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The design of the ECRH system of DTT

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The Divertor Tokamak Test (DTT) facility [1] is under construction in Italy with focus on power and particle exhaust and it will reach the condition of 15 MW/m power flow outwards through the separatrix by coupling up to 45 MW of auxiliary heating power to the plasma. To achieve this goal, the selected heating systems are Electron Cyclotron Resonant Heating (ECRH), Ion Cyclotron Resonant Heating (ICRH) and negative Neutral Beam Injector (NBI). The final power mix (32 MW ECH, 8 MW ICH, 10 MW NBI) will be based mainly on ECH power, exploiting the great advances in the field of the last two decades. The procurement of the first bunch of 16 MW of ECH, based on 1 MW/170 GHz/100 s gyrotrons technology, has already started and will be available for the DTT first plasma. A Quasi Optical (QO) approach has been chosen for the power transmission, as solution for the long distance between Gyrotron Hall and Torus Hall Building, with multi-beam mirrors installed under vacuum to reduce the overall transmission losses below the target of 10%. The power is injected into the tokamak using single-beam independent front-steering launchers, real-time controlled, for different tasks: assisted plasma breakdown, NTM and ST control, EC current drive and main electron heating. A single null configuration has been selected as reference plasma scenario to verify, by the beam tracing code GRAY, the effective flexibility of the EC launcher to fulfil the requirements. The DTT ECH system design, presented here, is based mainly on existing and assessed technologies, although challenging adaptations to the DTT case are considered. The design of an evacuated QO multi-beam requires a detailed evaluation of the stray radiation while a specific control system architecture is needed to manage such a large number of gyrotrons, with the aim to increase the reliability of the system.

References

[1] R. Martone et al., DTT Divertor Tokamak Test facility. Interim Design Report, ENEA (ISBN 978-88-8286-378-4), April 2019 ("Green Book")

Primary authors: ROMANO, Afra (ENEA / DTT S.c.a r.l.); BAIOCCHI, Benedetta (ISTP-CNR); BALBINOT, Luca; BIN, William; Dr BRUSCHI, Alessandro (ISTP-CNR); BUSI, Daniele; BUSSOLAN, Andrea; DE NARDI, Marco; FANALE, Francesco (ENEA); FANELLI, Pierluigi; FIGINI, Lorenzo (ISTP-CNR); GAIO, Elena; GARAVAGLIA, Saul; GIORGETTI, Francesco; GRANUCCI, Gustavo (ISTP-CNR); MORO, Alessandro (ISTP-CNR); PEPATO, Adriano; Dr PLATANIA, Paola (ISTP-CNR)

Presenter: ROMANO, Afra (ENEA / DTT S.c.a r.l.)

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