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P2.097 Prediction of mechanical behavior of the KSTAR CS magnet based on PF coil currents

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The KSTAR has seven pairs of ring-shaped poloidal field (PF) superconducting coils with rectangular cross section. The central solenoid (CS) is a vertical stack of four pairs of PF coils compressed axially by preloading structures. The axial compression (remaining preload) on the CS coils is monitored by a strain measurement, one of the important monitoring parameters for safe operation of KSTAR. The preload variation during plasma discharge can be predicted based on the PF coils and plasma currents without complicated structural analysis. For the prediction, the relations between stiffness of CS coil and structure, preloading, equivalent electromagnetic (EM) force, and displacement have been established using elasticity, experimental data and finite element (FE) analysis. The EM force can be quickly calculated using the superposition of EM analyses results for unit current of each PF coil and plasma. The relations were verified through the application to the case of a long pulse plasma discharge. This study will be helpful to provide the optimal combination of PF coil current limits for future KSTAR operations.

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