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Ideal MHD Stability Analysis of CFETR Design Scenarios using NIMROD

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The stability of ideal MHD modes in CFETR (China Fusion Engineering Test reactor) baseline (smaller sized) and upgrade phase-I (larger sized) scenarios have been evaluated using the initial-value extended full MHD code NIMROD. Different toroidal mode numbers have been considered for stability analysis with different positions of perfectly conducting wall. The EFIT reconstructed CFETR equilibria used in this study is for a H-mode case with high pedestal pressure and highly peaked edge bootstrap current. Also, the safety factor profile includes a core region with strong reverse magnetic shear. NIMROD calculation shows that for the baseline equilibrium, the modes n=2-10 are unstable for all positions of conducting wall. Growth rates of all modes are found to be increasing initially with wall position before they reach the no wall limit. For the upgrade phase-I scenario equilibrium, toroidal mode numbers n=1-30 are found to be unstable. In comparison of these two scenarios, the upgrade phase-I scenario appears more stable than the baseline case in terms of the ideal MHD instability. However, all the mode structures are edge localized, as found in both single-fluid and two-fluid MHD calculations. No global core ideal MHD modes are found unstable in any of these designs.

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