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Engineering, Manufacture and Preliminary Testing of the ITER Toroidal Field (TF) Magnet Helium Cold Circulator

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The ITER cryodistribution system provides the supercritical Helium (SHe) forced flow cooling to the magnet system using cold circulators. The cold circulators are located in each of five separate auxiliary cold boxes planned for use in the facility. Barber-Nichols Inc. has been awarded a contract from ITER-India for engineering, manufacture and testing of the Toroidal Field (TF) Magnet Helium Cold Circulator. The cold circulator will be extensively tested at Barber-Nichols' facility prior to delivery for qualification testing at the Japan Atomic Energy Agency's (JAEA) test facility at Naka, Japan. The TF Cold Circulator integrates features and technical requirements which Barber-Nichols has utilized when supplying Helium cold circulators worldwide over a period of 35 years. Features include a vacuum jacketed hermetically sealed design with a very low Helium leak rate, a heat shield for use with both Nitrogen & Helium cold sources, a broad operating range with a guaranteed isentropic efficiency over 70%, and impeller design features for high efficiency. The cold circulator will be designed to meet MTBM of 17,500 hours and MTBF of 36,000 hours. Vibration and speed monitoring are integrated into a compact package on the rotating assembly with operation and health monitoring in a multi-drop PROFIBUS communication environment using an electrical cabinet with critical features and full local and network PLC interface and control. For the testing in Japan and eventual installation in Europe, the cold circulator will be certified to the Japanese High Pressure Gas Safety Act (JHPGSA) and CE marked in compliance with the European Pressure Equipment Directive (PED) including Essential Safety Requirements (ESR). The test methodology utilized at Barber-Nichols' facility and the resulting test data, validating the high efficiency of the TF Cold Circulator across a broad operating range, are important features of this paper.

Primary author: Mr RISTA, P.E., Chris (Barber-Nichols Inc.)

Co-authors: Mr SARKAR, Biswanath (ITER-India); Mr VAGHELA, Hiten (ITER-India); Mr SHULL, Jeff (Barber-Nichols Inc.); Mr BHATTACHARYA, Ritendra (ITER-India)

Presenter: Mr RISTA, P.E., Chris (Barber-Nichols Inc.)

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