# Impact of plasma-wall interaction and exhaust on EU-DEMO design criteria

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In the present work, the role of plasma facing components protection in driving the EU-DEMO design will be reviewed, focusing on steady-state and, especially, on transients. This work encompasses both the first wall (FW) as well as the divertor. In fact, while the ITER divertor heat removal technology has been adopted, the ITER FW concept has been shown in the past years to be inadequate for EU-DEMO. This is due to the higher foreseen irradiation damage level, which requires structural materials (like Eurofer) able to withstand more than 5 dpa of neutron damage. This solution, however, limits the tolerable steady-state heat flux to ~1 $MW/m^2$, i.e. a factor 3-4 below the ITER specifications. For this reason, poloidally and toroidally discontinuous protection limiters are implemented in EU-DEMO. Their role consists in reducing the heat load on the FW due to charged particles, during steady state and, more importantly, during planned and off-normal plasma transients [1]. Concerning the divertor configuration, EU-DEMO currently assumes an ITER-like, lower single null (LSN) divertor [2], with seeded impurities for the dissipation of the power. However, this concept has been shown by numerous simulations in the past years to be marginal during steady-state (where a detached divertor is necessary to maintain the heat flux below the technological limit and to avoid excessive erosion) and unable to withstand some relevant transients, such as large ELMs and accidental loss of detachment. Various concepts, deviating from the ITER design, are currently under investigation to mitigate such risks, for example in-vessel coils for strike point sweeping in case of reattachment, or divertor configurations other than LSN. Key integration issues associated with these alternative configurations will be discussed. In parallel, a considerable effort has been spent on estimating the necessary pumping performance to exhaust the He generated by the fusion reactions, as well as on evaluating the influence of the seeded impurities on the fusion power generation. This latter aspect has been extensively investigated, for LSN, by means of coupled core/SOL modelling [3,4].

[1] Maviglia F. *et al.*, submitted to Fusion. Eng. and Design (ISFNT 2019)
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[3] Janky F. *et al.*, 2017 Fusion Eng. and Design **123** 555
[4] Zagórski R. *et al.*, 2013 Nucl. Fusion **53** 073030