FIVE SECOND HELIUM NEUTRAL BEAM INJECTION USING ARGON-FROST CRYOPUMPING TECHNIQUES*

J. Phillips, D.H. Kellman, R. Hong, J. Kim, G.J. Laughon
General Atomics, San Diego, California 92186-9784

High power helium neutral beams for the heating of tokamak discharges can now be provided for 5 seconds by using argon cryopumping to manage the gas flow in the beamlines.

The DIII–D neutral beam system has routinely provided up to 20 MW of deuterium neutral beam heating in support of experiments on the DIII–D tokamak. During normal operation each of the eight DIII–D neutral beams produces from 20–30 T l/s of deuterium gas for periods of up to 8 seconds per discharge. This gas is effectively pumped by the 4.3 K cryopanels present in each beamline, and only a small fraction is conducted into the DIII–D tokamak. Operation of neutral beams with helium has historically presented a problem in that pulse lengths have been limited to 500 ms due to reliance solely on volume pumping of the helium gas. Helium is not condensed on the cryopanels.

A system has now been installed to deposit a layer of argon frost on the DIII–D neutral beam cryopanels, between tokamak injection pulses. The layer serves to trap helium on the cryopanels providing sufficient pumping speed for five second helium beam extraction. The argon frosting hardware is now present on two of four DIII–D neutral beamlines, allowing injection of up to 6 MW of helium neutral beams per discharge, with pulse lengths of up to five seconds.

The argon frosting system is described along with experimental results demonstrating its effectiveness as a method of economically extending the capabilities of cryogenic pumping panels to allow multisecond helium neutral beam injection.

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Submitted by:

Signature

Typed Name: J. Phillips

Institution/Company General Atomics

Address P.O. Box 85608

City, Province, State/Postal Code

San Diego, California 92186-9784

Country USA

Phone: (619) 455-2728

Fax: 619 455-4190

E-mail: phillips@gav.gat.com