusion process requires a temperature of 150 million degrees Celsius, a temperature at which all material becomes gaseous and forms a plasma. 'When that plasma comes into contact with the reactor chamber's walls, it cools immediately,' says TNO's Peter Verhoeff. 'The fusion reaction then stops. You can prevent that by creating a powerful magnetic field and thus keep a distance between the plasma and the wall. Where the helium leaves the reactor at the "exhaust" the wall has to be reinforced. The wall has been the subject of much study just as the technology used to precisely control the "burning" plasma.'

MICROWAVE OVEN

The Netherlands has set out to develop two instruments for ITER: the *Upper Port Viewer* (UPV) and the plasma heating system *Electron Cyclotron Resonance Heating* (ECRH). The UPV monitors the status of the plasma. Verhoeff: 'We are using an advanced spectrometer to probe into the core of the plasma in order to establish whether a helium surplus needs to be removed. In developing this system we have been working with the Forschungszentrum Jülich near the German city of Aachen. You can compare the ECRH with a kind of microwave oven that locally heats the plasma and so get disruptions under control. We are doing this work in an international consortium, with partners from Germany, Switzerland and Italy.'

Dutch companies have a lot to offer, e.g., *remote handling*. Verhoeff: 'The large ITER vacuum chamber needs regular maintenance. Since the reactor wall and the control equipment become radioactive, maintenance can only be done at a safe distance using robotic systems. The Dutch company S&T specialised in predicting what could go wrong, and when. This enables a maintenance schedule to be modified accordingly. Furthermore, much of the technological knowledge developed by companies like Dutch Space and HIT to produce the ERA robot arm for use in space can be useful for ITER. And if you are working remotely with robots, you want to be able to see what you are doing. The great thing about that is that specialists in *vision technology* and corresponding software products are on the doorstep.'

COUNTRY ROADS

The vacuum chamber, whose diameter is twenty metres, comprises nine double-walled sectors of around sixty mm thick. ITER-NL has helped a TNO spin-off, Exploform, to develop a method to shape thick panels of this kind using controlled explosions. Verhoeff: 'This is a technology that can be very useful to ITER and its development has already led to quite a few spin-off orders outside the world of fusion.'

Verhoeff is able to read off a whole list of Dutch companies that have been able to contribute their technology and knowledge to the ITER project: 'Philips, for instance, has considerable knowledge in the area of tungsten. You just have to think about the tungsten you find in light bulbs. Tungsten has a very high melting point and is thus perfectly suited to coat the steel inner wall of the reactor. Another example: Mammoet Europe, based in Schiedam (Rotterdam) specialises in heavy land and sea transport. That could be very handy for the heavy transport needed along the country roads to Cadarache.'

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