JT-60SA Newsletter
No. 96, 29 December 2017

Headline

High temperature superconductor current lead procurement completed

Figure 1: KIT team with the HTS CL for the JT-60SA PF coil

Figure 2: Last batch of HTS CLs loaded onto a truck

On 9 November 2017, 10 high temperature superconductor current leads (HTS CLs) for the poloidal field (PF) coils of the JT-60SA device (the last shipment of 26 HTS CLs in total), and a couple of additional boxes containing auxiliary components for assembly, were picked up at Karlsruhe Institute of Technology (KIT) in Germany for their journey to Naka, Japan (Figure 2). On 16 November 2017, the boxes arrived safely at the QST Naka site, and were carried into the superconducting coil winding building (Figure 3). This final step marked completion of the Procurement Arrangement (PA) between F4E and QST, and the corresponding Agreement of Collaboration (AoC) between KIT and F4E, for the delivery of 26 HTS CLs for the JT-60SA superconducting magnets: 6 for the toroidal field (TF) coils and 20 for the PF coils.

Just as all the previous HTS CLs (TF01-06 and PF01-16 in the overall HTS CL numbering system of JT-60SA) which successfully passed their tests by early summer of 2017, the last 4 CLs (PF17-20) passed their cryogenic performance test smoothly. The team members related to the HTS CL manufacturing and testing were proud of their contribution to this important milestone (Figure 1).

When KIT realised that the Bi-2223 high temperature superconductor stacks (BSCCO ($Bi_2Sr_2Ca_2Cu_3O_{10}$)) may no longer be available for future CL manufacturing, they started on the development of next generation CLs, replacing the Bi-2223 with REBCO (Rare Earth Ba_2CuO_y) material. This newly designed CL was built and tested in addition to the tests required for the JT-60SA CLs by the PA and AoC. Performing a current test requires 2 CLs which are joined by a superconducting jumper. Therefore, the last JT-60SA CL test was performed with the test pair configuration where 1 CL was replaced with the newly designed one. This additional test was also successful without problems.

Meanwhile the coil terminal box (CTB), incorporating the 6 HTS CLs for the TF coils delivered to Naka by the 1st and 2nd shipments, has already been finished and is being prepared for a cold function test. The 10 HTS CLs for the PF coils, which were delivered by the 3rd shipment in December 2016, are being integrated in 2 other CTBs. The last 10 CLs, delivered this

time, will undergo an incoming inspection at the Naka site before they will be sent for integration to the manufacturer of the 4th and 5th CTBs in January 2018.

Figure 3: Delivered HTS CLs upon the receipt at the QST Naka site

News

Cryostat vessel body cylindrical section now on way to Japan

CVBCS sectors tightly packed and stored at Aviles port for their travel from Europe to Japan

The manufacturing of the JT-60SA cryostat vessel body cylindrical section (CVBCS) has now been fully completed. After the successful pre-assembly and metrology at the manufacturer, Asturfeito S.A. (ASTURFEITO) in Aviles, Spain, the pre-assembled CVBCS was disassembled into 12 large sectors again, and small scratches and dents, generated during the handling and pre-assembly, were repaired. The large surfaces involved took rather a long time to clean. However, the inner surfaces of the sectors are now polished smoothly and outer surfaces are sand-blasted beautifully.

After a final visual inspection and a few other checks, the 12 sectors were inserted in 10 strong transport frames (2 frames hold 2 sectors each). The sectors in the transport frames were wrapped and sealed in strong plastic bags, then fixed to wooden panels, and finally covered with thick tarpaulin covers.

Those robust and rather expensive protection systems were provided in order for the sectors not only to withstand long ocean and land transport but also long outdoor storage in safety (even allowing for earthquakes) at the QST Naka site. The CVBCS sectors will in fact arrive in Naka about 1 year ahead of their entrance into the torus hall for the final assembly.

In addition to the sectors, a 11 m long lifting beam (also used for handling of the packages in Aviles) and a specially manufactured lifting frame (for handling the lower sectors in Naka) were completed and coated with antirust paint for travel. All

these auxiliary parts (including removable lifting hooks, assembly devices, bolts, spacer sleeves, nuts) and the material left over from manufacturing will be transported to Naka as well.

