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3.4 A steady state magnetic sensor for ITER and beyond: development and final design

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The measurement of the magnetic field in tokamaks such as ITER and DEMO will be challenging due to the long pulse duration, high neutron flux and elevated temperatures. The long duration of the pulse makes standard techniques, such as inductive coils, prone to large error. At the same time, the hostile environment, with repairs possible only on blanket exchange, if at all, requires a robust magnetic sensor. This contribution presents the final design of novel, steady-state, magnetic sensors for ITER. A poloidal array of 60 sensors mounted on the vacuum vessel outer shell contributes to the measurement of the plasma current, plasma-wall clearance, and local perturbations of the magnetic field. Each sensor hosts a pair of bismuth Hall probes, themselves an outcome of extensive R&D, including neutron irradiations (to 1023 n/m2), temperature cycling tests (73 – 473 K) and tests at high magnetic field (to 12 T). A significant effort has been devoted to optimize the sensor housing by design and prototyping. The production version features an indium-filled cell for in-situ recalibration of the onboard thermocouple, vital for the interpretation of the Hall sensor measurement. The contribution will review the potential use of similar Hall sensors in DEMO and the associated R&D program.

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