MT 26
International Conference on Magnet Technology
Vancouver, Canada | 2019

Contribution ID: **1105** Type: **Poster Presentation**

Wed-Mo-Po3.02-01 [11]: Conceptual Design of Compact CS Insert for HTS Spherical Tokamak FNSF

Wednesday, 25 September 2019 09:30 (1h 45m)

Second-generation high temperature superconductors (HTS) are available for producing >25 T at magnet bore compared to 16 T for low temperature superconductors (LTS) magnets proposed in recent studies of the Fusion Nuclear Science Facility (FNSF), thus enabling higher fusion power density and a smaller device size. High current density is required for engineering design of the next step FNSF to allow space for interior plasma components. PPPL is teaming up with US industry in developing the compact high field central solenoid (CS) insert design made with high current transposed cable comprised of mechanically enhanced Bi-2212 wires. This collaboration is aimed at demonstrating the feasibility of producing a small (a few centimeters diameter) but high field HTS solenoid insert that meets the challenging fast current ramp rate and low AC loss requirements while maintaining high current density needed for the low aspect ratio ST FNSF pilot plant design.

HTS magnets with high current density are particularly attractive in reducing the size of a device, beneficial for low-aspect-ratio compact tokamaks, due to their space constraints. Successful HTS magnet development may enable the design of smaller and cheaper fusion "pilot plants"with a mission of demonstrating net electricity. This paper focuses on exploring HTS CS insert design options and prototype coil development using mechanically enhanced Bi-2212 wires.

The prototyping and small coil testing plan developed will demonstrate maturity of the enabling Bi-2212 wire technology desired in ˜20T high field prototype coil for fusion pilot plants. The goal is to demonstrate design of small CS insert solenoid coil for plasma startup while maintaining a low fabrication cost, for solenoid coil winding using directly commercially available Bismuth strontium calcium copper oxide (Bi-2212) strands to achieve 20T high field on coil and 1-2 Wb flux swing therefore, validating maturity for compact fusion magnet design, prototyping and testing. The plan includes production of small Bi-2212 of solenoid prototype coil, and prototype coil testing.

Primary author: ZHAI, Yuhu (Princeton Plasma Physics Laboratory)

Presenter: ZHAI, Yuhu (Princeton Plasma Physics Laboratory)

Session Classification: Wed-Mo-Po3.02 - Fusion VI: Conductors for Fusion & New Designs