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P2.024 Experimental Studies on Arc Chamber Failure Mechanisms on DIII-D Neutral Beam System

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Neutral Beam Injection (NBI) is used for non-inductive heating, current drive, fueling and diagnostics in most major magnetic confinement fusion devices. The DIII-D device comprises eight NBI ion sources based on the US Common Long Pulse Source (CLPS), with a total output power of 20 MW.
Here we report on efforts to improve performance and longevity of the NBI system by initiating a R&D program aimed at studying the most common failure mechanisms for the ion sources. Toward this end, a filament driven plasma chamber has been constructed that attains plasma parameters similar to the arc chamber of a NBI ion source. This Miniature Arc Chamber Experiment (MACE) has a diagnostic suite that includes Langmuir probes, spectroscopy, infrared imaging and mass spectroscopy.
A report on investigations into two common failure mechanisms is presented here: Firstly, a failure mechanism observed during helium beam operations on DIII-D that results in electrical breakdown of the insulation material that separates the filament plates from the anode. The fault is reproduced in MACE and the proposals for amelioration of the issue will be discussed. Secondly, the failure of the water-cooled Langmuir probes that are necessary for beam current control will be discussed. The original probe design requires a complicated manufacturing technique involving several intricate brazes. When this component fails, it can produce a water leak that impacts operational availability. On MACE, we are testing a redesign of this component to provide a more robust solution.

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