JT-60SA Newsletter
No. 56, 29 August 2014

Headline

Impregnation of the first TF coil winding pack

Figure 1: WP moved to impregnation station

Figure 2: WP ready for impregnation

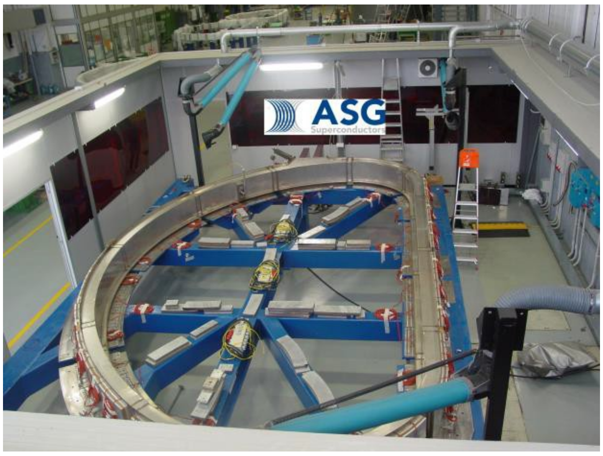


Figure 3: WP at the end of impregnation

Figure 4: WP moved to cleaning and finishing station

ENEA contributes in kind to the Broader Approach programme by manufacturing, among others, 9 JT-60SA toroidal field (TF) coils. The supply is provided by a contract between ENEA and ASG Superconductor (Genoa). In this framework, at the end of June 2014, the first winding pack (WP) of the TF magnet system was completed. The WP has been manufactured in several steps: first the six double pancakes (DPs) were wound, then each DP was dimensionally surveyed and ground insulated with a 0.5 mm layer of glass tape, and at the end the DPs have been stacked and the electrical connections between adjacent DPs have been created. After application of an additional 2.5 mm thick WP ground insulation, the WP has been moved to the impregnation station where vacuum pressure impregnation (VPI) using epoxy resin was started at the beginning of June 2014.

Before starting the impregnation, several electrical, flow and dimensional measurements were performed at the different steps of the production to identify any deviations from the nominal values. Additional tests will be carried out after the impregnation also using the vacuum chamber already available in ASG.

Figures 1 to 4 show four steps of the impregnation phase. Figure 1 shows the WP being moved from the ground insulation station to the impregnation station. Figure 2 shows the status of the impregnation station before the start of operation and after the complete mounting of the impregnation mould. Figure 3 shows the mould after impregnation without the support structure that applied the pressure on the WP during the impregnation. Figure 4 shows the WP extracted from the mould at the end of the impregnation process and moved to the cleaning and finishing area. Finally Figures 5 and 6 show the WP on the cleaning station before application of the conductive paint.

