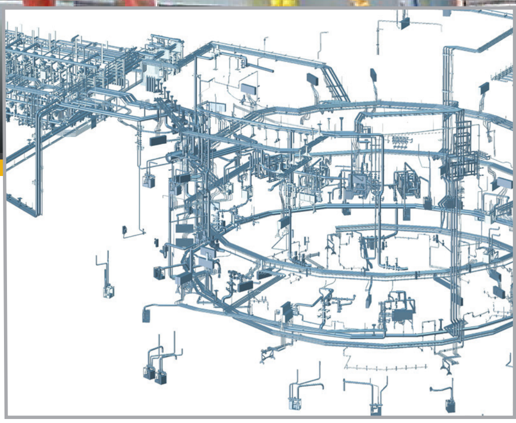
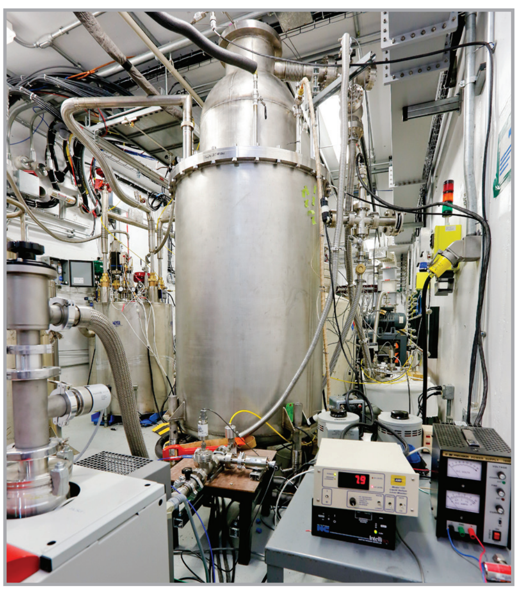
Vacuum Auxiliary and Roughing Pumps Systems

Rouging pump test stand at ORNL. Photo: US ITER



Vacuum system design. Image: US ITER



The cryoviscous compressor prototype underwent testing at the ORNL Spallation Neutron Source Cryogenic Facility before shipment to the ITER site. Photo: US ITER/ORNL

US Contribution

US ITER is responsible for the development, design, and fabrication of the vacuum auxiliary and roughing pumps systems.

Overview

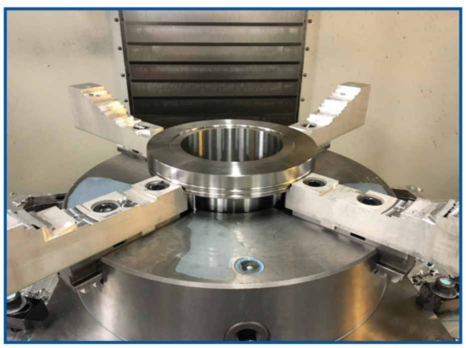
ITER has unique vacuum pumping requirements due to high throughput tritium operation. The ITER tokamak, cryostat, and auxiliary vacuum chambers must be evacuated prior to start of high vacuum operations with active vacuum pumping provided to certain clients during operations. The roughing pump system provides vacuum to the torus, neutral beam, and cryostat volumes, and supports active monitoring and vacuum distribution via the service vacuum system. The system also supports the regeneration of the torus, cryostat, and neutral beam injector cryopumps. Components include a matrix of pump trains with various technologies to match specific vacuum system requirements, including tritium-compatible backing pumps.

The vacuum auxiliary system consists of valves, pipe manifolds, high vacuum pumping stations, sensors, and controls used to connect the vacuum clients to the roughing pump system. Many elements are required to be compatible to high radiation and magnetic fields as well as suitable for tritium service.

Status

Final design, procurement, and fabrication activities are underway on subsystems of the vacuum auxiliary and roughing pumps systems. US ITER has completed development and prototyping of the cryo-viscous compressor pump (CVC), completed design for the main vacuum roughing headers, completed delivery of a complete set of vacuum testing equipment to the ITER site, begun fabrication of the cryo-guard vacuum system (CGVS) pump stations, begun delivery of piping hardware and high vacuum pumps, and started procurement of the roughing pumps for non-tritiated services.

A prototyped double-walled vacuum bellows fabricated by Kompaflex for use in the cryostat vacuum system. Photo: Kompaflex



Vacuum flange fabrication at Nor-Cal. Photo: US ITER

Technical Description

Tokamak vacuum volume: 1,330 m^3

Cryostat vacuum volume: 8,500 m^3

Neutral beam injectors' volume: 860 m^3

Vacuum system performance: $1*10^5$ Pa (101,000 Pa) to 10 Pa in 24 hours (for roughing); an additional ~150 high vacuum pumping stations operating at $1x10^{-6}$ Pa

Roughing pumps: Three tritium compatible roughing trains using specially developed roots, scrolls, and screw pumps. Two non-active pump trains using industry standard roots and screw pumps.

Service vacuum system: more than 5,000 clients

Vacuum piping: 6 km

Contributors include

Equans (Mios, France)

Inovoal (Houston, TX, U.S.)

Kompaflex (Egnach, Switzerland)

Pfeiffer Vacuum (Asslar, Germany)

Vacuum Technology Incorporated (Oak Ridge, TN, U.S.)

VAT Valve (Haag, Switzerland)

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