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Electromagnetic Analysis of APPEL Linear Device Magnets

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The APPEL (Applied Plasma Physics Experiments in Linear Device) is an experimental system designed to carry out basic plasma physics experiments as well as serve as a test-bed for experimenting various plasma facings components interaction with strongly magnetized plasma. This versatile device consists of 16 large electromagnet coils weighing up to 700 kg each, which are made from CTC (Continuously Transposed Conductors), winded in double pancake configuration. Each electromagnet coil is made by sandwiching two double pancakes between 10 mm thick stainless steel plates to obtain 100 turns/ magnet. The individual coil has 52 cm internal diameter and outer diameter is around 110 cm. The stainless steel plates provide the necessary strengths to the magnets while its surface acts as radiator to dissipate the heat. The individual electromagnet can be operated continuously to produce peak axial magnetic field in excess of 0.1 Tesla by passing 750 A for 600s. All the 16 magnets in linear configuration produce peak magnetic field in excess of 0.5 Tesla by passing 750 A for 600s. In this set-up different magnetic field profile can be generated by optimizing the current using two high current D.C power supplies as well as configuration of the coils. The paper presents the electromagnets field simulation performed by Finite Element Analysis (FEA) using Comsol Multiphysics and ANSYS to obtain tailored magnetic field profile in linear, magnetic cusp & mirror configurations achieved in APPEL device. In-house magnetic field measurements carried out for the APPEL magnet and experimental validation of the FEA results. The heat loads and stresses on the coils have been calculated for steady state operation of the APPEL device.

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