Status of Design and Manufacturing of ITER 1st batch Assembly Tools

Jinho Bae [a]*, Kyoungo Nam [a], Sikun Chung [a], Min-su Ha [a], Geun-hong Kim [b]
[a] *ITER Korea National Fusion Research Institute, Gwahangno 305-806, Yuseong, Daejeon, Korea 169-148*
[b] *ITER Organization, CS 90 046, 13067 St Paul lez Durance Cedex, France*
**Corresponding author: jhbae@nfri.re.kr*

1. Introduction

In December 2006, the Korean National Assembly adopted into law the Fusion Energy Development Promotion Act, and in September 2007 the government formally designated ITER Korea within the National Fusion Research Institute as the Korean Domestic Agency (KODA) for the ITER project charging it with all matters related to ITER on behalf of the Republic of Korea [1]. The ITER tokamak assembly tools are purpose-built and specially designed to complete the ITER tokamak machine which includes; Vacuum Vessel (VV), VV Thermal Shield (VVTS), Toroidal Field Coil (TFC) and other components contained in the cryostat [2]. KODA has carried out the preliminary and final design of these assembly tools [3, 4].

This paper shows that the current status, first quarter of the 2016, including manufacturing of ITER 1st batch assembly tools and briefly summarized the design process through design work of Sector Sub-assembly Tool (SSAT) that is most important tool representing ITER 1st batch assembly tools.

2. Design Review Groups of the Assembly Tools

The 1st batch tool was split into 2 groups; Group A has 21 kinds of 1st batch tools and Group B has 50 kinds of 1st batch tools. And also Group B was split into 2 groups again due to some design input issues (on the interface, procedure, etc.) and according to the transfer situation of design requirements from IOCT. So, 1st batch assembly tools can be identified following 3 Group, as shows Fig. 1; Group A (21 kinds), Group B1 (16 Kinks) and Group B2 (35 kinds).

1st Final Design Review (FDR) for group A was performed in December 2014 and kick-off meeting for manufacture was in July 2015. Lastly, KODA have planned that the 2nd FDR (Group B1) be held in June 2016.

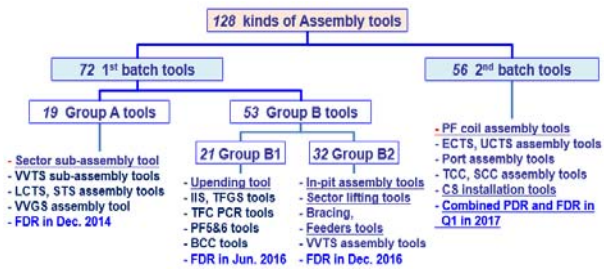

Fig. 1. Design Review groups for ITER assembly tools

3. Sector Sub-assembly Tool

3.1 The Purpose of Sector Sub-Assembly Tool

The Sector Sub-assembly Tool (SSAT) is the device in which the VV sector, VVTS sectors, and TFCs are integrated to form the assembly unit (40º sector shown in Fig. 2.), on which the in-pit assembly of the Tokamak is based. These are located in the assembly hall, within the reach of the dual crane system. The associated operations are carried out with the components in the "vertical" orientation.

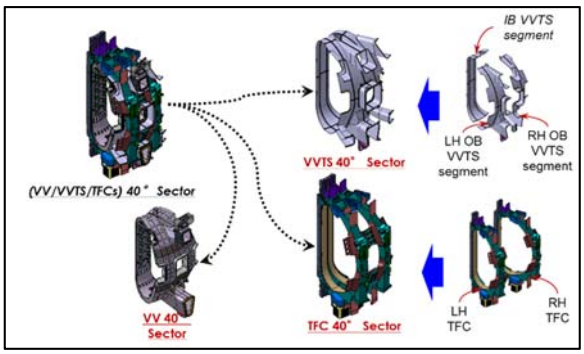

Fig. 2. Configuration of 40º sector in sector sub-assembly

The SSAT as shown in Fig. 3, is composed of main structure including OB/IB columns and connecting beams, two rotating frames including align units, lower component supports including rail system and aligning units. In main structure, the inboard and two outboard columns are connected via a pair of horizontal beams at their upper end. Two outboard columns are connected via a support beam.