To take account of such careful and complete pre-shipment activities and the 3-layer-protection, the ex-works (EXW) ASTURFEITO delivery of the sectors was postponed from 29 September to 27 October 2017.

All of the 36 packages and 2 lifting devices with a total weight of 322 t were loaded onboard ship on 3 and 4 December 2017, and left Aviles harbour towards Japan. The shipments are scheduled to arrive at Hitachi port in Japan on 17 January 2018.

News

360° torus appears again - final vessel sector pre-assembled

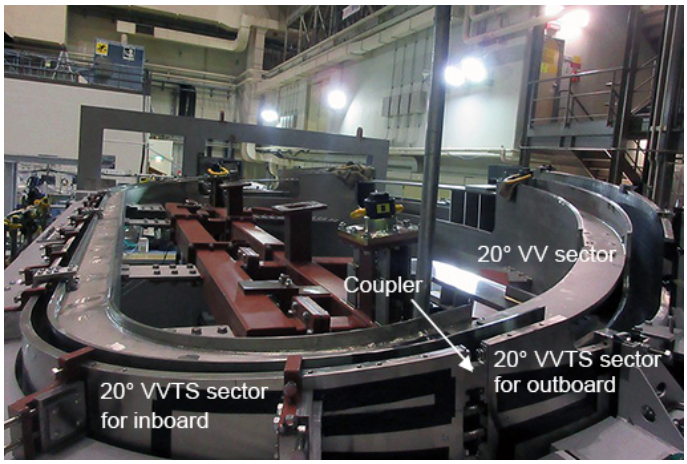


Figure 1: Integrated 20° VV, VVTS inboard and outboard sectors on the erection jig

