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PIEZO- AND BIMETALLIC ACTUATORS FOR ITER IN-VESSEL APPLICATION *)

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Several dozen shutters will be used for in-vessel applications in ITER to prevent degradation of diagnostic components caused by redeposition of materials sprayed from the first wall. The extreme environment in ITER, such as high temperatures and significant neutron fluence, as well as an intense magnetic field, make it difficult to use conventional electric motors. Piezomotors based on high-temperature piezoceramics are considered promising for this task. This paper presents the resonant-type rotary piezomotor developed to control shutters of Divertor Thomson scattering (DTS), which can be used with a gearbox providing an increase in torque with a proportional loss of speed.

The fast neutrons (> 0.1 MeV) and gamma rays (> 0.1 MeV)–fluences of 10^{19} cm^{-2} at the proposed location of the DTS shutter are expected over its lifetime. Previous tests of the ultrasonic piezemotor have shown that some of the existing high-temperature piezoceramics can withstand the required neutron/gamma loads [1,2].

The second type of engine developed for the use in ITER is a prototype of shutter combined with actuator system consisting of bimetallic plates connected by a jumper and allowing operation in both the presence and absence of magnetic field. In absence of a magnetic field, the engine is driven by heating bimetallic parts, providing by a current of about 20 A flowing through them. The opening/closing cycle in this mode is about 5 minutes. In presence of a magnetic field, the actuator is driven by Ampere force, and operation takes a few seconds. For this type of drive, we developed a locking system to hold the drive in the open and closed position, operating on the same principle as the main drive. Firstly, the locks securely fix the shutter and prevent its movement during possible vibrations, and secondly, they allow no electric current to pass through during the entire lifetime of the ITER first wall erosion monitor. The report presents the results of testing of the driver prototype, including seismic testing that meets ITER requirements.

References

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