

EXPLORATION OF A COMPACT DEMO REACTOR: CONSTRAINTS ON SHIELDING MATERIALS AND HTS MAGNETS FROM PARAMETER-SPACE SCANS

P.N. MAYA

Institute for Plasma Research

Gandhinagar, India

Email: pnmaya@ipr.res.in, maya@pnmaya.org

S.P. DESHPANDE

Institute for Plasma Research

Gandhinagar, India

Abstract

An exciting question for the development of fusion DEMO roadmap is whether it is possible to design a compact tokamak reactor with a net electricity production. The DEMO designs will continue to evolve based on the advances in fusion science and technology front and hence multiple routes for a DEMO reactor will have to be explored. With the advances in the high-temperature superconductors and novel ideas for extreme heat handling, worldwide a new paradigm of a compact ST-DEMO is emerging. A parameter-space scan is presented for a compact DEMO with a 250 MWe net electricity production which requires a minimum fusion power of about 1250 MW with a $Q \sim 30$. The choices for the minimum machine size are explored based on the constraints arising from the magnet current density which is a crucial factor in the design of the centerpost, and the shielding thickness at the inboard side. The studies show the requirement of a HTS based magnet with an engineering current density above 55 A/mm². The constraints on the shielding thickness and the material requirements along with the details of the parameter-space will be discussed. Some of the design decisions cannot be taken until supporting databases and the insights are developed. Therefore, quantitative targets for R&D and the development of a database for various shielding materials and HTS under nuclear conditions along with possible experiments and modelling strategies will be discussed.