A Conduction Cooled $\text{Nb}_3\text{Sn}$ Racetrack Coil: Design, Construction, and Testing

Reed Sanchez
Department of Electrical and Computer Engineering
University of Illinois at Urbana-Champaign

Abstract

This presentation describes a detailed design of a 6 Tesla $\text{Nb}_3\text{Sn}$ superconducting racetrack coil designed for conduction cooling. We then describe a bench test pursued as a proof of concept for one winding of an actively-shielded, air core electric machine with superconducting field windings. Design selection from a previously computed pareto-optimal front as well as electromagnetic performance of the test coil is discussed. The winding and support structure design is discussed. Analysis of the thermal performance is carried out to verify required temperatures given the cryostat and cryocooler setup. Finally, a strain analysis is performed in order to verify that the superconducting windings are within an acceptable strain level to avoid mechanical breakage as well as excessive degradation of the critical surface. Additionally, the structural integrity of the support components is verified. Test procedures and preliminary results are described.

Creating Realistic Synthetic Power Grids using Statistical Analysis

Adam B. Birchfield
Department of Electrical and Computer Engineering
University of Illinois at Urbana-Champaign

Abstract

To enable greater innovation in power systems, our research seeks to create entirely fictitious synthetic power system networks that capture the functionality, topology, and defining characteristics of actual transmission systems, and thus provide realistic public test cases for research, without compromising confidential data. This presentation outlines a method to generate completely synthetic transmission system networks at two nominal voltage levels, focusing on the features needed for geomagnetic disturbance analysis. Public energy and census data form the basis for geographic substation placement, and the topology of the synthetic network is designed to match statistical characteristics observed on the Eastern Interconnect in North America: average nodal degree, average shortest path length, and average clustering coefficient. We apply the Delaunay triangulation to transmission network synthesis, showing it provides an excellent starting place for generating realistic topologies. A soon-to-be-released 150-bus case is presented as an example.