

**DEVELOPMENT AND FABRICATION OF NEW ACCELERATOR GRID  
MODULES FOR ION SOURCES IN THE 80 keV  
NEUTRAL BEAM LINES FOR DIII-D\***

H. J. Grunloh, M. G. Madruga, J. L. Busath, R. W. Callis, H. K. Chiu,  
M. DiMartino, R. M. Hong, R. Klasen, W. C. Martin, C. P. Moeller,  
H. H. Streckert, R. Tao, and P. W. Trester  
General Atomics, P.O. Box 85608, MS 13-250, San Diego, CA 92186-5608  
[grunloh@fusion.gat.com](mailto:grunloh@fusion.gat.com)

In 2001, efforts commenced to develop the technology to fabricate new accelerator grid modules for the ion sources in the 80 keV neutral beam lines for DIII-D. This campaign arose after water leaks began occurring with increasing frequency in the molybdenum grid rails and stainless steel water bellows of the original grid modules, fabricated in the mid-1980s. Root causes of the damage were determined and operational adjustments were made to correct the problems, but the string of failures depleted the DIII-D program of its supply of spare grid rail modules, and the two spare ion sources became unavailable.

The program was unable to procure new grid rail modules from any commercial source, nor was it able to obtain the molybdenum grid rails needed in two of the four module types. Efforts were then focused on fabricating new molybdenum rails required to make all four module types as well as developing the procedures to successfully braze together the molybdenum and stainless steel parts into modules. Producing the diamond-shaped cross-section plasma grid rails proved to be very difficult, and a parallel task was initiated to design a modified plasma grid module that would employ circular cross-section grid rails while maintaining the most critical parameters of the original design.

The brazing development program produced procedures that yielded consistently successful brazes in all the joint types present in all the modules. The parts for new grid modules, including the new modules containing circular cross section plasma grids, were fabricated. The new brazing procedures were successfully utilized to produce four new plasma grid modules of the new design. These modules were installed in an ion source and tested to full power before being utilized in service for five weeks of the 2005 DIII-D experimental campaign. An overview of the ion source development program is presented and a summary of the performance of the ion source containing the new plasma grid modules is reported.

---

\*This work supported in part by the U.S. Department of Energy under DE-FC02-04ER54698 and General Atomics internal funding.