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P3.171 Addressing the feasibility of inboard direct-line injection of high-speed pellets for core fuelling of DEMO

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Core fuelling of the EU-DEMO tokamak is under investigation within the EUROfusion Work Package "Tritium, Fuelling and Vacuum". Pellet injection still represents the most promising option. Modelling of pellet penetration and fuel deposition profiles for different injection locations, assuming specific DEMO plasma scenarios and the ITER reference pellet mass (6×1021 atoms), indicates that effective fuelling can be achieved launching pellets from the High Field Side (HFS) at velocities ⩾1 km/s. To implement suitable inboard injection schemes for DEMO, two complementary approaches are being considered: one uses guide tubes with curvature radii ⩾ 6 m, to preserve pellet integrity at ⩾ 1 km/s; the other is investigating the feasibility of injecting high-speed (⩾ 3 km/s) pellets along "direct line of sight" (DLS) trajectories, from either the HFS or a vertical port. The identification and integration of suitable oblique HFS straight injection paths, not interfering with the central solenoid (CS), requires careful investigation. Options using the upper vertical port have been therefore explored first, as they represent the simplest approach; simulations using the HPI2 pellet ablation-deposition code indicate, however, that vertical injection may be effective only if pellets are injected from radial positions well inboard the port axis. High-speed injection through oblique inboard "DLS" paths, not interfering with the CS, are instead predicted to grant good fueling performance, provided that the trajectories intercept the separatrix at a distance from the equatorial mid-plane ⩾ 2.5 m. The angular spread of high-speed free-flight pellets trajectories, and/or the suitability of straight guide tubes to reduce the corresponding open cross section on breeding blanket penetration, are being explored using an existing facility, in collaboration with Oak Ridge National Laboratory, with the initial goal of measuring the scatter cone of free-flight pellets. The neutron flux across DLS injection paths is also being investigated. Progress are reported.

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