Contribution ID: **73** Type: **Oral**

Advancing ECH Technology using Multiphysics Modelling

Monday, 20 June 2022 15:10 (20 minutes)

Electron cyclotron heating (ECH) technology is advancing to meet demands for higher power (>1 MW) and longer pulse lengths (~3600 s). New requirements from heating systems for ITER, the Wisconsin HTS Axisymmetric Mirror (WHAM) experiment, and future systems such as STEP and FPP are leading to more complex ECH designs. Although General Atomics (GA) iterates its designs based on prototyping and testing under high power conditions, Finite Element Analysis (FEA) tools are also an essential step of the design process. FEA software packages such as COMSOL and ANSYS have been used to develop many new designs by providing rapid characterization of hardware performance across a wide range of operating conditions. A new compact RF dummy load was designed to minimize reflected power below 0.5% independent of input polarization. High power testing of the load at DIII-D with 0.8 MW input power demonstrates thermal performance is in agreement with FEA predictions. Extended studies indicate this load design can be modified to accept 1.4 MW steady state input power across multiple frequencies while maintaining acceptable temperatures. A new split waveguide has been designed using FEA tools for the WHAM experiment underway at the University of Wisconsin, Madison. This component enables the application of a bias voltage across two halves of the waveguide, and allows the injection of microwave power through potentially dangerous electron resonance regions at or near the vessel. New methods for water cooling corrugated waveguides and couplings have also been analyzed using FEA methods. These analyses resulted in the development of cost-effective cooling solutions for large scale ECH systems requiring 1 MW steady state power per transmission line.

Acknowledgements:
This work was supported by General Atomics internal R&D funding and by the U.S. Department of Energy, Office of Science, Office of Fusion Energy Sciences, using the DIII-D National Fusion Facility under Award Nos. DE-SC0018107 and DE-FC02-04ER54698.

Primary author: Mr ZELLER, Kurt (General Atomics)

Co-authors: Mr HOLMES, Ian (General Atomics); Dr MOELLER, Charles (General Atomics); Dr ANDERSON, James (General Atomics); Mr PIZZO, Jon (University of Wisconsin-Madison); Dr ANDERSON, Jay (University of Wisconsin-Madison); Mr WALLACE, John (University of Wisconsin-Madison)

Presenter: Mr ZELLER, Kurt (General Atomics)

Session Classification: Technology