Press Release

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Successful Demonstration of Key ITER Technology

Test Coil Using Nb-Ti Superconducting Conductor attains 52 kA at 6.4 Tesla

Cadarache France (05.09.08)... The ITER Organization with the Japanese and European Domestic Agencies, represented by Japan Atomic Energy Agency (JAEA) and Fusion for Energy (F4E) with the support of the European Commission, respectively, have jointly tested a prototype Niobium(Nb)-Titanium(Ti) superconductor for the ITER Poloidal Field (PF) coils. The test coil using the Nb-Ti conductor achieved stable operation at 52 kA and 6.4 Tesla, emulating the operating conditions of the PF coils in the ITER tokamak.

Extremely powerful superconducting magnets will be used to maintain the fusion plasma equilibrium and shape inside ITER. Demonstrating that the superconducting strands for these magnets would perform to design specification was one of the most important technological milestones for the project.

"These results are very important for the project because they confirm the performance of the current design." said Gary Johnson, Director of ITER's Tokamak department. "They are also very timely, given our plans for PF conductor procurement arrangements to be finalized and signed in the coming weeks."

The test coil with an outer diameter of 1.5 m and weighing 6 tons was manufactured by an international collaboration: the Russian Domestic Agency produced the 0.73-mm diameter Nb-Ti superconducting strands and bundled them into a cable consisting of 1,440 strands; the European Domestic Agency assembled the cable into a steel jacket to make the final conductor. Winding of the conductor, insulating the turns and bonding them together to form a coil was also performed in Europe.
The testing took place at the JAEA site in Naka, Japan, selected for the tests because of its technical characteristics and the availability of world class expertise. A team, consisting of experts from JAEA, F4E and the ITER Organization, performed the tests with participation from Russian and United States Domestic Agencies.

The ITER PF coils require an operation of a large conductor current of more than 50 kA, which is about 70% larger than achieved in any similar coils. To reach such a conductor current requires many individual strands. However, in such a cable, two competing and contradictory requirements have to be

resolved: to maintain AC losses (heat generation in a superconductor in a varying magnetic field) within acceptable levels under operating conditions while maintaining sufficient electrical contact between Nb-Ti strands to give high stability and equal distribution of the current. The solution was to apply nickel coating to the strand surface with a thickness of 2 microns to provide an appropriate contact resistance between strands for low AC losses and stable operation. The test coil was operated stably up to at least 52 kA at 6.4 T and 4.5 K and the AC losses of the conductor were confirmed to be below one half of the target figure. The coil also withstood 9,000 load cycles up to full current and overloading conditions 40% larger than the nominal operating ones. The results gave the researchers complete confidence that this conductor would fulfill the extremely demanding performance needed for the ITER PF coils, demonstrating a key technology required for ITER. Based on these achievements, the Chinese, European and Russian Domestic Agencies will start procurement of the ITER PF conductor.

BACKGROUND

ITER will be the world's largest experimental fusion facility and is designed to demonstrate the scientific and technological feasibility of fusion power. Fusion is the process which powers the sun and the stars. When light atomic nuclei fuse together to form heavier ones, a large amount of energy is released. Fusion research is aimed at developing a prototype fusion power plant that is safe and reliable, environmentally responsible and economically viable, with abundant and widespread fuel resources. The ITER project is sited at Cadarache in the South of France. Europe will contribute almost half of the costs of its construction, while the other six Members to this joint international venture (China, India, Japan, the Republic of Korea, the Russian Federation and the USA), will contribute equally to the rest.

For photos, go to:
http://www.iter.org/press_release/pf_coil/2008_09_05/