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Mon-Af-Po1.17-03 [55]: Comparison of FEM Predicted and Measured values of the TF coil closure welding distortion

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The International Tokamak Experimental Reactor relies in magnetic confinement of hot plasma. The main driver for the confinement is played by the Toroidal Field Coils (TFC). These magnets are composed by a winding pack, made of Nb3Sn superconductors, and a surrounding stainless steel structure or coil case (TFCC) which is closed by welding once the WP is inserted in the TFCC. The closure GTAW weld of the TFCC includes about 70m of weld ranging from 40 to 120mm.
Due to the tight tolerances that have to be respected on the final TFC, a mechanical quasi-static Finite Element Model (FEM) has been developed using ANSYS® software by Enginsoft and SIMIC, under the workframe of an F4E contract, to predict the welding distortion by simulating different welding scenarios and to confirm the definition of the required extra-material in the TFCC.
The FEM model was firstly benchmarked with validation coupons, then verified and fine-tuned with four 1:1 scaled TF coil case cross section mock ups. Finally, a full TF coil FEM model was developed in order to predict the deformation of the TFCC during the welding process.
The first TF coil was welded during the first half of 2019.
In this paper, a comparison between the deformation predicted by FEM and direct dimensional measurements of the distortions taken during the welding process of the TFC is presented. From the observation of the real deformed TFC shape, a new tuning of the model is proposed in order to improve the FEM model and reproduce with higher fidelity the welding distortions.

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