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ITER CS Magnet Module Test Facility Status Report

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Oral presentation (20 min) + Q&A (10 min)

General Atomics (GA) is under contract by US ITER organization (UT-Battelle c/o Oak Ridge National Laboratory) for the fabrication of ITER Central Solenoid (CS) Magnet Modules. GA will provide seven modules to ITER Organization (IO), six of which will be assembled in a stack that forms the ITER Central Solenoid. All CS Modules are required to pass factory acceptance testing (FAT) at General Atomics' Magnet Technology Center (MTC) test facility prior to shipment to IO. Currently, CS Modules 1, 2, 4, and 5 have completed FAT and have been delivered to IO. CS Module 7 has completed FAT and is being prepared for shipment to IO. CS Module 6 has completed the FAT powered testing portion and CS Module 3 will repeat FAT after repairs are completed on the Module.

The MTC test facility was designed and built to conduct factory acceptance tests on low-temperature superconducting magnets for fusion research, i.e. CS Modules. The test facility consists of the test chamber, high vacuum system, 4.5 K recirculating supercritical helium refrigeration plant, 50 kA direct current power supply, counter-pulsed direct current circuit breakers, 1 GJ discharge resistor, high-temperature superconducting current feeders, data acquisition system, supervisory control logic, and magnet quench protection system.

Each CS Module FAT campaign comprises of a pre-cooldown 30 kV electrical insulation test at ambient pressure, pre-cooldown 15 kV electrical insulation tests at sub-atmospheric (Paschen) pressures, pre-cooldown 30 bara global helium leak test, controlled cooldown to 4.5 K, hydraulic impedance tests at 4.5 K, AC loss measurements (6.8 and 23.4 second decay time constants) at currents up to 40 kA, current cycling from 0.5 kA to 40 kA, coil height displacement and surface strain measurements, cold (<20 K) 30 bara global helium leak test, controlled warmup to room temperature, post-cooldown 30 kV electrical insulation test at ambient pressure, and post-cooldown 15 kV Paschen tests. Additionally, temperature-current sharing tests up to 8 K were performed on CS Module 6 and are planned for CS Module 3.

A summary of the test facility equipment and operational lessons, upgrades, and modifications developed and implemented from tests performed on CS Modules 1-7 (thus far) will be discussed.

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Presenter: KHUMTHONG, Kenneth (General Atomics for ITER)