JT-60SA Newsletter

No. 69, 30 September 2015

Headline

340° VV torus now fully integrated

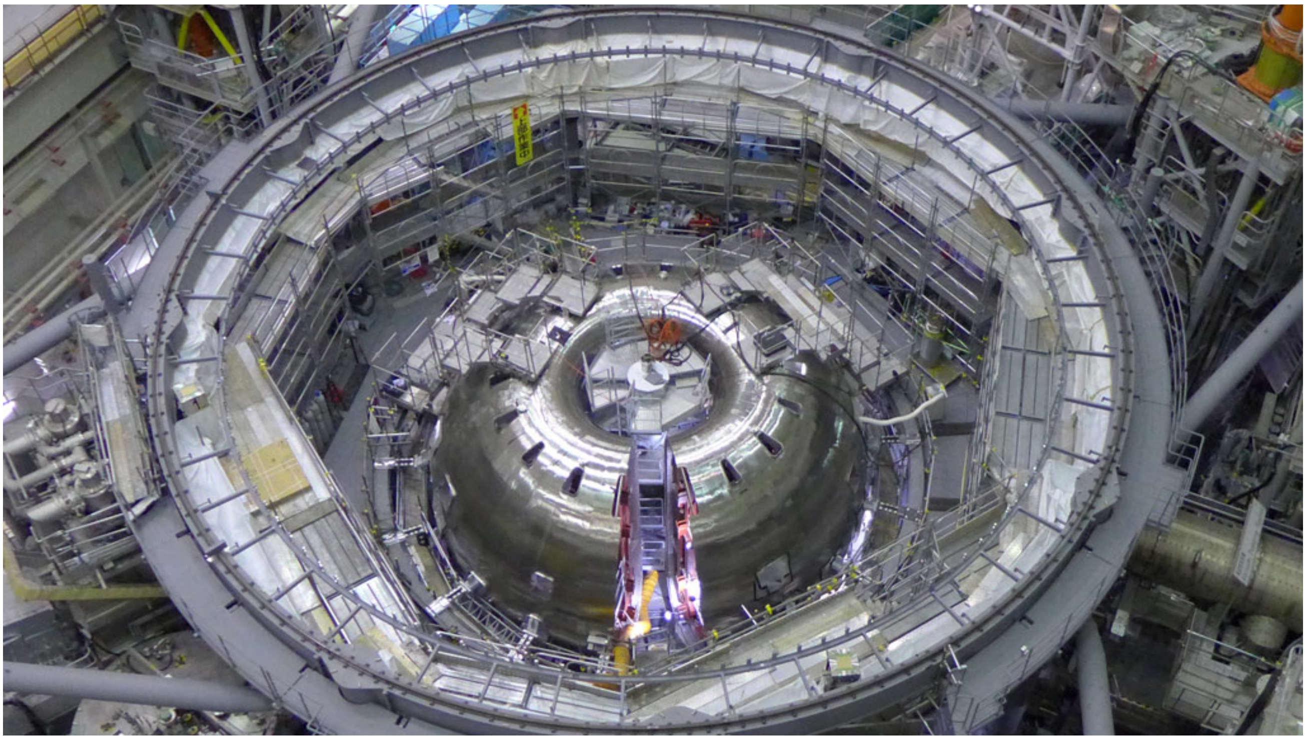

Figure 1: 3 VV blocks under welding with splice plates

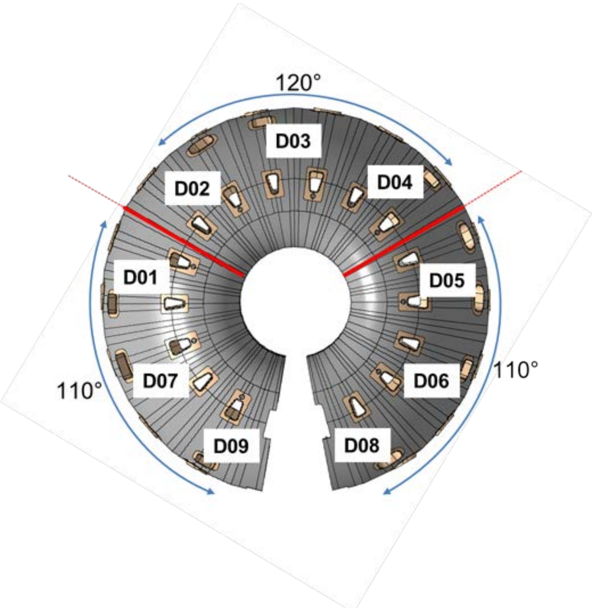

Figure 2: Weld zones with splice plates (red line)