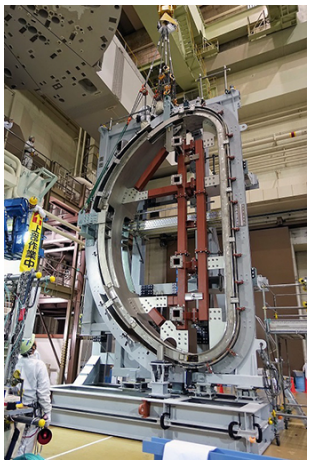


Figure 2: Erected final 20° sector

Figure 3: Inserting the final 20° sector

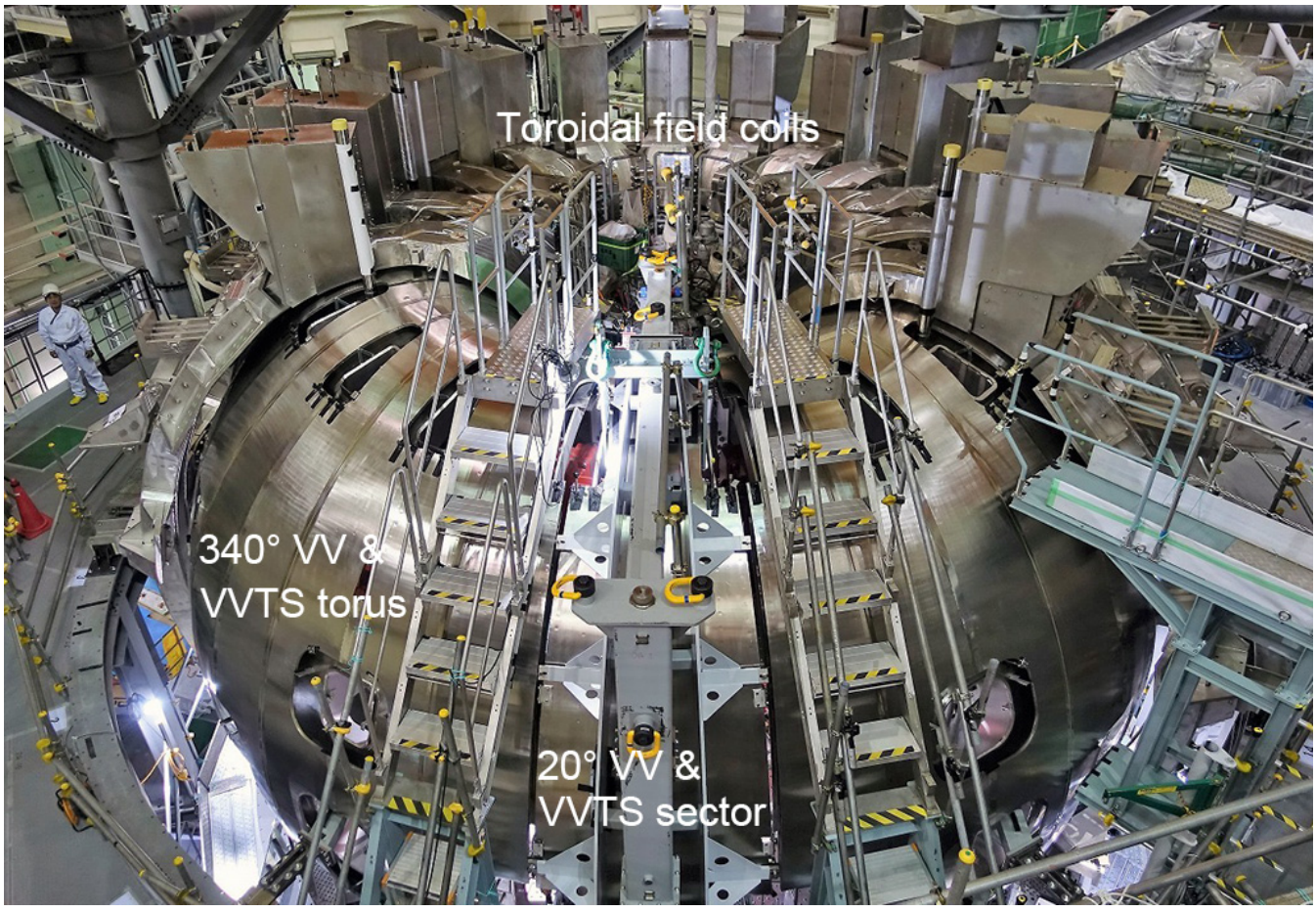


Figure 4: 360° VV and VVTS torus temporarily appeared

In October and November 2017, pre-assembly of the final 20° vacuum vessel (VV) sector was performed according to the following procedures.

1. Modifying fixtures of the toroidal field coil erection jig so that it can be used for the final sector assembly as well,
2. Positioning, fixing, integrating the 20° VV, VV thermal shield (VVTS) inboard and outboard sectors on the erection jig (Figure 1),
3. Transporting integrated sectors with the erection jig to 20° opening of the 340° torus (Figure 2 and 3).

On 31 October 2017, the final sector assembly was temporarily inserted into the 20° opening, completing the 360° VV and VVTS torus (Figure 4). Then, the 20° sector position was finely tuned. Finally, VV splice plate profiles were measured and confirmed, and VVTS connection couplers were inspected and customised. This part is now ready for the arrival of the final TF coil.

News

Magnet controller gets in position

Figure 1: Delivered magnet controller panels

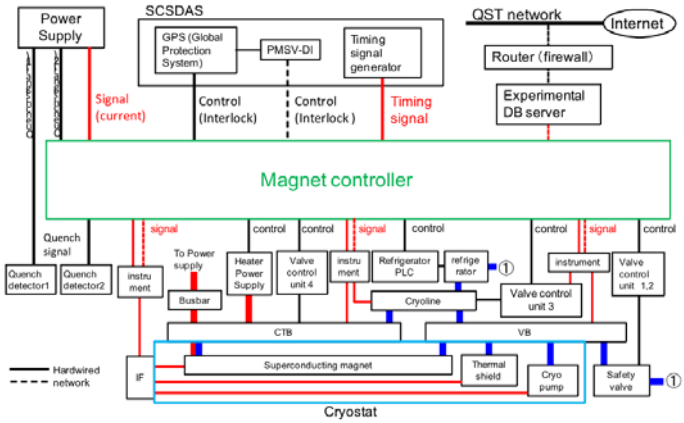


Figure 2: Magnet controller interface diagram

On 10 November 2017, the magnet controller panels were delivered to the QST Naka site (Figure 1), and successfully installed in the toroidal field coil power supply room.

