

DIAGNOSTICS

Fabrication of antenna block weldment for the low field side reflectometer. Photo: General Atomics/Keller Technology

U.S. CONTRIBUTION


US ITER is responsible for the research and development, design, and fabrication for 14% of ITER's port-based diagnostic systems. This includes seven instrumentation systems (of ITER's approximately 45 individual diagnostic systems) and integration of four diagnostic port plugs. The European Union, Japan, the Russian Federation, China, Korea, India, and the technical teams at ITER headquarters are also contributing diagnostics to ITER.

OVERVIEW

ITER diagnostic systems provide measurements to aid understanding of plasma behavior and optimize fusion performance. Because of the harsh environment inside the tokamak vacuum vessel, these systems must cope with a range of conditions not previously encountered by diagnostic technology, all while performing with high reliability. Diagnostics provided by US ITER include microwave, laser, x-ray, and optical systems. Seven instrumentation systems are in US ITER's scope: the core X-ray crystal spectrometer, electron cyclotron emission system, low field side reflectometer, motional Stark effect diagnostic, residual gas analyzer, toroidal interferometer/polarimeter, and upper infrared/visible cameras. US ITER also will design, fabricate, assemble, and test four port plugs: upper ports UP11 and UP14 and equatorial ports EP3 and EP9. US ITER also supports the integration of multiple diagnostics into these plugs, including some from other ITER members.

STATUS

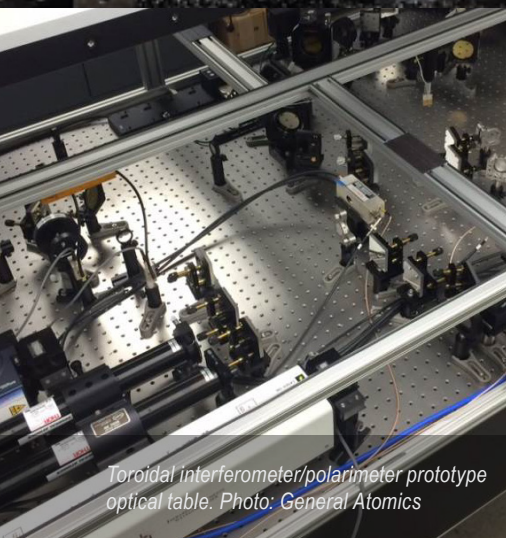
Most of the diagnostic systems are in final design. Fabrication of in-vessel components for the low field side reflectometer is underway. Captive overhead supports for both the low field side reflectometer and toroidal interferometer/polarimeter have been installed at the ITER site.



Precision long-bore drilling in a component of the low side field side reflectometer. Photo: General Atomics/Grand Valley Manufacturing



Gun-drilled block at start of pre-weld machining of antenna block for the low field side reflectometer. Photo: US ITER/Keller Technology



Toroidal interferometer/polarimeter prototype optical table. Photo: General Atomics

CONTACT

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TECHNICAL DESCRIPTION

Core X-ray crystal spectrometer. Measures the temperature of the ions from the hot plasma core to the cooler plasma edge.

Diagnostic residual gas analyzer. Measures the composition of exhaust gases leaving the tokamak in the edge and divertor regions, including hydrogen and helium isotopes and other constituents.

Electron cyclotron emission radiometer. Measures the temperature of the electrons from the core to the edge.

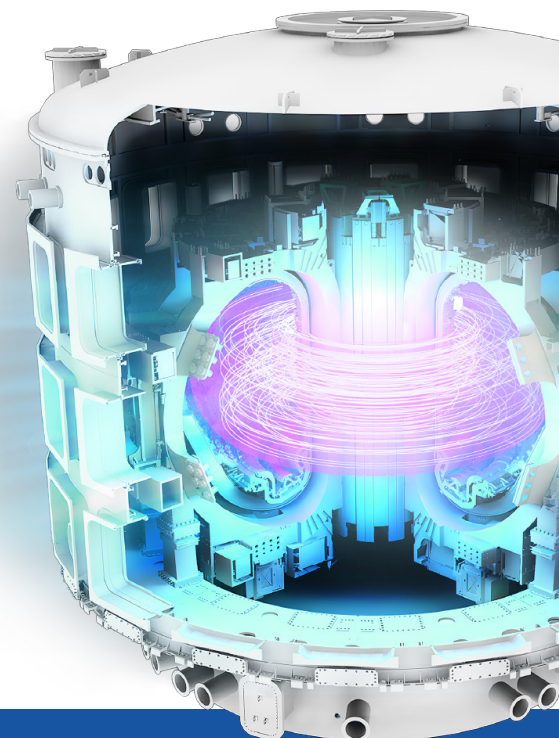
Low field side reflectometer. Measures the electron density in the outer layers of the plasma, by probing the plasma with microwave beams and detecting the reflected wave.

Motional Stark effect diagnostic. Measures the plasma current density, providing data that are important for understanding conditions for plasma stability.

Port integration. Integrates 18 tenant diagnostics into four U.S.-supplied port plugs (two upper ports and two equatorial ports) including interspace and port cell support structures.

Toroidal interferometer/polarimeter. Measures the electron density profile by probing the plasma with laser beams, providing data that will be used to control the density in real time.

Upper infrared/visible cameras. Image the high heat flux surfaces in the vacuum vessel to check for hot spots.



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US ITER is managed by Oak Ridge National Laboratory in Tennessee, with partner labs Princeton Plasma Physics Laboratory in New Jersey and Savannah River National Laboratory in South Carolina.