



Contribution ID: 207

Type: Poster

## Electrical and Magnetic Analyses and Design of New NSTX-U PF1A Coil

*Tuesday 6 June 2017 13:40 (2 hours)*

**Abstract** –The PF1A coil is one of the Poloidal Field (PF) shaping coils on the NSTX-U machine. It is critical for shaping highly elongated, and high triangularity plasmas current. In July 2016, the failure of the PF1A Upper coil resulted in shutdown of the NSTX-U experiment. As part of the causal analysis, it was discovered that several passive structures around the PF1A coil had an adverse effect on the electrical and magnetic behavior of the coil system under AC conditions, more than was expected. This effect, although not a direct cause of the failure, significantly increased the harmonic ripple in the coil current as well as the plasma current beyond the design target, and also caused problems with the magnetic diagnostics. Therefore, several analyses were conducted to understand the electrical and magnetic behavior of the coil system at under AC conditions and to account for it in the new design.

A finite element analysis was first performed to map the magnetic field around the coil and capture the eddy current and magnetic coupling effect of the surrounding passive structures on the effective coil resistance and inductance over a range of AC frequencies. The calculated AC impedance is first compared to field measurement, and then the resistance and inductance, at the characteristic power supply frequency, is put into a detailed electrical model, which includes a detailed representation of the power supply system and electrical network, to simulate the electrical behavior during operation. Results from the electrical simulation were then compared to operational records for verification.

Using results from these analyses, the new PF1A coils have been designed, which includes an external reactor to account for the passive structure effect. Same methodology can also be applied to design of the other new PF coils.

**Key Words:** NSTX-U, PF Coil, Magnetic Coupling, Eddy Current, Thyristor based power supply, effective resistance, effective inductance

### Eligible for student paper award?

No

**Author:** GAO, Zhi (pppl)

**Co-authors:** Mr ARTHUR, Brooks (PPPL); Mr CHARLES, Neumeyer (PPPL)

**Presenter:** GAO, Zhi (pppl)

**Session Classification:** T.POS: Poster Session T

**Track Classification:** Magnets