

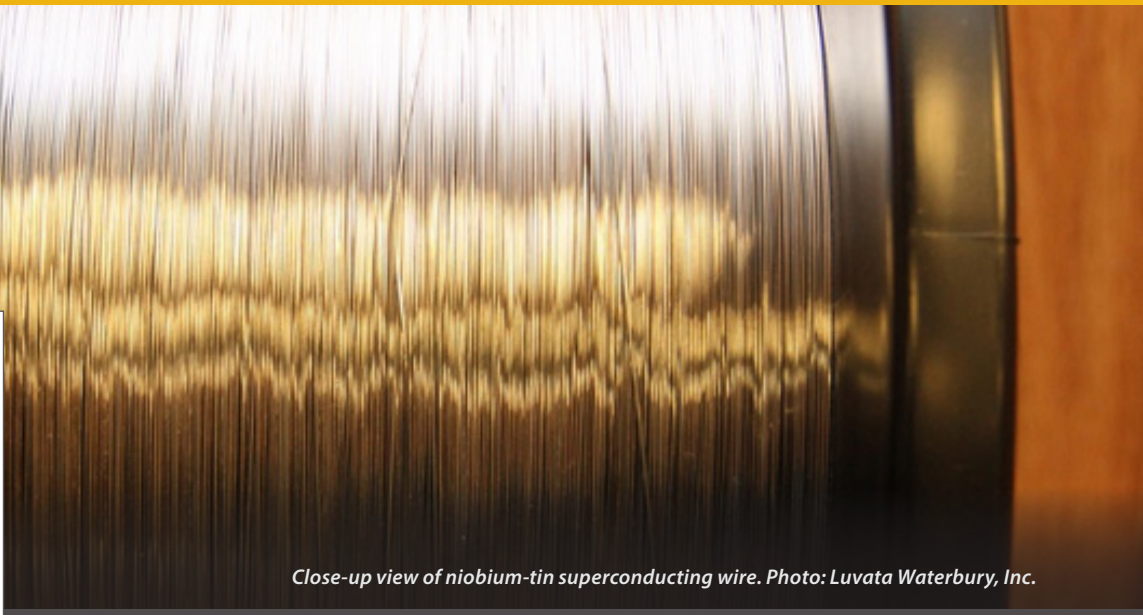
Toroidal Field Coil Conductor



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.

U.S. Contribution

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

Overview

The 18 toroidal field coils produce a magnetic field of 5.3 tesla 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. The United States is responsible for enough conductor to wind slightly over one TF coil, which is equivalent to more than 4 miles of conductor constructed from 40 tons and over 4,000 miles of niobium-tin superconducting strand. The coils are 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 United States' toroidal field contribution includes nine active double-pancake lengths (about 765 meters each), with three using Oxford Superconductor Technology (OST) strand and six using Luvata strand; one dummy length of 765 meters for winding trials; and two active lengths of 100 meters each for qualification.

Status

The United States completed delivery of conductor in 2017.



Jacketing material at the conductor integrator at the High Performance Magnetics facility. 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 (TF) coil height: 16.5 m

TF coil width: 9 m

Single TF coil weight: 310 t

Total TF coil weight: 6,540 t

Number of coils: 18

Peak field strength: 11.8 T

Operating voltage: 7 kV

Operating current: 68 kA

Operating temperature: 5 K

Current per TF coil: 9.11 MA

Maximum magnetic field: 11.8 T

Total magnetic energy of all TF coils: 41 GJ

Number of turns per 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)