

UPGRADE OF THE EUROPEAN ITER 170 GHZ 1 MW CW INDUSTRIAL GYROTRON (TH1509)

A. Leggieri¹, F. Albajar², S. Alberti³, A. Allio⁴, K. A. Avramidis⁵, D. Bariou¹, W. Bin⁶, A. Bruschi⁶,
I. Chelis⁷, R. Difonzo⁴, F. Fanale⁶, G. Gantenbein⁵, V. Hermann¹, J.P. Hogge³, S. Illy⁵, Z. Ioannidis⁵,
J. Jelonnek⁵, J. Jin⁵, F. Legrand¹, G. Lietaer¹, C. Lievin¹, R. Marchesin¹, I. Gr. Pagonakis⁵,
T. Rzesnicki⁵, F. Sanchez², L. Savoldi⁴, P. Thouvenin¹, M. Thumm⁵, I. Tigelis⁷
E-mail of corresponding author: alberto.leggieri@thalesgroup.com

¹Microwave & Imaging Sub-Systems, THALES Vélizy-Villacoublay, France, F-78141

²Fusion for Energy, Barcelona, Spain, E-08019

³Swiss Plasma Center, EPFL, Lausanne, Switzerland CH-1015

⁴Dipartimento Energia, Politecnico di Torino, Corso Duca degli Abruzzi 24, Torino, Italy, I-10129

⁵IHM, Karlsruhe Institute of Technology, Karlsruhe, Germany, D-76131

⁶Institute for Plasma Science and Technology, National Research Council of Italy, Milano, Italy, I-20125

⁷Department of Physics, National and Kapodistrian University of Athens, Athens, Greece, GR-157 84

ABSTRACT

The first installation of the plasma heating system for ITER will rely on twenty-four 170 GHz 1 MW CW gyrotrons for the Electron Cyclotron Heating and Current Drive (ECH&CD) system. The European contribution to the ITER project is managed by the European Joint Undertaking for ITER, Fusion for Energy (F4E), under the control of EURATOM Agency. As a response to those needs, Thales Microwave & Imaging Sub-Systems (MIS) is industrializing the TH1509 gyrotron, whose physical design and is under the responsibility of the European GYROTRON Consortium (EGYC), consisting of the European institutes: Swiss Plasma Center at EPFL Lausanne (SPC), Karlsruhe Institute of Technology (KIT), Euratom- HELLENIC ASSOCIATION (HELLAS) and Istituto per la Scienza e Tecnologia dei Plasmi (ISTP-CNR) [1]. Motivated by the acquired knowledge during the gyrotron development and manufacturing for the German stellarator Wendelstein 7-X, the design of the TH1509 started in 2012. The prototype was tested at KIT in 2016 and until 2019 at EPFL-SPC [2]. With the results so far, the gyrotron complies with most of the requirements; but the CW power output (>800kW) was below the desired level (1MW). The prototype has been subjected to accurate expertises [3] to find the root causes of this performance limitation. The design modifications aim to fulfil the ITER technical specification in terms of output power and efficiency. The interventions on the tube consist in a moderate design upgrade, accurate manufacturing and prototype retrofit. It includes an optimization of the interaction cavity and the improvement of the cathode. The upgrade also concerns i) the enhancement of the cavity cooling circuit, ii) the revision of the mechanical design to improve the alignment of internal subassemblies, iii) the improvement of the high-voltage feedthroughs and the potential depression scheme to increase the voltage stand-off and the efficiency. The reassembly of the prototype will be completed during 2020. The tube will be fitted with modified subassemblies and finally factory-tested. The power tests of the upgraded prototype will be carried out by EGYC at KIT and SPC premises.

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