Figure 3: Constraint jigs inside of the VV sector

On 22 August 2015, the welding with splice plates to join the 3 segments (120° x 1, 110° x 2) of the vacuum vessel (VV) (Figure 1) was completed on schedule. This means that a major milestone (the completion of the 340° torus assembly) has been achieved. Non-destructive inspection of the weld zones (Figure 2) was successfully finished in September as well.

In parallel, the constraint jigs in the VV sectors (Figure 3) were removed one by one. No significant deformation of the VV D-shape, which could affect subsequent tokamak assembly, was found.

News

The heart and brain of the cryogenic system arrives

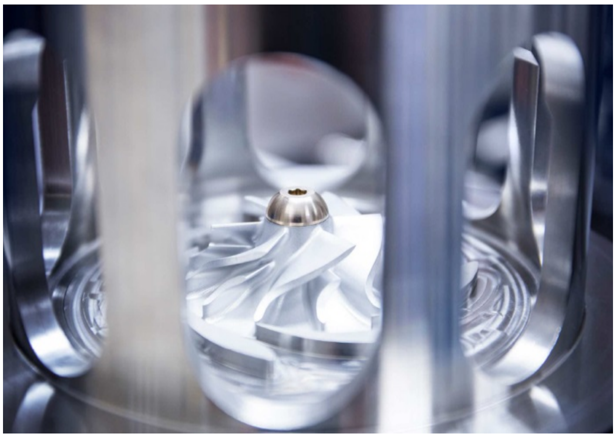

Figure 1: Turbine wheel

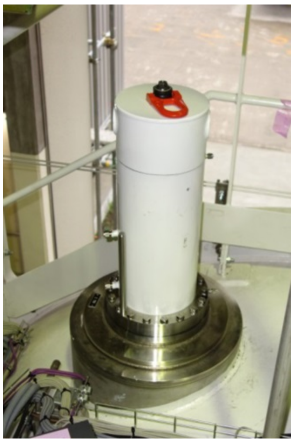

Figure 2: Cold compressor

On 20 August 2015, the last package of the cryogenic system was delivered to the JAEA Naka site by CEA through its contractor, Air Liquide Advanced Technologies (AL-AT). The box contained the heart of the system, namely 3 turbines (Figure 1), 2 cold circulators and a cold compressor (Figure 2), and the brain, namely the control system composed of computers, screens and programmable logic controllers (PLCs).

In the refrigerator cold box (RCB), helium is pre-cooled by liquid nitrogen, and expanded by 2 turbines in series from 1.6 MPa to about 0.13 MPa, so that its temperature drops to about 10 K. A parallel high-pressure flow is expanded in a third turbine from 1.3 MPa to 0.5 MPa, reaching a temperature of about 5 K. The supercritical flow at 0.5 MPa is partly expanded in a Joule-Thomson valve to produce and collect liquid helium at a temperature of 4.3 K in a thermal buffer. The remaining flow supplying the TF and PF coils and structures of the superconducting magnet system is circulated by 2 cold circulators.

AL-AT's turbine uses a cold centripetal expansion wheel and a centrifugal brake compressor mounted on a common shaft. Static gas bearings of the shaft allow the turbine to rotate at a speed up to 150,000 rpm. The compressed gas is re-cooled in a water cooler mounted on the top of the brake compressor. In order to achieve isentropic efficiencies up to 80 %, thermal conduction and leakage of helium gas between the rotor and the expansion wheel must be kept at a minimum.

