An overview of the upgrade of the TCABR tokamak

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ABSTRACT

- An upgrade is being conducted on the TCABR tokamak, which consists in the installation of
 - graphite tiles to cover entirely the inner surface of the vacuum vessel wall
 - new poloidal field coils to allow for the generation of various plasma configurations

PRELIMINARY RESULTS

- A versatile plasma control system is being designed for TCABR to allow for a wide range of plasma configurations
 - 17 fast, programmable, and robust power supplies
- Various power electronic topologies are being considered
 Thyristor-based

- in-vessel HFS and LFS RMP control coils
- a coaxial helicity injection system
- Preliminary studies of the different plasma configurations envisaged for TCABR are being used for
 - Designing the PID plasma controllers
 - determining the required voltage/current wave forms that shall be supplied by 17 high-current power supplies
- Additional power supplies are also being designed to allow for toroidally rotating RMP fields

This upgrade will serve to pave the road towards the establishment of a national laboratory that will be constructed in Brazil to concentrate and coordinate studies on nuclear fusion across the country

BACKGROUND

 TCABR is a small-sized tokamak (R₀ = 0.62 m and a = 0.2 m) of maximum I_P = 120 kA and B₀ = 1.5 T

- IGBT full bridge
- Resonant converters (Low EMI)



 The plasma scenarios generated used the Lagrange Multiplier technique to find the shaping coil currents that minimise the dissipated power and current dipoles [1]

PRELIMINARY RESULTS

- An innovative set of RMP coils will allow for physics model validation of plasma response under a wide range of coil geometries and spectra
 - 5 sets of 18 inter-connected power supplies are being designed to allow for rotating RMP fields



- In the minimisation processes, the best trajectory of the actuators is found by also minimising the vessel currents
- To create the plasma configurations envisaged for TCABR, 17 high-current power supplies will be built
- Various power electronics topologies are being considered
- Thyristor-based
- HFS RMP coils expected to perturb plasma edge more than plasma core [2]



- IGBT full bridge
- Resonant converters (Low EMI)
- Goal is to identify the most adequate solution considering the modern topologies available nowadays

REFERENCES / ACKNOWLEDGEMENTS

[1] F. Hofmann, Computer Physics Communications, 48 (1988) 207[2] General Atomics Internal Report, Presentation by T.E. Evans

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