Challenges and Status of ITER Conductor Production

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Abstract - Taking the relay of the Large Hadron Collider (LHC) at CERN, ITER has become the largest project in applied superconductivity. In addition to its technical complexity, ITER is also a management challenge as it relies on an unprecedented collaboration of 7 partners, representing more than half of the world population, who provide 90% of the components as in-kind contributions. The ITER magnet system has a stored energy of 51 GJ and involves 6 of the ITER partners. The coils are wound from Cable-In-Conduit Conductors (CICCs) made up of superconducting and copper strands assembled into a fully transposed, rope-type cable, inserted into a conduit of butt-welded austenitic steel tubes. The conductors for the Toroidal Field (TF) and Central Solenoid (CS) coils require about 500 tons of Nb_3Sn strands while the Poloidal Field (PF) and Correction Coil (CC) and busbar conductors need around 250 tons of Nb–Ti strands. The required amount of Nb_3Sn strands far exceeds pre-existing industrial capacity and has called for a significant worldwide production scale up. The TF conductors are the first ITER components to be mass produced and are more than 50% complete. During its life time, the CS coil will have to sustain several tens of thousands of electromagnetic (EM) cycles to high current and field conditions, way beyond anything a large Nb_3Sn coil has ever experienced. Following a comprehensive R&D program, a technical solution has been found for the CS conductor, which ensures stable performance versus EM and thermal cycling. Productions of PF, CC and busbar conductors are also underway. After an introduction to the ITER project and magnet system, we describe the ITER conductor procurements and the Quality Assurance/Quality Control programs that have been implemented to ensure production uniformity across numerous suppliers. Then, we provide examples of technical challenges that have been encountered and we present a status of ITER conductor production worldwide.

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