The cold circulators and the cold compressor use magnetic bearings, and are driven by an electrical motor. Each of the circulators for the toroidal field and poloidal field coil cooling circuits drive around 1 kg/s of supercritical helium flow with a pressure head of about 0.1 MPa. The cartridges of the rotating machines will be installed at the beginning of next year, just before the cool-down of the refrigerator.

The control system is composed of 3 SIEMENS "SIMATIC S7-400" PLCs (each for the compressor building, RCB and auxiliary cold box), 2 operating stations, a programming station, and a portable remote operating station. The PLCs manage about 350 inputs/outputs, both digital and analogue signals. The remote station can be connected to through a Wi-Fi network. The computers and 8 control screens have been installed in the control room on the 3rd floor, above the cryogenic hall.

News

First TF coil seal welding started at ASG

18 toroidal field (TF) coils are being produced by 2 manufacturers: 9 at ASG superconductors S.p.A. (ASG) for Italy and the balance at Alstom S.A. for France. On 29 July 2015, E. Di Pietro (Deputy Project Manager of the EU Home Team), K. Tsuchiya (JA Home Team), and the responsible officers from ENEA for the Italian contract, awarded in 2011, visited ASG's premises in Genoa (Figures 1 and 2).

During the visit, the delegation welcomed the progress made by ASG and congratulated them on the successful completion of their first transverse welding on the TF coil casing (a mechanical structure made from stainless steel, which provides necessary strength for the coils).

ASG's careful preparation resulted in a smooth winding pack insertion. The transverse weld was then readily completed, thanks to the good geometrical tolerances achieved on the casing and winding pack (WP) manufacture, careful design and validation of tooling, extensive verification of technologies, and effective training of personnel. This is the first step of the coil welding, which will be completed by inboard cover plate welding (Figure 3).

All superconducting WPs of the 9 TF coils were completed on 21 July. This constitutes an important milestone in the manufacturing process. Since the manufacturing started, 54 double pancakes (DPs) have been wound at an average rate of 1

DP every 10-calendar days. The DP stacking process has been completed as well, and only the last WP remains to be impregnated with epoxy resin under vacuum. The rest of the WPs have already been completed and tested.

The visit was also a good occasion to view the second casing components delivered to ASG by Walter Tosto S.p.A., ENEA's industrial partner for the production of the 18 sets of TF coil casing components (Figure 4).

Figure 1: JAEA, F4E, ENEA and ASG representatives in front of the first TF coil

Figure 2: ASG workshop with completed WPs

Figure 3: The first TF coil set up for cover plate welding

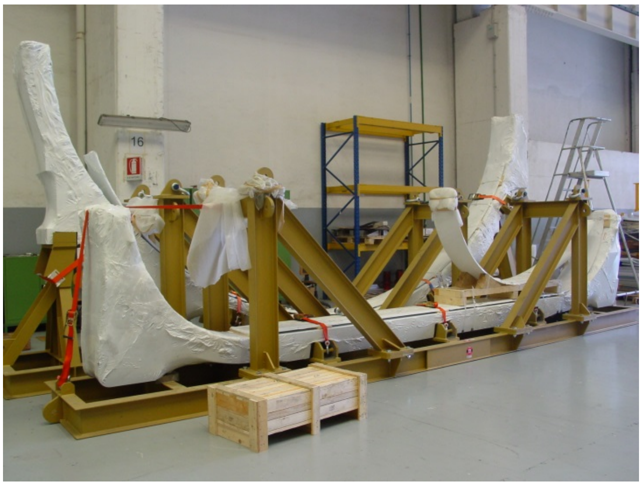

Figure 4: The second TF coil casing components

<u>News</u>

Successful completion of MPS-WCS procurement

Figure 1: Demineralised WCS for the PF and FPPC coil PSs

Figure 2: Cooling towers and raw water pump unit of the WCS

Figure 3: Demineralised WCS and cooling towers for the TF coil PS

The procurement of the magnet power supply water cooling systems (MPS-WCSs) was successfully completed in August 2015. The systems provide cooling water, which is essential for the operation of the MPS components. The water is demineralised to preserve electrical insulation, and tailored for use with aluminium components in order to avoid corrosion due to dissimilar metals.

