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The Impact on Tritium Breeding Ratio of Neutral Beam Port Location in DEMO

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The Tritium Breeding Ratio (TBR) is a critical quantity on DEMO as it will determine the continued availability of one of the required fuels and thus strongly affect the viability of the device. The breeding blanket segments will be designed to cover as much of the inside of the vessel as feasible, excepting the divertor region. They must also take account of remote maintainability and allow necessary gaps for plasma heating systems and plasma diagnostics to function. The location and size of such ports on the reactor vessel may reduce the TBR by reducing the area of the blanket. In order to examine the sensitivity of the TBR with respect to the placement of Neutral Beam (NB) ports, modelling of Neutral Beam Current Drive (NBCD) has been undertaken in relevant plasma scenarios with reference to a model of a Helium Cooled Pebble Bed (HCPB) blanket. For the scenarios examined, it is shown that NBCD can equally well be deployed using ports at elevations up to 4m above and below the mid-plane. Consequently, the effect of the ports required for NB on the available blanket area reduces the TBR in the model from 1.12 to 1.08 if they are located at the mid-plane, but only to 1.09/1.10 if the ports are located optimally above or below the mid-plane. This difference may become critical as other aspects of the design requiring ports, such as diagnostics, are integrated into the design as the value of TBR must, critically, exceed unity by a healthy margin.

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