EVALUATION OF SUPER CRITICAL HELIUM AS A COOLANT FOR DIII-D TYPE CRYOCONDENSATION PUMPS*

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DIII–D tokamak uses three cryocondensation pumps for plasma density control. Each DIII–D pump consists of a series of concentric stainless steel tubes. The pumping surface is a 10 m long 25 mm diameter stainless steel tube. The pumping surface of each of the three cryocondensation pumps is about 1 m^2 in area and is maintained below 5 K by cooling with a two phase helium (1.3 atm, 4.35 K). The two-phase helium (TP) was chosen for DIII–D because it is available on DIII–D site and is used for NB and other applications. The pumping speed is about 30000 l/s per pump. The three pumps inside DIII–D have performed as expected for last several years.

Super conducting machines under construction such as KSTAR and SST-1 have supercritical (SC) helium available on site and would prefer to use it for cooling the cryocondensation pumps. The typical condition of the available helium is 0.4 MPa (3.94 atm) pressure and 4.2 K temperature.

The design of DIII–D cryocondensation pump is simple, robust, inexpensive and reliable. This study was undertaken to evaluate if the supercritical helium can be used as a coolant for GA design of the cryocondensation pump. Thermodynamic, thermal hydaulic and stability evaluation was done. It is concluded that with super critical helium a flow rate of 50 to 60 g/s (compared to 5 to 10 gm/s with two phase helium) will be required to achieve a similar performance. The co-axial insert used in DIII–D helium panel will not be required with SC helium.

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