

Non-linear Analysis of the Modular Coil Windings for the National Compact Stellarator Experiment

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A non linear FEA study has been performed on the modular coils of the National Compact Stellarator Experiment (NCSX). The modular coils provide the primary magnetic field within NCSX and consist of flexible cable conductor wound on a cast and machined winding form and vacuum impregnated with epoxy. Eighteen coils and associated winding forms are connected at assembly into a toroidal shell structure. The purpose of this study was to evaluate the structural response of the windings and shell structure during cooldown and normal operation. Two separate software packages were used for the study, and two independent analyses were undertaken. The first analysis performed with Pro/Mechanica®, examined both the response of the modular coils to magnetic pressure and thermal effects during a 2 Tesla pulse. Modeled items included a portion of the shell structure the winding packs, and a set of 48 “pseudo clamps”. The so called “pseudo clamps” are represented simply by blocks of material that are restrained in their respective normal directions and have properties which mimic the stiffness of the spring washers of the actual preload clamps. The winding pack is free to slide on the shell structure and is restrained only by the clamps. A second model, including the complete shell structure of each coil, was studied with the FEA program ANSYS®. Contact regions defined in both Pro/Mechanica and Ansys allow the winding to slide and detach form the shell structure. The two analyses are compared for parameters such as winding/structure gap, overall displacement, equivalent stress and principle strain values.