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P3.073 Prospects for the Hall sensors based steady-state magnetic diagnostic for future fusion power reactors

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The magnetic diagnostic is essential for today's tokamaks to determine the plasma position, stability, energy content and additional parameters critical for safe operation of these devices. Conventional sensors, such as the inductive sensors, have to be supplemented by steady-state magnetic sensors in devices with long pulse capability, as is planned for the ITER reactor. In ITER, the set of 60 discrete outer vessel steady state magnetic sensors, based on bismuth Hall sensors, will be deployed. The steady state magnetic sensors are considered also for future fusion power reactors starting with DEMO device. The main difference in requirements with respect to ITER will be the higher ambient temperature at sensors location (~ 350 ℃, compared to up to 100 ℃ in ITER during the normal operation and 220 ℃ during baking) and up to 3 orders of magnitude higher lifetime neutron fluence exposure. The use of the ITER Hall sensors is not possible in DEMO due to a low melting temperature of bismuth which is 272 ℃. As a consequence, alternative sensing material solutions have to be sought.

This contribution will review the present status of the DEMO steady-state magnetic sensors based on antimony and antimony/bismuth materials. Possible ways to further increase radiation hardness of the sensor with respect to Hall sensors planned for ITER will be highlighted. A control electronics for these sensors plays a key role to achieve required accuracy of measurement in the noisy environment of fusion power reactors. Advanced techniques, such as synchronous detection and current spinning techniques is planned to be used to achieve satisfactory performance of the Hall sensor controller. The concept for the DEMO Hall sensor controller will be contemplated within this contribution. Finally, the design of the "DEMO prototype" Hall sensors, recently proposed to be tested inside ITER port plugs, will be presented.

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