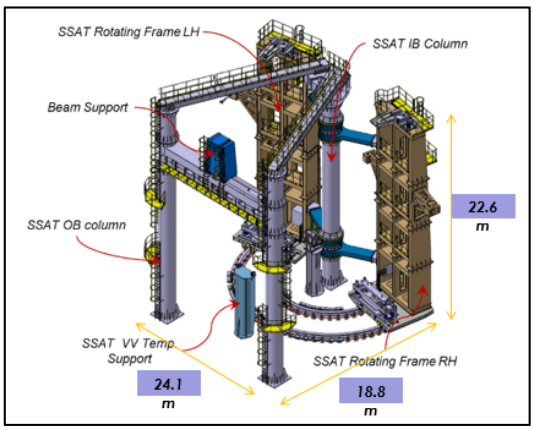

Fig. 3. Configuration of Sector Sub-assembly Tool (SSAT)

3.2 Design Verification in the Final Design Phase

For structural integrity of SSAT, seismic and structural analysis were carried out to verify structural strength with design factor and seismic load [5, 6]. However, some points can't be verified from analysis results directly. So, calculation note was prepared to support analysis reports to check bolts, fillet weld, commercial items, and so on.

Assessment was carried out according to the design criteria classified by Steel Structure and Lifting Table in ITER Load Specification [7] and EN codes [8-9]. First of all, the points which are to be verified in calculation note were identified and calculations were performed according to EN codes. Input loads including forces and moments for calculation were extracted from ANSYS analysis results. And these verification reports should be approved by ITER, and then the design work can be closed.

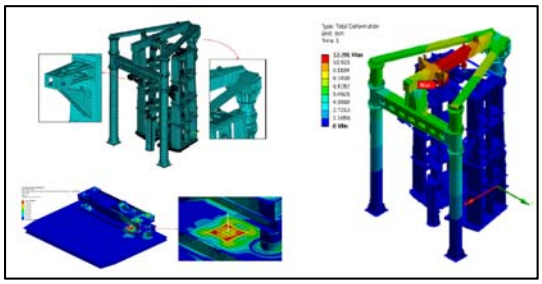

Fig. 4. Structural and seismic analysis for SSAT

3.3 Current Status of SSAT Manufacturing

Between the end of final design phase and the beginning of manufacturing phase, the manufacturer (KODA and their sub supplier) should prepare the QA documents for manufacturing quality such as Welding Procedure Specification (WPS), Manufacturing Procedure, Manufacturing and Inspection Plan (MIP) and so on. If these mandatory documents are approved by ITER and then the manufacturing can be started. Now, cutting and rolling of SSAT main material (SM490YB, steel plate) were started on Feb 2016 as shown in Fig. 4, and also the welding is started on Mar 2016.

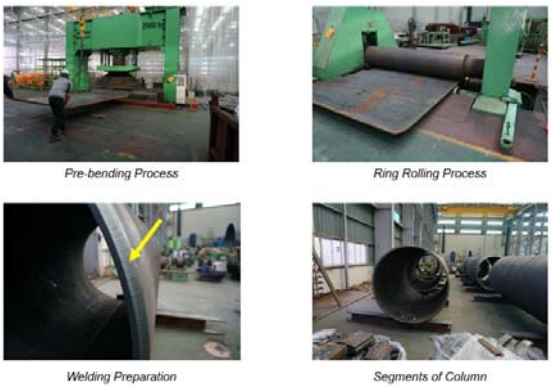

Fig. 5. SSAT manufacturing process on Mar 2016

Factory Acceptance Test (FAT) for SSAT is planned on end of 2016. At the time, basic requirements of SSAT is assessed and if FAT will be finished without critical problem, the SSAT will be delivered to ITER on beginning of 2017. The following figure. 6 shows that overall schedule for SSAT procurement.

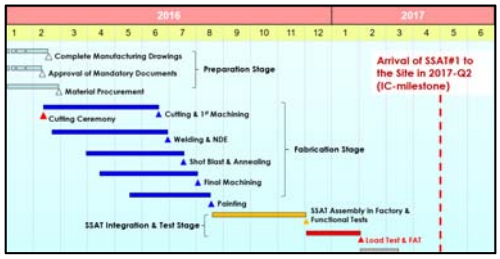

Fig. 6. Schedule of manufacturing and procurement for SSAT

4. Summary and Future Work

KODA (Korea Domestic Agency) should provide 128 kinds of the purpose-built assembly tools for ITER Tokamak machine, and the ITER 1st batch assembly tools are split into 3 groups. The FDR for Group A was performed in December 2014, and design of SSAT has been verified by FE analysis and engineering calculation using EN cords.

The SSAT is now under manufacturing phase to meet the ITER milestone. After factory acceptance test of SSAT on end of 2016, the 1st SSAT will be delivered and arrived in ITER site on second quarter of the 2017. And the 2nd and 3rd FDR of remaining assembly tools (Group B1 and B2) will be held in 2016.

ACKNOWLEDGEMENT

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