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## P3.022 Development of two directional beam steering ECH/CD launcher for JT-60SA

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Wide range poloidal ( $\sim 60^\circ$ ) and toroidal ( $\sim 30^\circ$ ) beam steering capability and the reliability for high-power (0.8 MW/waveguide), long-pulse (100 s) operation are required for the launcher of the Electron Cyclotron Heating and Current Drive (ECH/CD) system in JT-60SA (Super Advanced). The two directional beam steering launcher has been designed by a linear motion antenna concept, which has an advantage of the reduction of the risk of water leakage in vacuum by eliminating flexible tubes for cooling water in vacuum.

Recently, a development of a bellows (vacuum boundary) and of a support structures for both linear and rotational motions of the steering shaft in vacuum environment has been carried out. The target lifetime of those structures is 100,000 cycles for linear motion (40 cm) and 10,000 cycles for rotational motion ( $30^\circ$ ). The cyclic tests of a full scale mock-up of the bellows structure were successful up to the target cycles without any problem. A full-scale ( $\sim 7$ m) mock-up including four sets of the support structure was fabricated. It consists of a pair of angular ball bearings made of SiN housing and balls for rotational motion and a linear guide assembled by a rail and a housing made of non-magnetic stainless steel and SiN balls. It is noted that no lubricant was used in this test. Although the rotational motion was successful up to 10,000 cycles in the test, the linear guide was damaged at 10,000 cycles, which was 1/10 of the target. In order to overcome this issue, a new linear guide with solid lubricant was developed. The linear motion of 100,000 cycles was successfully performed by the new one. Based on the mock-up test results that satisfy the requirements for the bellows and support structures, the final design of the launcher is underway targeting start of its fabrication in near future.

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