

**DYNAMIC STRAIN AND TEMPERATURE INSTRUMENT FOR NCSX
MODULAR COIL DEVELOPMENT***

C. C. Tsai, B. E. Nelson and D. A. Rasmussen
Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831-6169
TSAIC@ORNL.GOV

The National Compact Stellarator Experiment (NCSX), a fusion research device, is being designed for improved plasma confinement and stability by applying a novel three-dimensional magnetic field configuration. The external magnetic field shaping is implemented by using 18 modular (stellarator) coils that are in quasi-axis-symmetric configuration and installed as toroidal modules. Emphasizing both plasma properties and geometrical constraints has been used for optimizing coil-winding shapes (Ref. 1). Prototype coil has been designed, fabricated, tested for the NCSX modular coil development.

Physical properties, such as strains and temperatures on the prototype coil under simulation tests, are very important for design and construct NCSX modular coils with the desired reliability and long lifetime. During the simulation tests, strain and temperature sensors will be attached on various crucial locations of the test coil that would be immersed inside a liquid nitrogen pool. The signals measured from the sensors could be interfered by strong electromagnetic noises generated by the exciting current of the test coil. To improve sensitivity, resolution and frequency response of strain and temperature data, the fiber-optic metrology that was developed for the SNS mercury target development (Ref. 2), has been applied to instrument the test coil. Miniature fiber-optic sensors are used for measuring the dynamic strains and the temperatures on the test coil. Engineers will use the measured data to benchmark and improve sophisticated computer modeling codes for modular coils design. In this paper, the instrument for measuring strains and temperatures and test data will be presented and discussed.

Reference:

1. Nelson, B. E., et al, "Engineering Aspects of Compact Stellarators," Paper IAEA-CN-94/FT2-4, Proc. of the 19th International Atomic Energy Agency Fusion Energy Conference, Lyon, France, October 14-19, 2002.
2. Tsai, C. C., Cates, M. R., Allison, S. W., Riemer, B. W., Haines, J. R., and Rasmussen, D. A., "Optical Measurements on Spallation Neutron Source Targets and Fusion Devices," Paper 02AERO4202_PDF, 48th International Instrument Symposium, San Diego, California, May 5-9, 2002.

*Research sponsored by the Oak Ridge National Laboratory, managed by UT-Battelle, LLC, for the U.S. Department of Energy under contract DE-AC05-00OR22725.