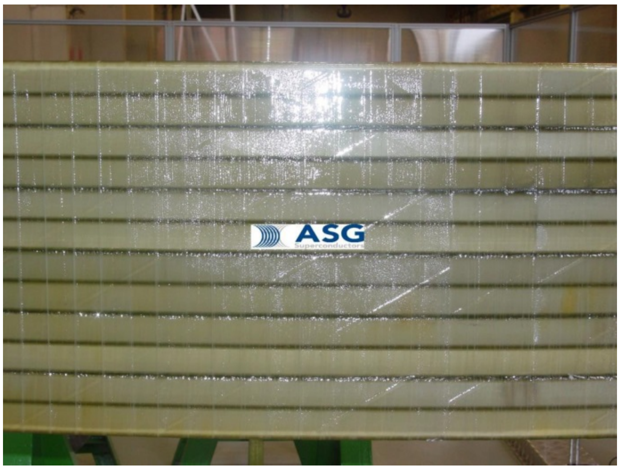


Figure 5: WP status at the end of the impregnation phase

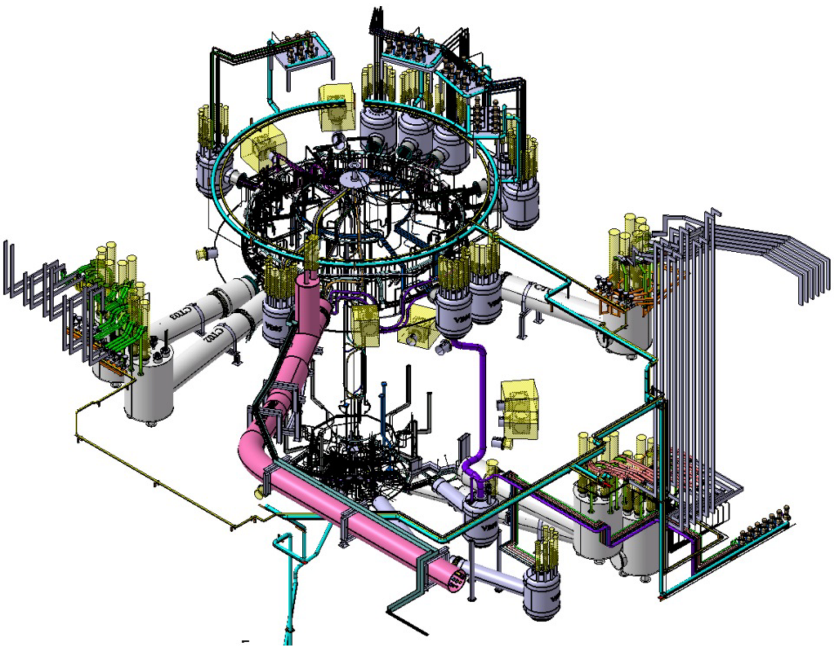
Figure 6: WP waiting for the application of the conductive paint

After dimensional, flow, leak and electrical tests (including a Paschen test at room temperature), the WP will be prepared for insertion in the casing to complete the first TF coil. The acceptance tests will be performed during the summer.

The second WP has been already inserted in the impregnation mould and should be ready at the end of August 2014, and the third WP is in the process of being wound.

News

Magnet shared components for TF magnet PA signed



Configuration model of the magnet shared components

The magnet system for JT-60SA consists of 18 toroidal field (TF) coils, a central solenoid (CS) made up of 4 modules, and 6 equilibrium field (EF) coils. It is contained in a cryostat and generates an average heat load of 3.2 kW at 4 K to the cryogenic system, from nuclear and thermal radiation, conduction and electromagnetic heating. It requires current supplies of 25.7 kA to the TF coils and 20 kA for the CS and EF coils. The supercritical helium flow at pressures up to 0.4 MPaG and temperatures between 4.4-4.8 K remove this heat, and is distributed to the coils and structures through the valve boxes from the cryoline connected to the auxiliary cold box located outside the torus hall.

The inaugural PA signature for the new PL, H. Shirai

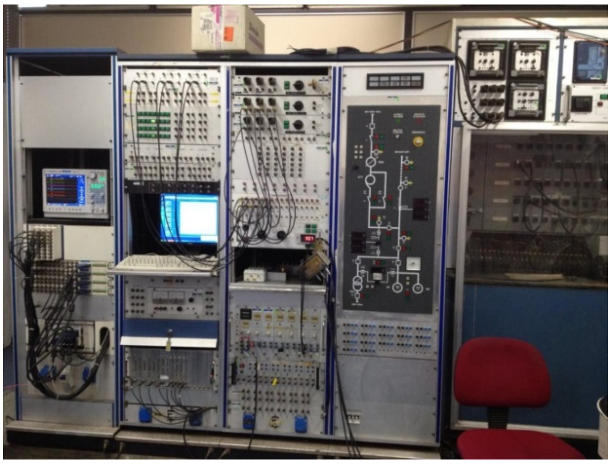
The magnet shared components (MSCs) consist of the following:
- coil terminal boxes including high temperature superconductor current leads for superconducting coils, and their cryogenic supply lines
- feeders in the cryostat for superconducting coils
- cryogenic supply lines and valve boxes for superconducting coils and their in-cryostat feeders, as well as for cryopumps
- quench detection system for superconducting coils and their in-cryostat feeders
- instrumentation of temperature, pressure and flow measurement for superconducting coils and their in-cryostat feeders, as well as cabling and cubicles
- main cryoline
- quench relief valve assemblies
- copper busbars
- ground fault detection system.

A Design Review Meeting (DRM) on MSCs of the TF magnet was held on 17 December 2013. According to the recommendation by the DRM, JAEA made the technical specification much more comprehensible. The Procurement Arrangement (PA) for MSCs was approved by the former PL, S. Ishida, on 18 June, and following signatures by representatives of F4E and JAE, it fell to H. Shirai, his successor, to become the signer of the PA, his first one for the project. JAEA has now started a call for tender process for the MSCs for the TF magnet in order to meet the assembly schedule.

News

FPPCC PS transformer tested

CESI Laboratories, the FPPCC PS transformer tested



CESI Laboratories, the short-circuit test hall

SEA Laboratories, the test hall

SEA Laboratories, the FPPCC PS transformer tested

The ENEA procurement of eight power supply (PS) units for the poloidal field (PF) coils of JT-60SA includes the supply of two fast plasma position control coil (FPPCC) PS, provided with four 18 kV/415 V transformers, each one having a rated capacity of 3 MVA and designed as dry-type for indoor installation.

