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The Effect of RMP ELM Control for ITER on Pedestal Pressure Compared to EPED No-RMP Predictions

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The ITER baseline and alternate scenarios use 3D Resonant Magnetic Perturbation (RMP) fields to control ELMs, and therefore ITER operating scenario (IOS) analysis needs to include the effect of the 3D fields on the pedestal pressure and overall device performance. In IOS analysis, the pedestal pressure, for a given pedestal density, will be predicted with the EPED code. Neural net techniques (NN-EPED) have already been applied to databases of EPED computational results to decrease the time needed to make a pedestal pressure prediction by about a factor of 10^9. A new neural network (NN-RMP), trained on measured pedestal data from RMP ELM control discharges in DIII-D, determines the effect of RMP application on the pedestal pressure compared to EPED pressure predictions. Consistent with Random Forest statistical analysis of the parameters most important to the effect of RMP on pedestal pressure, the NN-RMP shows a strong dependence of the reduction in achieved pressure vs. EPED predictions on applied RMP amplitude, but also on pedestal toroidal rotation and either toroidal field (BT) or plasma current (Ip). The dependence on pedestal rotation is indicative of the dependence on RMP penetration and bifurcation physics. The dependence on either BT or Ip, with other geometry parameters fixed, is indicative of the sensitivity to edge safety factor (q95) seen in many DIII-D RMP ELM control discharges. The NN-RMP predicted pedestal height is up to 20-25% lower than EPED predictions for the cases with strongest ELM mitigation or ELM suppression. For ITER operating scenario analysis, this work provides a tool to adjust the EPED-predicted ITER pedestal pressure for the use of RMP fields to mitigate or suppress ELMs. This work was supported in part by the US Department of Energy under DE-FC02-04ER54698, LLNL DE-AC52-07NA27344 and the Science Undergraduate Laboratory Internship (SULI) program and under DE-FC02-04ER549698.

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