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ITR/P5-05: Results of ITER TF Coil Sub and Full Scale Trials Performed in Japan

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Japan Atomic Energy Agency (JAEA) is responsible for the procurement of 9 Toroidal Field (TF) coils as Japanese Domestic Agency. The TF coil consists of 7 double-pancakes (DPs), a DP consists of radial plates (RPs) which are mechanical structure supporting large electromagnetic force, and a TF conductor using Nb3Sn cable-in-conduit superconductor. In manufacturing the TF coil, heat-treated TF conductor whose length varies due to heat treatment shall be inserted in the groove of the RP. There are some technical issues for the TF coil manufacture as follows: 1) The winding with the accuracy of 0.01%. 2) Evaluation of the conductor elongation due to heat treatment. 3) Development of insulation/impregnation procedure using the newly developed resin which has high resistance to irradiation. 4) Manufacturing RP satisfying tight tolerances of a few mm in flatness and in-plane displacement.
JAEA had started reduced and full-scale trials to develop technologies for the TF coil manufacture with resolving above-mentioned technical issues, from March 2009 to March 2011, prior to series production of the TF coils. In this activity, JAEA performed one-third scale trials for the DP fabrication and full-scale trial for the RP fabrication. One of one-third scale DPs was made by using the copper dummy to demonstrate winding and insulation/impregnation procedure and, in addition, the other is fabricated using TF conductor to demonstrate heat treatment technology. The findings from these trials are follows: 1) The accuracy of 0.011% in the conductor length was achieved, resulting in enabling to insert the conductor into the RP groove. 2) The conductor elongation of the one-third scale DP due to heat treatment was evaluated as 0.073% due to heat treatment. This conductor elongation should be taken into account in the fabrication of the TF coils. 3) The one-third scale DP was successfully impregnated with the CE resin.
In the full-scale trial, a RP was fabricated from 10 segmented RP subsections, which were machined SS316LN hot rolled plates in parallel. These subsections were joined by the laser welding and the flatness and in-plane displacement of fabricated RP within 2 mm were achieved.
These trials indicate feasibilities of the TF coil manufacture. After final qualification by manufacturing a dummy DP, JAEA will start series production of the TF coils.

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