Contribution ID: **458** Type: **Poster**

Numerical investigations towards manufacturing of high current carrying superconducting CICC

Friday 26 October 2018 14:00 (20 minutes)

Fusion relevant high field superconducting magnets require large current carrying conductor of the order of tens of kilo-Amperes. High current carrying the cable in conduit conductor (CICC) are based on low-temperature NbTi and Nb3Sn superconductors. The manufacturing of superconducting cable is carried out by twisting required strands into the desired configuration by application of tensile and compressive forces using cabling machine. The selection of tensile and compressive forces is critical as it can lead to deformation of superconducting strands which may lead to degradation of its performance. The long length CICC is manufactured by adopting pulled through technique where the superconducting cable is inserted inside stainless steel jacket tube which further shaped to require size using rotary swaging. The cold working during this process results in the generation of stresses in jacket material as well as in superconducting cable. The effect of critical factors on the distribution of stresses during cabling (such as twist pitch, contact angles, and compression forces) and jacketing (such as the percentage of cold work and feed velocity) of CICC have been simulated using FEA. The contact stress and deformation between two strands of cable and distribution of radial stresses along with a change in thickness for jacket tube have been estimated during this numerical investigation. These kinds of studies are essential to generate and optimize the manufacturing parameters for cabling and jacketing of CICC.

Country or International Organization

India

Paper Number

FIP/P8-15

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Session Classification: P8 Posters

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