Challenges for Cryogenics at ITER

L. Serio for the ITER Organization, Domestic Agencies and Collaborators

ITER Organization CS 90 046, 13067, St. Paul-Lez-Durance Cedex, France

Abstract - Nuclear fusion of light nuclei is a promising option to provide clean, safe and cost competitive energy in the future. The ITER experimental reactor being designed by seven partners representing more than half of the world population will be assembled at Cadarache, South of France in the next decade. It is a thermonuclear fusion Tokamak that requires high magnetic fields to confine and stabilize the plasma. Cryogenic technology is extensively employed to achieve low-temperature conditions for the magnet and vacuum pumping systems. Efficient and reliable continuous operation shall be achieved despite unprecedented dynamic heat loads due to magnetic field variations and neutron production from the fusion reaction. Constraints and requirements of the largest superconducting Tokamak machine have been analyzed. Safety and technical risks have been initially assessed and proposals to mitigate the consequences analyzed. Industrial standards and components are being investigated to anticipate the requirements of reliable and efficient large scale energy production. After describing the basic features of ITER and its cryogenic system, we shall present the key design requirements, improvements, optimizations and challenges.

Keywords *(Index Terms)- Large* scale refrigerator, cryogenic distribution, supercritical helium, cold compressor, superconducting device, fusion.

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