After the official approval of the transformers' First Design Report (FDR) by ENEA, F4E and JAEA in April 2014 and of the FPPCC converters' FDR in July 2014, the first FPPCC PS transformer unit has been manufactured and tested.

In order to prove the good margin of the design and to ensure the quality and the reliability of the transformers, the manufacturer POSEICO-Jema proposed to perform both a short-circuit type test and a thermal type test on one transformer, although this was not required in the technical specification.

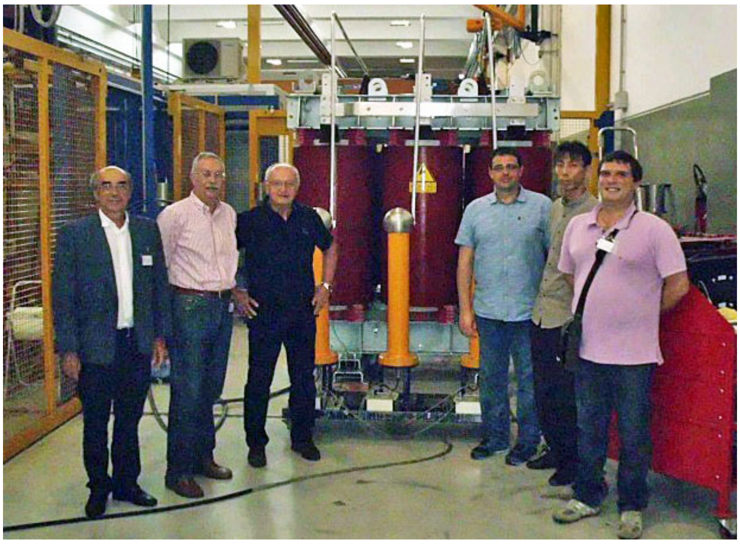
Prior to the short-circuit tests, the transformer was successfully subjected to the acceptance routine tests as specified in IEC 60076-1.

The short-circuit type test was carried out on 7 July 2014 at CESI Laboratories of Milan (Italy), in accordance to IEC 60076-5. In attendance were P. Zito, A. Cucchiaro and A. Lampasi (ENEA), L. Novello (F4E), K. Yamauchi (JAEA), D. Cinarelli and K. Celaya (POSEICO-Jema), C. Ceretta (SEA). The terminals at the secondary of the transformers have been connected in short-circuit, and a suitable value of current (with a peak value of about 160 kA in the transformer secondary) was injected in the transformer and the currents and voltages waveform were measured. Nine short-circuit shots were carried out, three for each phase of the transformer and, after each shot, the short-circuit reactance was measured. All short-circuit type tests were passed.

Afterwards, the PS transformer was transferred to the SEA Laboratories for final acceptance tests, held on 10-11 July 2014. The following tests were made in accordance with IEC 60076-1/11:

- ✓ measurement of winding resistance;
- ✓ measurement of voltage ratio and check of phase displacement;
- ✓ measurement of short-circuit impedance and load loss;
- ✓ measurement of no-load loss and current;
- ✓ dielectric tests;
- ✓ partial discharge test;
- ✓ temperature-rise test;
- ✓ determination of sound level (IEC 60076-10);
- ✓ hot-spot temperature-rise measurements.

In particular, the thermal type test was performed monitoring the temperature measurement in the secondary windings of the transformer through a temperature probe in each secondary winding, placed at the upper hottest point. In addition, the temperature distribution in the outer resin insulation was monitored with a thermo-graphic camera.



SEA Laboratories, before of the partial discharge test

P. Zito, A. Lampasi and V. Cocilovo (ENEA), K. Yamauchi (JAEA), D. Cinarelli and M. Portesine (POSEICO-Jema) attended the test. All tests gave positive results, including the hot-spot temperature-rise measurements by thermal probes and thermo-graphic camera. No critical hot spots were found.