The magnet controller provides control of the helium flow in the superconducting magnet system, protection and interlock, and data acquisition (Figure 2). While the cryogenic system globally controls helium flow of the overall JT-60SA device, the magnet controller locally controls helium flow through each component. For instance, the magnet controller controls mass flow rates of 50 K helium, supplied by the cryogenic system, to 26 high temperature superconductor current leads independently.

The protection and interlock provided by the magnet controller are designed to give priority to protecting the machine by triggering a normal machine stop sequence before potentially damaging quench conditions can develop in the magnet. Thus, the controller reacts in the event of abnormal coil temperature or pressure even before a quench signal is detected. In addition, it has redundant signal paths for more reliability.

Wiring of the quench detectors, supervisory control system and data acquisition system will be performed from 2018 through to the beginning of 2020.

News

All quench detectors delivered

Figure 1: Controller section of the TF/PF quench detector

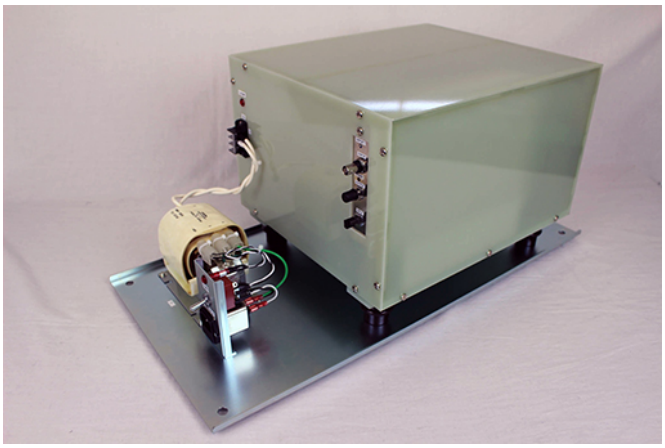


Figure 2: High-voltage amplifier section

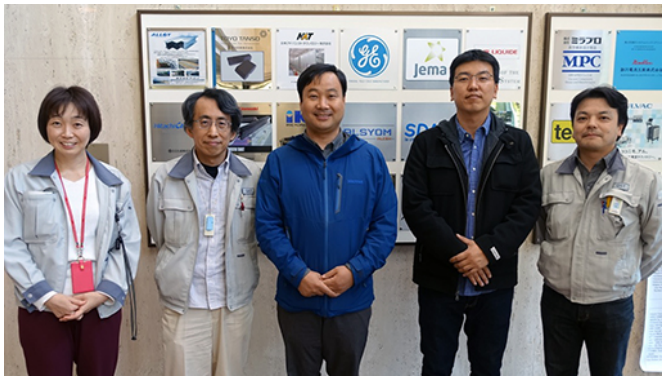
At the end of October 2017, a final 31 units of the quench detectors for the toroidal/poloidal field (TF/PF) coils, high temperature superconductor current leads and feeders (Figure 1) were successfully tested and delivered to the QST Naka site, completing procurement of 102 quench detectors in total. These have been manufactured by Techno AP Ltd., in Ibaraki, Japan as a part of the Japanese contribution to JT-60SA.

