IAEA International Atomic Energy Agency (/)

World's Fusion Project Nearing Milestone

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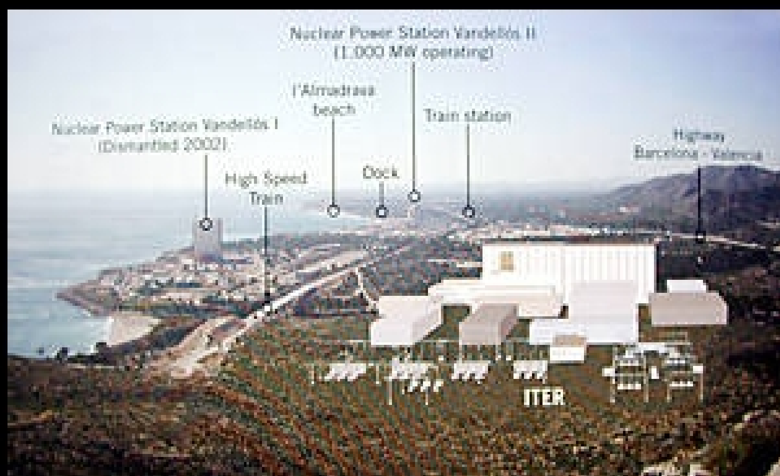

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One of the candidate sites for the ITER project (Credit: CIEMAT, Spain)

Is nuclear fusion the sun's energy, created by the fusion of light nuclei going to become a realistic energy source on this planet? At the 19th IAEA Fusion Energy Conference in Lyon, France, in October 2002, scientists were confident the planned construction of ITER – the International Thermonuclear Experimental Reactor - would be a major step toward the development and future reliable exploitation of this energy source. Nearly 600 scientists and technologists from the fusion community attended this meeting. Although scientific debate and discussion continue, there is broad consensus that all aspects of fusion research and technology will move forward together to support and build ITER.

ITER was the main focus of many of the scientific papers submitted to the conference, and fusion researchers were confident that the project will keep its promise and deliver the expected results. Under ideal conditions ITER will be able to produce ten times more power through the fusion process than is input into the plasma from outside (i.e. 500 megawatts produced from 50 megawatts input).

When it is built, ITER will be the world's largest international cooperation research and development project. At the time of the conference, there were four members of the ITER project: Canada, the European Union, Japan, and the Russian Federation. While project leaders feel the number of member countries must be kept manageable, at least two other countries are expected to join this effort within the next months. The United States, which left the ITER project in 1998, is now giving serious consideration to rejoining the project, as recent reports indicate.

One of the most positive aspects of the ITER project has been the co-operation of science and technology beyond national boundaries and interests. And not only scientists are already working together to advance ITER – firms from countries participating in the project are able to join to contribute the manufacturing of prototype components. Scientists have already assembled and successfully tested for compatibility real-scale parts built to ITER specifications by companies in different countries.

In keeping with this, the political independence of ITER is an essential part of its co-operative and international commitment. Once the site decision has been taken, ITA – the ITER Transitional Arrangements (to manage the project until the entry into force of the ITER Joint Implementing Agreement, and to prepare an efficient start of machine construction)- will focus on moving forward to ensure that the fusion reactor is built within the established time frame.

Four countries – Canada, France, Japan, and Spain – have proposed ITER construction sites, and a site selection committee is reviewing the proposals. A decision on the siting is expected by mid-2003. Each of the four candidate sites offers excellent scientific, socio-economic and technological infrastructure. Although each has its own individual composition, the ITER blueprint has been drawn up to ensure a degree of adaptability to the geography and geology of each site.

Construction of this project will pose a considerable challenge to science and technology – the sheer size and weight of the component parts and the intricacies of assembly demand exact preparations and planning. This will come as no surprise given the need to transport and assemble sections of the vacuum vessel weighing 500 metric tonnes each.

A project the size of ITER will need a large, well developed infrastructure in the communities around it. The review encompasses the feasibility of the proposed site itself, liability, licensing, safety and insurance factors. It also covers employment, housing, and impact on facilities and structures such as roads, bridges and power lines, as well as seismic studies.

For the estimated ten year construction phase, the management of ITER will need approximately 4500 man hours of scientists and technicians, plus support staff. As soon as the experimental reactor becomes operational, the number of staff employed will be approximately 1000.

The ITER Project Team will operate from several different locations, but a Central Team will take overall responsibility for the project after construction begins. Field Teams will follow up on the technical progress – including quality control – of procurement contracts awarded within each given territory.

The Science and the Machine

Interest in the inherently safe and clean nature of fusion energy is the major driving force behind research in the field: in fusion, there is virtually no release of radioactivity to the environment, the waste disposal process is more straightforward, and the half-life of the waste products far shorter, than in the case of fission products.

As the world faces the future reality of energy crises, fusion researchers – theoreticians, experimentalists, and technologists - are committed to working together to advance the fusion energy option and create a viable experimental fusion reactor within the next decades.

Reproducing the process by which energy is created by the sun gave the concept of nuclear fusion to science, and the sea and stones can provide the ingredients necessary to create fusion on earth: both light nuclei used in the fusion process are isotopes of hydrogen: deuterium can be won from sea water through a fairly straightforward process, whereas the second isotope, tritium, is won out of lithium, an element commonly found in stone.

The critical point in fusion research has been the best way to create, confine and heat the ionised gas known as "plasma", a mixture of hydrogen isotopes. The work of plasma physicists – scientists studying the physics of the ionised gas – has set the foundation. The field is now expanding into technology and calling for intense research in materials science as metals - so-called "low-activation materials" - able to withstand the energetic neutron from the fusion process are called for.

Top fusion laboratories all over the world have contributed to this research, and there is general agreement about the ideal technology for ITER – the tokamak, a toroidal vessel of a doughnut shape into which the plasma is confined by a high magnetic field created by superconductors cooled by helium at a temperature close to absolute zero. The plasma is heated to approximately 200 million degrees Centigrade: at this temperature the deuterium and tritium fuse with a large enough probability to produce energy.

Fusion specialists view ITER – like other experimental fusion devices before it - not as their final goal, but as a significant step on the path to harnessing fusion power as a possible future electricity provider. Scientists agree that the machine must be built as proposed – a smaller device than ITER will not be able to produce the results needed to advance enough towards this goal.

ITER will be a major stepping stone towards making fusion energy part of the world´s energy mix. Scientists and technologists at the IAEA Fusion Energy Conference in Lyon agreed that - site preferences aside – ITER will move the world one important step closer to creating energy by controlled thermonuclear fusion.

Related Resources

- Canada (http://www.itercanada.com/host/s4/clarington.cfm)
- Focus on Fusion (https://www.iaea.org/NewsCenter/News/2001/08012001_news01.shtml)
- France (http://www.itercad.org/)
- ITER Pages (http://www.iter.org/)
- Japan (http://157.111.156.241/mext/Rokkasho.html)
- Nuclear Fusion Journal (http://epub.iaea.or.at/fusion/)
- Spain (http://www.iter.org/)
- The Science and the Machine (https://www.iaea.org/NewsCenter/News/2002/3-836460.shtml#science)
- What's Fusion? (https://www.iaea.org/NewsCenter/News/2001/08012001_news02.shtml)

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