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DTT: an Integrated Bulk and Edge Plasma Experiment to Tackle the Power Exhaust Problem in View of DEMO

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A DTT experiment should be capable to: 1) demonstrate a safe and robust power handling solution that can be extrapolated to DEMO; 2) achieve the previous goal without degrading the plasma core and pedestal performances, in a plasma regime as close as possible to a reactor one; 3) demonstrate the possibility to achieve points 1) and 2) by integrating as much as possible all the Physics and the Technological aspects. The challenging task of integrating these three targets has been tackled by combining the approach of considering the divertor as a separated regions, as well as integrating the main adimensional physics aspects of the divertor and of the plasma bulk. A cost constraint of 500M€ has been included among the scaling parameters. The integration of these aspects leads to a machine with R≤2.3m. A reasonable minimum size with R>1.8m has been evaluated by: evaluating the necessity of varying the local divertor magnetic topology; considering the radiation load on the first wall; considering the necessity of long discharge to study the technical aspects of the divertor materials. An intermediate size of R=2.15m has been selected, with a=0.70m, Ip=6.0MA, BT=6T, and elongation k≈1.76. The heating power will be PADD=45MW. The selected mix of heating is: ≈15÷25MW ECRH at 170 GHz; ≈15÷25MW ICRH at 60-90 MHz; ≈5÷15MW NBI at 300 keV. The main expected performances are an average density $\langle n \rangle = 1.7 \times 10^{-20} m^{-3}$, an average temperature $\langle T \rangle = 6.2 KeV, P_{SEP}/R = 15 MW m^{-1}$ and a parallel flow q// ~ P_SEP B/R =125. DTT will be equipped with a set of external poloidal coils able to guarantee a large set of different divertor magnetic configurations. The presence of a set of small internal coils will allow to locally modifying the magnetic configuration, so as to produce a very large set of quite different topologies. The possibility to use a liquid metal divertor has been included in the design. A double null standard X point divertor scenario will be possible. All the external coils are designed by using superconductor technology, allowing discharges lasting around 100s.

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