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ANALYSIS OF NSTX TF JOINT VOLTAGE MEASUREMENTS*

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This reports presents methods and findings of analyses of recorded current and voltage data associated with 72 electrical joints operating at high current and high mechanical stress. The "data mining" analysis goal is to characterize the mechanical behavior of each joint and thus evaluate its mechanical supports. The joints are part of the toroidal field (TF) magnet system of the National Spherical Torus Experiment (NSTX) pulsed plasma device operating at the Princeton Plasma Physics Laboratory (PPPL). Since there is not sufficient space near the joints for much traditional mechanical instrumentation, small voltage probes were installed on each joint and their voltage monitoring waveforms have been recorded on sampling digitizers during each NSTX "shot."

Strong magnetic forces arise during pulsed operations, far stronger than the joint conductors could long survive without the restraining assistance of a mechanical support system. A joint's apparent electrical resistance changes dynamically if sufficiently strong net lateral force on conductors causes a reduction in the joint's area of high-pressure contact. Since the electromagnetic forces are well known, this circumstance would arise if the mechanical supports were not working properly. Analyzing the nonlinear relations between pulsed magnetic forces and joint electrical resistances can thus identify and even diagnose mechanically overstressed joints.

The present design of the joints and their supports was operated in two successive run periods, February–July 2004 and April–August 2005. Because of indications from analyzing the first run period's voltage probe data that the mechanical support system's fabrication was flawed, the joints and their mechanical supports were rebuilt before the second run period without changing the design. Analyses of voltage probe data from the second run period indicate improved mechanical support function.

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