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OPTICS AND THERMO-MECHANICAL ANALYSIS OF THE ACCELERATOR FOR THE DEMO NEUTRAL BEAM INJECTOR

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DEMO (DEMOnstration Fusion Power Plant) is a proposed nuclear fusion power plant that is intended to follow the ITER experimental reactor. The main goal of DEMO will be to demonstrate the possibility to produce electric energy from the fusion reaction. The injection of high energy neutral beams is one of the main tools to heat the plasma up to fusion conditions.

A conceptual design of the Neutral Beam Injector (NBI) for the DEMO fusion reactor, is currently being developed by Consorzio RFX in collaboration with other European research institutes. High injector efficiency and low recirculating plant power, which are fundamental requirements for the success of DEMO, have been taken into special consideration for the DEMO NBI. Moreover, a particular attention has been paid to the issues related to Reliability, Availability, Maintainability and Inspectability (RAMI).

A novel design of the beam source for the DEMO NBI is being developed featuring multiple sub-sources, following a modular design concept, with each sub-source featuring its Radio Frequency driver, capable of increasing the reliability and availability of the DEMO NBI. Copper grids with increasing size of the apertures have been adopted in the accelerator, with three main layouts of the apertures (circular apertures, slotted apertures and frame-like apertures for each sub-source). This design is expected to permit a significant decrease of the stripping losses in the accelerator while maintaining good beam optics, in terms of divergence and deflection.

The conceptual design of the accelerator grids and the related beam optics and thermo-mechanical investigation are presented in this paper. The beam optics calculations, in particular, have been carried out using a fully comprehensive model, able to calculate the magnetic field, the electrostatic field and the trajectory of the negative ions in a self-consistent way.

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Eligible for student paper award?

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