News

Fabrication of CVBCS started

Figure 1: Machining of the welding frame for lower sectors

Figure 2: Group photo in front of the welding frame for upper sectors

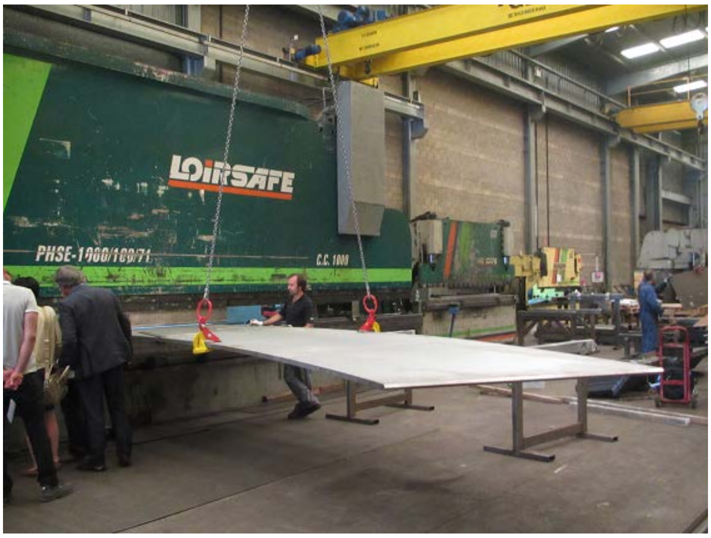


Figure 3: Forming of the first conical part

The manufacture of the cryostat vessel body cylindrical section (CBVCS), which is composed of 12 sectors, has started. At present, welding frames for the upper and lower sectors are being fabricated (Figures 1 and 2). In addition, forming of conical parts has also started (Figure 3).

Gas metal arc welding (GMAW) is the welding process selected for all type of welds. The manufacturer has defined a welding procedure specification and performed its corresponding procedure qualification to qualify the GMAW process, which covers 100 mm thickness.

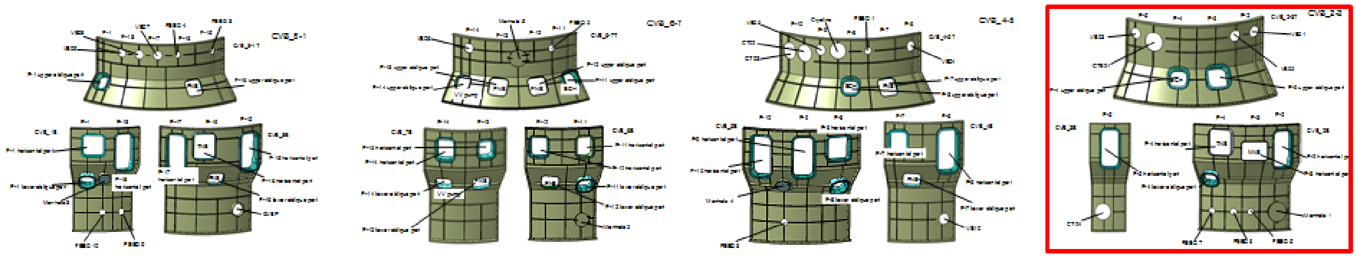


Figure 4: 12 sectors forming the CVBCS

The manufacture of the first sector 2-3 shown in the red square of Figure 4, considered as a prototype, will give the necessary experience, in terms of welding distortions, machining steps, etc., for the manufacture of the remaining sectors, in order to get the specified tolerances in the whole component.

Representatives from CIEMAT, F4E and JAEA attended a progress meeting held in July 2014 at ASTURFEITO in Spain, for technical discussion of assembly issues and to see the progress of the fabrication. The manufacture of the CVBCS is expected to be completed by May 2016.