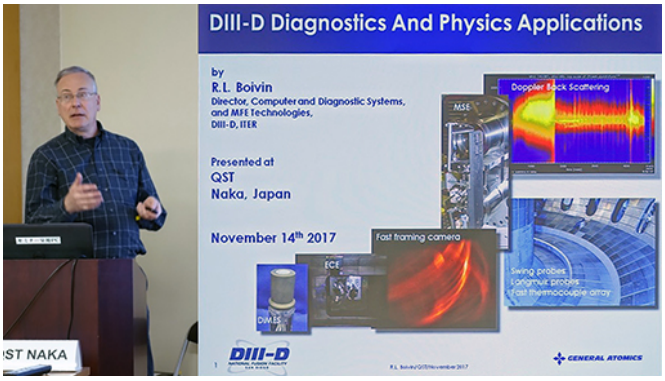
Quench of the TF coil is detected by comparing the voltage of 2 adjacent TF coils, while that of the PF coil is detected by comparing the voltage of the coil and the disc-shaped (for the central solenoid) or co-wound (for the equilibrium field coils) pick-up coil installed along the coil.

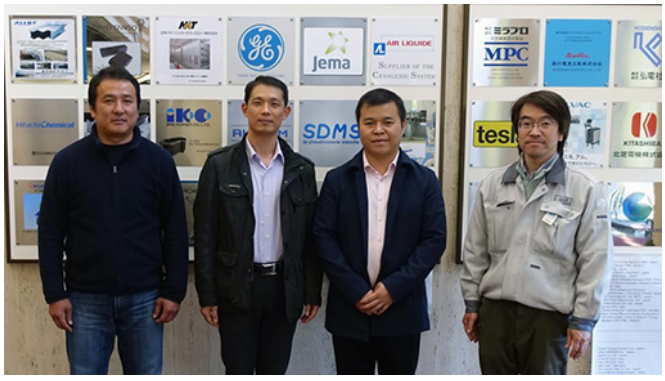
High-voltage amplifier sections (Figure 2) for the quench detection signals are installed in a relatively high radiation environment in the torus hall. Therefore, they do not have built-in CPU and memory and have some radiation-resistant components (e.g. cables), in order to prevent malfunction due to neutron damage.

News

Professionals visit QST Naka site







Upper left: Mr. Kim Tae-Seong (centre) and
Mr. Jung Bongki (2nd from the right)

Upper right: Mr. Réjean Boivi and his presentation

Lower left: Mr. Jiang Caichao (2nd from the left) and
Mr. Xie Yahong (3rd from the left)

In October and November 2017, the following people visited the QST Naka site to see the progress of JT-60SA construction and to discuss fusion research and development.

On 31 October:

- Mr. Kim Tae-Seong and Mr. Jung Bongki (Korea Atomic Energy Research Institute).

On 14 November:

- Mr. Réjean Boivin (General Atomics), giving a presentation entitled “DIII-D Diagnostic Developments in Support of Experimental Plans” in the Large Tokamak Seminar held at QST Naka Institute.

On 16 November:

- Mr. Jiang Caichao and Mr. Xie Yahong (Institute of Plasma Physics of the Chinese Academy of Sciences).

Representatives of QST welcomed and guided them on a tour of the JT-60SA device, including the toroidal field coils being assembled in the torus hall, etc.

Local

Maple leaf illumination at Kairaku-en

Kairaku-en, which is located about 14 km to the southwest of the QST Naka site, is one of the three outstanding gardens in Japan. Despite its location in the busy, central part of Mito city, people can casually enjoy the rich natural environment there.

Momiji dani ("maple valley" in Japanese) in the garden is a great spot to celebrate autumn foliage. Leaves of approximately 170 maple trees turn red and yellow, and the best time to see the rich and colourful autumn scene is November.

In this high season only, the maple leaves are illuminated at night. Emerging from dark and still space, the lights through the coloured leaves look so dreamy (see figures). It is also fun to walk on the fallen leaves in an autumn outfit during the day.

Calendar

17 - 18 January 2018
29th Technical Coordination Meeting (TCM-29)
Saclay, France

7 March 2018
22nd Meeting of the STP Project Committee (PC-22)
Naka, Japan

26 April 2018
22nd Meeting of the BA Steering Committee (SC-22)
Naka, Japan

1 - 6 July 2018
45th European Physical Society Conference on Plasma Physics (EPS 2018)
Prague, Czech Republic

4 - 5 July 2018
30th Technical Coordination Meeting (TCM-30)
Naka, Japan

Contact Us

The JT-60SA 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/.