



IAEA FEC 201

Contribution ID: 779

Type: **Poster**

The Development of the European 1 MW, 170 GHz CW Gyrotron for the ITER Electron Cyclotron Heating System

Wednesday, 19 October 2016 14:00 (4h 45m)

The EU gyrotron for the ITER Electron Cyclotron heating system has been developed in coordinated efforts from several EU institutions (organized in the EGYC European Gyrotron Consortium, TED and F4E) and under the supervision of ITER Organization Central Team. The design of the ITER gyrotron is based on the EU expertise in the series production of high power and long pulse gyrotrons for the W7-X Stellarator, and incorporates key improvements recently validated to enhance the quality of the electron beam at the cavity and the output RF beam at the window. Following a risk-reducing staged approach, the design was first verified in 2015 with tests on a short pulse prototype, showing >1 MW of output RF power at the right frequency (~170.1 GHz) in stable and reproducible conditions. The electronic efficiency (~35%) obtained with the short pulse gyrotron was consistent with an ~50% output efficiency in voltage depression and in a CW electrostatic configuration. No parasitic oscillations were observed and a high quality of the output RF beam was measured (TEM₀₀~98%). A CW gyrotron prototype was then produced with the same design of the internal RF and electronic components. The CW prototype was delivered in November 2015 to the KIT gyrotron test facility, where it will be tested in 2016. This paper presents the main experimental results from the main prototyping and qualification activities aiming to demonstrate compliance with the ITER specifications and reduce the technical risks during the series production phase.

Paper Number

FIP/P4-29

Country or International Organization

European Commission

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Session Classification: Poster 4

Track Classification: FIP - Fusion Engineering, Integration and Power Plant Design