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Improvement of ITER equatorial EC launcher design for poloidal steering compatibility

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This report describes the key development of the ITER equatorial ECH/ECCD launcher (EL) for poloidal steering compatibility. The steering direction of the EL has been changed from toroidal to poloidal in order to enhance the current drive capability. The design modification is being progressed toward the design finalization in 2019.

The concept of upper launcher (UL) steering mechanism of steering-mirror assembly (SMA) is adapted for EL for poloidal steering. However, the redesign of the SMA for EL is needed and the key of the design is the torque balance between the bellows actuator, the coil springs and spiral pipe for mirror. Since the heat load of the steering mirror is larger than that of UL, the pipe diameter of the spiral-cooling water channel must be larger to provide more cooling water, which increases the torque of the spiral pipe. In order to compensate the increased torque, the design change of the coil spring is performed.

Another of the redesign issues is the thermal stress at the Blanket Shield Module (BSM) for poloidal steering configuration. The thermal analysis shows the peak stress of the cooling channel is 820MPa, which exceeds the allowable stress limit (370MPa). By separating the first wall from the integrated shield structure, more cooling water channels can be routed close to the surface, which reduces the thermal stress of the cooling channel to around 300MPa.

The mirror and waveguide unit are attached to the closure plate by rectangular flanges in the poloidal steering configuration. Because the surface pressure at the corner of the rectangular flange is high, it is impossible to keep homogeneous pressure to the rectangular vacuum seal. A simulation of the vacuum seal compression shows the necessary load for the bolts is 67.8kN, which exceeds the stainless steel bolt limit. In order to solve this problem, the introduction of the Inconel 718 bolt is considered.

The 8 RF beams radiated from 8 waveguides are injected to the large parabolic steering mirror and focused to plasma. Therefore, injection angles of each beam are slightly different, which gives modified RF absorption profile compared to expected profile. In order to improve this situation, a ray tracing code is integrated with the EL optical system optimization program.

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