Structural Assessments of Magnets for the Next Generation Spherical Tokamaks

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Spherical tokamaks (ST) typically have lower fields which reduce the wedging pressures in the TF inner leg. The smaller radial build of the central column also reduces the wedging stress. If a conventional multiple coil case arrangement is chosen rather than the large single central conductor, then the out-of-plane (OOP) load on the TF inner leg must be taken by friction or mechanical keys. With the lower wedge pressure, friction can be a marginal torsional shear support mechanism. Advanced divertors will impose different out of plane loading and may introduce a different regime of OOP loading. ST's offer little space for a solenoid and inner corner shaping coils and will pose new PF coil support challenges. Structural analysis of 2 and 3 meter major radius next generation ST's is presented. The 3 meter design uses a proposed long legged super X configuration. Both TF and PF coils are evaluated. The TF coils are cased coils with HTS superconductor winding packs. Space allocation issues for the TF inner leg are also discussed. Structural contributions from the tape structure of the high temperature superconductor are considered.