



One of ITER's 18 toroidal field coil magnets.
Image: US ITER



A completed spool of conductor at Criotec
in Chivasso, Italy. Photo: US ITER

Close-up view of niobium-tin superconducting wire. Photo: Luvata Waterbury, Inc.

US Contribution

US ITER will fabricate 8% of the toroidal field (TF) coil conductors. The ITER Organization is responsible for the conductor design released for fabrication. Japan, the European Union, the Russian Federation, Korea, and China are also contributing TF conductor.

Overview

The 18 toroidal field coils produce a magnetic field of 5.3 T around the ITER tokamak torus to confine the plasma particles. The TF coils have a total magnetic energy of 41 gigajoules and a maximum magnetic field of 11.8 tesla. US ITER is responsible for enough conductor to wind slightly over one TF coil, which is equivalent to over 4 miles of conductor constructed from 40 tons and over 4000 miles of niobium-tin superconducting strand. The coils will be made of cable-in-conduit superconductors, which are composed of superconducting strands cabled together, compacted into a stainless steel conduit, and cooled by supercritical helium. The US toroidal field contribution includes: 9 active double-pancake lengths (about 765 meters each), with 3 using Oxford Superconductor Technology (OST) strand and 6 using Luvata strand; 1 dummy length of 765 meters for winding trials; and, 2 active lengths of 100 meters each for qualification.

Status

US ITER completed delivery of conductor in 2017.



Jacketing material at the conductor integrator High Performance Magnetics. Photo: US ITER



A close-up view of conductor shows the density of compacted strand around a helium cooling channel. Photo: US ITER



Cabled conductor at New England Wire Technologies. Photo: NEWT

Technical Description

Toroidal Field Coil Height: 16.5 m
Toroidal Field Coil Width: 9 m
Single TF Coil Weight: 310 t
Total TF Coil Weight: 6540 t
Number of Coils: 18
Peak Field Strength: 11.8 T
Operating Voltage: 7 kV
Operating Current: 68 kA
Operating Temperature: 5 K
Current in 1 TF Coil: 9.11 MA
Maximum Magnetic Field: 11.8 T
Total Magnetic Energy of All TF Coils: 41 GJ
Number of Turns in 1 TF Coil: 134

Contributors include

Luvata Waterbury, Inc. (Waterbury, CT)
Oxford Superconducting Technologies (Carteret, NJ)
New England Wire Technologies (Lisbon, NH)
High Performance Magnetics (Tallahassee, FL)
Criotec (Chivasso, Italy)