Under the Procurement Arrangement (PA) signed in March 2013, 2 sets of independent MPS-WCSs were provided. One (Figures 1 and 2) is for the PF coil PSs and the fast plasma position control (FPPC) coil PSs to be installed in the JT-60 rectifier building, and the other (Figure 3) is for the TF coil PS in the active beam line PS room (to be renamed the TF PS room) on the 3rd floor of the JT-60 experiment building extension. Their net cooling capacities for the demineralised water are 4,820 kW and 400 kW, respectively.

In September 2013, the procurement contract for the MPS-WCSs was awarded to Kitashiba Electric Co., Ltd. in Japan. After the detailed design, the manufacturing of the MPS-WCSs started in May 2014. It was finished at the end of December 2014, and the subsequent factory tests were successfully completed early in January 2015. Meanwhile, the installation and commissioning, including their preparation, started at the JAEA Naka site at the beginning of November 2014. After the delivery of the components to the site, the commissioning and the site tests were performed until February 2015. According to the successful completion of site acceptance tests and the completion of documentation, the procurement contract was completed at the end of March 2015, as planned. Finally, the PA was completed on schedule in August 2015 by acceptance of the final report.

News

PA for the ECRF PS signed

The Procurement Arrangement (PA) for the power supply (PS) feeding 2 gyrotrons of the electron cyclotron range of frequency (ECRF) system was approved and signed by H. Shirai, Project Leader on 22 July 2015.

According to the signed PA, F4E will procure the PS enabling 2 gyrotrons to inject a power of 1.5 MW for 100 s at either a frequency of 110 GHz or 138 GHz into the plasma.

The ECRF PS PA includes the design, manufacture, factory test, delivery, installation and commissioning of 5 PS systems with different ratings in its scope. In fact, the reference design of the ECRF PS foresees 1 high voltage main power supply (HVMPS) feeding, in parallel, 2 gyrotron cathodes with a voltage of 60 kV and a total current of 110 A, 2 body power supplies (BPS) applying voltage of 35 kV between the body and the collector of each gyrotron, and 2 anode power supplies (APS) regulating the 50 KV voltage between the anode and the cathode of each gyrotron. The HVMPS will be installed in the power supply building, while the BPS and the APS will be located in the gyrotron room near the gyrotrons.

After the approval of the technical specification, and in parallel to the PA signature, the call for tender for the ECRF PS was launched by F4E in July 2015. Its design activities are expected to start in the last trimester of 2015, just after the contract signature with the selected industrial supplier.

News

CVB assembly scenario finalised

The assembly scenario of the cryostat vessel body (CVB) was finalised.

As shown in Figure 1, the CVB consists of a top cylindrical section (CVB-T, 4 sectors) and a bottom cylindrical section (CVB-B, 8 sectors). The CVB-B sectors are currently under production in Europe and will be delivered to the JAEA Naka site. JAEA will assemble and complete those sectors into a vessel, together with those of the CVB-T, according to the following processes:

1. Mount and weld the horizontal vacuum vessel (VV) ports, used by the neutral beam injectors (NBIs), to the VV, as it is difficult to insert those ports after CVB-B installation. Retract those port bellows,
2. Locate each CVB-B sector along the lines marked by a laser tracker on the cryostat base (CB). Bolt external flanges of adjacent sectors together, and seal junction areas between the sectors and the CB by vacuum quality welding. Attach the thermal shield side of multi-layer insulators (MLIs) in the narrow space between the cryostat thermal shield and the CVB-B, after the weld of the CVB-B sectors is completed (Figure 2),
3. Bolt and weld the CVB-T sectors together, and complete the CVB-T in the assembly hall. Measure the final dimensions with a laser tracker. Transport and mount the CVB-T by crane onto the complete 360° CVB-B according to marks set by laser tracker. Bolt and clamp the CVB-T to the CVB-B, and seal by welding from inside and outside (Figure 3),

Temporary stages will be installed in the CVB, using fittings attached on the CVB-B inner walls, to perform internal welding. For work from outside of the CVB-B, temporary scaffolds will be prepared on the first level of the assembly frame stage as well. The CVB will be arranged and assembled according to the reference points marked by a laser tracker on the torus hall walls. The measurement accuracy is ±0.35 mm and is precise enough to carry through this large-scale but elaborate work.

