

サテライト・トカマク (JT-60SA) 計画の進展 Progress of the Satellite Tokamak (JT-60SA) Programme

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The mission of JT-60SA is to contribute to the early realization of fusion energy by supporting the exploitation of ITER and research towards DEMO by addressing key physics issues associated with these machines. As reported in 1-3), the Satellite Tokamak Programme has been jointly implemented since 2007 by Europe and Japan at the JAEA Naka site as shown in Fig.1 by constructing and exploiting JT-60SA, a device with $I_p=5.5$ MA, $B_t=2.25$ T, $R_p\sim 3$ m, $P_{NBI+ECRF}=41$ MW for 100 s.

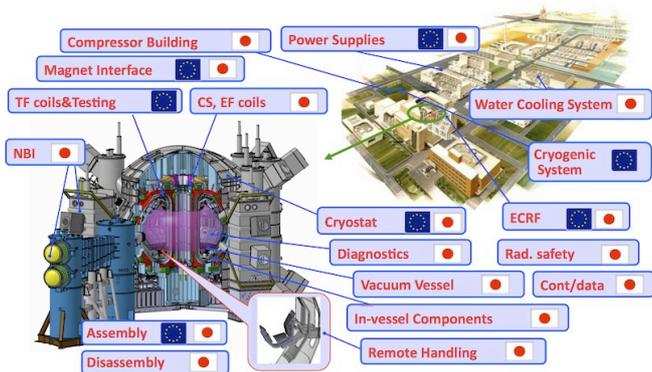


Fig.1 In-kind contributions from Europe and Japan

So far, 18 Procurement Arrangements (about 80% of the total value of construction) have been agreed between the two Implementing Agencies (IAs), JAEA for Japan, and Fusion for Energy (F4E) for Europe, and related contracts awarded and implemented for manufacturing the components including toroidal field coils (TFC), poloidal field coils (PFC), high temperature superconducting current leads (HTS-CL), vacuum vessel (VV), cryostat base (CB), power supplies (PS), first wall materials, diverter cassettes, and remote handling (RH) tools. In Europe, some parts are directly contributed by F4E, but the bulk of the procurement is being also carried out by EU Voluntary Contributors: CEA in France (Cryogenic system, TFC, PS, TFC test), ENEA (TFC, PS, TFC test) and Consorzio-RFX (PS) in Italy, KIT (HTS-CL) in

Germany, CIEMAT (Cryostat) in Spain, SCK-CEN (TFC test) in Belgium.

Overall the project has progressed well as described below along the high-level project schedule as shown in Fig.2. JT-60SA is now foreseen to start operating in 2019, pursuing its challenging mission for the realization of fusion energy. For the procurement implementation, significant delays affecting the critical path in the schedule have not been encountered either in Europe or Japan. Most recently, the successful manufacturing of the cryostat base, the first massive deliverable from Europe to Japan, ensures the real start of the JT-60SA assembly at the JAEA Naka site from January 2013. The disassembly of JT-60 and removal from the torus hall was also successfully completed in October 2012.

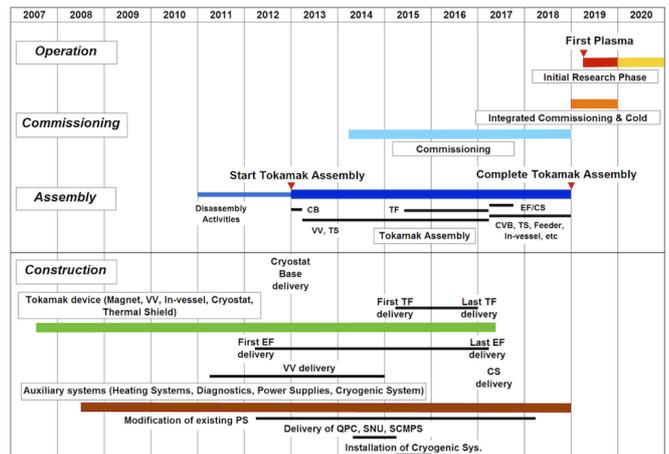


Fig.2 High-level project schedule

For the TFC, the NbTi strand production continues on schedule. Manufacture of the TFC conductors and windings is also on track for series production as shown in Fig.3. The contract for the TFC casings was awarded in July 2012. Delivery of all the components such as the cryostat and valve box vessel for the TFC test facility by truck from Liege to CEA Saclay was

completed in October 2012. For the PFC, series production of the conductors for the equilibrium field (EF) coils and central solenoid (CS) is in progress in the conductor manufacturing building in Naka. The lowest EF coil (EF4) was completed and delivered to Naka in April 2012. A CS quad pancake using a copper dummy conductor was completed. Lower EF coils (EF5 and EF6) are now being fabricated in the coil winding building in Naka as shown in Fig.4.



Fig. 3 Impregnation mould of winding pack TF coil



Fig.4 Fabrication of EF coils in Naka



Fig.5 Assembly of VV 40-degree sector in Naka

Assembly of the inboard and outboard parts of the VV 40-degree sector is in progress in the vacuum vessel sector-assembly building in Naka. Three VV 40-degree sectors have already been completed as shown in Fig.5. Connection by welding of the inboard and outboard parts of the fourth 40-degree sector delivered to Naka will be completed in November 2012.

Manufacture of the cryostat base will be completed by the end of October as shown in Fig.6. The delivery of the cryostat base to Japan is foreseen at the beginning of January 2013 in time for the assembly on site. The cryostat base will be transported from Aviles in Spain to the Hitachi port by F4E and from the port to Naka by JAEA.



Fig.6 Pre-assembly of lower structure for cryostat base

The JT-60SA Research Plan (version 3.0) to be carried out once JT-60SA is operating is now under revision - this plan is being developed jointly by the several hundred researchers involved in the fusion programmes of Europe and Japan.

Despite the complicated nature of arrangements for the involved institutions, and the long distance between Europe and Japan, there is a good and ever-improving understanding and relationship between members of the JT-60SA Team, and enthusiasm and dedication from all to try to maintain the schedule and quality of the delivery of components and eventual machine assembly and commissioning. This is very encouraging for the successful outcome of this international project.

References:

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- 2) P. Barabaschi et al., Fusion Eng. and Des. 86 (2011) 484
- 3) Y. Kamada et al, "Progress of the JT-60SA Project" Proc. 24th Int. Conf. on Fusion Energy 2012 (San Diego, US, 2012) OV4-1