Contribution ID: **618** Type: **Poster**

Thermo-structural and heat load analysis of SST-1 Superconducting coils

Friday 26 October 2018 08:30 (4 hours)

Steady-State Superconducting Tokamak-1 (SST-1) has Sixteen Toroidal field (TF) and nine superconducting poloidal field (PF) coils[1]. TF coils are connected in series, whereas, PF coils are to be operated individually in pulse mode. TF coils are operating up to 2.5 T in steady state condition but PF coils have hydraulic as well as heat load issues [2]. In order to operate TF coils and PF coils simultaneously and understand related issues, thermo-structural and heat load analysis have been initiated using ANSYS software.In these analysis, a CATIA model is prepared for SST-1 consisting of superconducting coils, support structure, 80 K cooling system and cryostat. Meshing is done using ANSYS. Initial condition and boundary conditions for temperature, pressure and other constraints in structure are given as inputs from experimental data. Steady state thermal and static structural modules of ANSYS are used for these analyses. Structural analysis of supports, cantilever ring, TF and PF coils, OICS at cryogenic temperatures carried out. Validation of stresses and thermal contraction results compared with analytical results, design and experimental results. Using similar CATIA model, radiative heat loads on PF and TF magnet coils, conduction loads from OICS supports, hydraulic pipes, valves and other instrumentations and on cantilever support ring from ground supports also estimated using ANSYS software. Estimated heat loads due to residual gas conduction, radiation and conduction on various components are compared with analytically calculated and experimental results. Simulated and estimated heat loads are found comparable. Model preparation, meshing, boundary conditions and calculation methodologies will be discussed in this presentation.

Country or International Organization

India

Paper Number

FIP/P7-21

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Session Classification: P7 Posters

Track Classification: FIP - Fusion Engineering, Integration and Power Plant Design