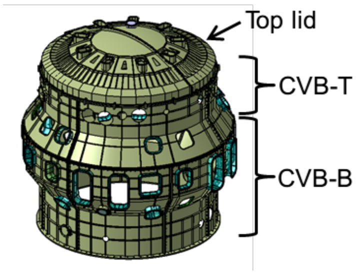

Figure 1: CVB and top lid

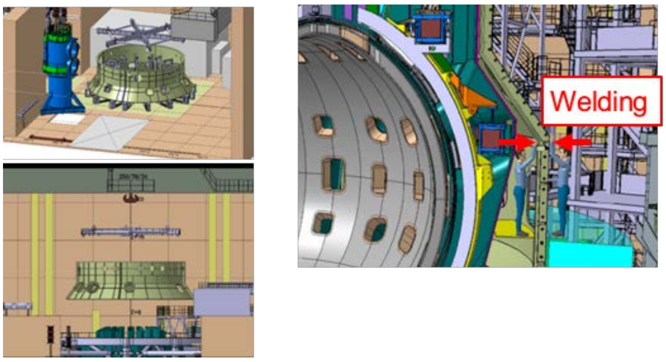

Figure 3: CVB-T mounting and welding with CVB-B

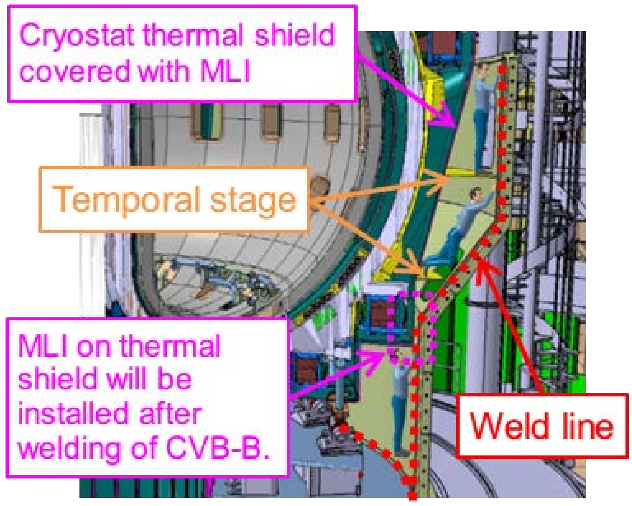

Figure 2: CVB-B assembly details

Local

250,000 sunflowers at best in Naka city

The sunflower is the flower symbol of Naka city, where the JT-60SA project site is located. Its round petals represent the harmony of its citizens, as they look like people holding each other's hands. Its bright and vivid colours express the future of the city and the vitality of its citizens.

Every year, more than 250,000 sunflowers are planted throughout an area of 4 hectares next to the Naka municipal multi-purpose park. All of them come to full-bloom when the annual Naka sunflower festival is held in the end of August. A viewing deck and a maze between the flowers are built to give close access. Many people come along from near and far, and enjoy the unending stretch of flowers. The spectacular sunflower carpet is worth seeing.

Calendar

26 Oct 2015
The 17th Meeting of STP Project Committee (PC-17)
Naka, Japan

3 – 6 Nov 2015
25th International Toki Conference (ITC-25)
Toki, Japan

11 Dec 2015
17th Meeting of the BA Steering Committee (SC-17)
Padua, Italy

14 – 18 Dec 2015
10th Asia Plasma and Fusion Association Conference (APFA 2015)
Gandhinagar, India

3 – 4 Feb 2016
24th Technical Coordination Meeting (TCM-24)
Naka, Japan

Contact Us

The JT-60 Newsletter is released monthly by the JT-60SA Project Team.
Suggestions and comments are welcome and can be sent to newsletter@jt60sa.org.

For more information, please visit the website: http://www.jt60sa.org/.