ENGINEERING DESIGN OF CRYOCONDENSATION PUMPS FOR THE DIII–D RADIATIVE DIVERTOR PROGRAM*

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A new double-null, slotted divertor configuration will be installed for the DIII–D Radiative Divertor Program at General Atomics in late 1996. Four cryocondensation pumps, three new and one existing, will be part of this new divertor. The purpose of the pumps is to provide plasma density control and to limit the impurities entering the plasma core by providing pumping at each divertor strike point.

The three new pumps are based on the design of the existing pump, installed in 1992 as part of the Advanced Divertor Program. The pump continues to operate successfully. The torodially continuous pumps vary in lengths from approximately 7 to 12 m depending upon their locations within the vessel. Each pump is independently operated and offers on average 0.7 m^2 of liquid helium-cooled pumping surface. The pumping surface is surrounded concentrically by nitrogen shields and particle shields of larger diameters. The nitrogen-cooled shields limit the heat flux on the helium surface. The particle shields limit incoming particles from impacting the helium and nitrogen cooled surfaces, preventing the condensed gases on the pump, primarily water, from being released.

The new pumps require geometry modifications on the original design. Therefore, extensive dynamic and modal analyses were performed to determine the behavior of these pumps and their helium and nitrogen feed lines during disruption events. Thermal and fluid analyses were also performed to characterize the helium two-phase flow regime in the pumps and their feedlines.

A flow testing program was completed to test the change in geometry of the pump feed lines with respect to helium flow stability. The results were compared to the helium thermal and fluid analyses to verify predicted flow regimes and flow stability.

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