News

Installation accuracy of TF coil assembly

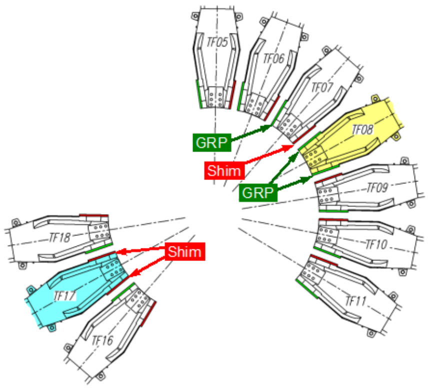


Figure 1: Layout of GRP insulation plates and shims between TF coils

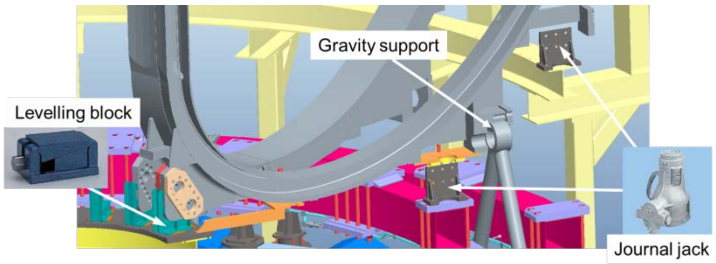


Figure 2: Positioning jigs of TF coil at inner and outer temporary supports

To insulate adjacent toroidal field (TF) coils toroidally glass fibre reinforced plastics (GRP) insulation plates with a thickness of 3 mm, are installed between adjacent coils. Shims, made of stainless steel, are also installed between the TF coils to maintain contact at the upper and lower joints (crowns) and a maximum 0.5 mm gap along the length of the inner straight legs (Figure 1). Prior to the installation work, GRP is fixed to one side of the TF coil to be installed first, and the gap between the adjacent TF coil (only the side facing the GRP) is measured to determine the required thickness of the shim. Using the shim customised in accordance with the measurement result, the required installation accuracy is ensured.

Furthermore, since the gravity support is elastically deformed by the weight of the TF coil, it should be assembled while temporarily raising all TF coils on the inner support (levelling block) and the outer support (journal jack) to support their weight (Figure 2). After installing and joining all 18 TF coils, the inner and outer supports are lowered and the weight is smoothly transferred to the gravity supports. As a result, the gravity supports are uniformly deformed and the TF coils are well balanced.

News

Installation of peripheral equipment for secondary cooling system started

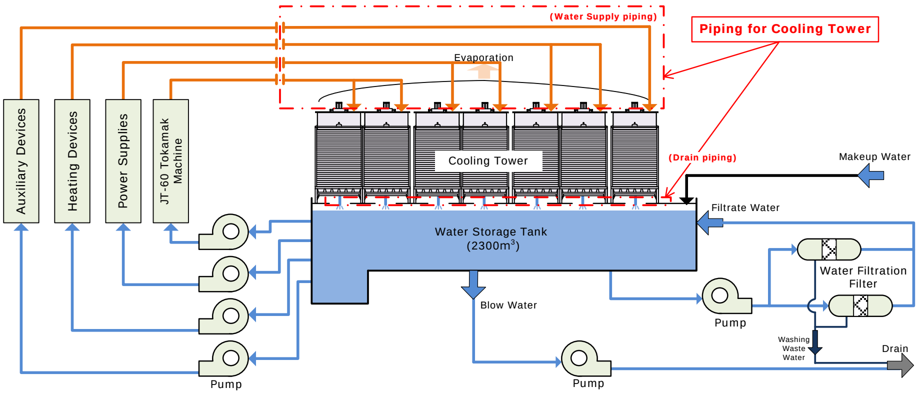


Figure 1: Structure of secondary cooling system

Figure 2: Installed water supply pipes for cooling tower

Figure 3: Support frame foundation for water supply pipes

The installation work on the peripheral equipment for the secondary cooling system, whose modification work was completed in March this year, has started and has been progressing steadily.

Water supply pipes for the cooling tower, which were fabricated at the factory, are now being delivered and installed sequentially (Figure 2). Installation of the support frame foundation for the water supply header pipe (other than that of the secondary cooling) has also been progressing (Figure 3). All the pipe installation including the drainage pipe will be completed this October. At the same time, the electric facility for the cooling tower will be installed separately, ready to make a trial run this December.

Meetings

Design review meeting for FPPCC design report

The 20th Design Review Meeting (DRM) on magnet power supply (DRM-MPS20) was held by videoconference with attendance of 20 experts from Germany (F4E Garching), Italy (ENEA, POSEICO-Jema) and Japan (JAEA Naka).

The purpose of the meeting was to agree the First Design Report (FDR) of the magnet power supply for the fast plasma position control coil (FPPCC) converter. During this meeting, ENEA, F4E and JAEA made presentations of their comments on the draft report (FPPCC FDR Rev.1) and a discussion took place between the meeting participants.

At the end of the discussion it was decided to make a new revision. A new version of FPPCC FDR (Rev. 2), including answers to all comments, was then prepared by POSEICO-Jema and approved in July by ENEA, F4E and JAEA.

Calendar

September 26 - October 3, 2014
28th Symposium on Fusion Technology (SOFT-28)
San Sebastian, Spain

October 7, 2014
15th Meeting of the STP Project Committee (PC-15)
Naka, Japan

October 13-18, 2014
25th Fusion Energy Conference (FEC 2014)
Saint Petersburg, Russia

November 4, 2014
15th Meeting of the BA Steering Committee (SC-15)
Karlsruhe, Germany

November 12-13, 2014
21st Technical Coordination Meeting (TCM-21)
Saclay, France

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/