JT-60SA Newsletter
No. 49, 31 January 2014

Headline

BA steering committee visits TF coil test facility

BASC representatives in front of the cryostat of the TF coil test facility for JT-60SA at CEA-Saclay

On 17 December 2013, the Broader Approach Steering Committee (BASC) meeting took place. Representatives of Europe and Japan met at the CEA Headquarters in Paris (France) and approved the Work Programme 2014 for the three projects (IFMIF/EVEDA, IFERC and STP (JT-60SA)). For the Satellite Tokamak Programme (JT-60SA), as the Project Leader (PL), S. Ishida, reported, "The assembly of the cryostat base was fully completed at the JAEA Naka site in Japan, and the manufacture of the toroidal field (TF) coil has commenced in both Italy and France. There is steady progress towards the scheduled first plasma of JT-60SA in March 2019. In 2014, three equilibrium field (EF) coils will be installed on the cryostat base, and the vacuum vessel assembly will start at the JAEA Naka site". The SC expressed satisfaction with the progress of the STP Project, and recognised that the achievement of 100% implementation of the Work Programme 2013 was particularly noteworthy. The day before the BASC meeting, the representatives visited the BA facilities at CEA-Saclay (France), including the TF coil test facility (TFCTF) for JT-60SA.

The day after the BASC meeting, the PL joined a progress meeting on the TFCTF between F4E (Germany) and CEA, and visited the TFCTF at CEA-Saclay. Laurent Genini, who is responsible for the set-up of the TFCTF and the performance of the tests, presented the status of the installation, and explained the remaining tasks until its completion in June 2014.

Most of the components of the test facility have been delivered. The large test cryostat, allowing to cool and maintain a TF coil at liquid helium temperature, is in place, and the helium refrigeration system, the valve box, and the cryogenic transfer lines connecting refrigerator and valve box, are installed. In January, cryogenic valves, the circulator for supercritical helium, and novel current leads using high temperature superconducting material, will be integrated in the valve box. The data acquisition and control system has been ordered and will be available in spring 2014. Commissioning of the TFCTF and validation of its performance will be performed with a prototype coil of the W7-X project in summer 2014.

B. Salanon, Associate Director for Fusion CEA, L. Genini, the PL, M. Wanner (F4E), W. Abdel Maksoud (CEA) and R. Gondé, CEA JT-60SA Project Director in front of the test cryostat which is an in-kind contribution of the Belgian association SCK-CEN

The cryogenic transfer lines connecting the refrigerator (rear) with the valve box (front)

During the tour the PL could also visit CEA´s material test laboratory where special elements for the support structures of the TF coils of JT-60SA are being examined at cryogenic temperatures and high mechanical loads.

After the meeting the PL expressed his satisfaction to the CEA management about the progress of work towards testing of the first TF coil according to schedule.

News

EF5 and EF6 manufacturing completed

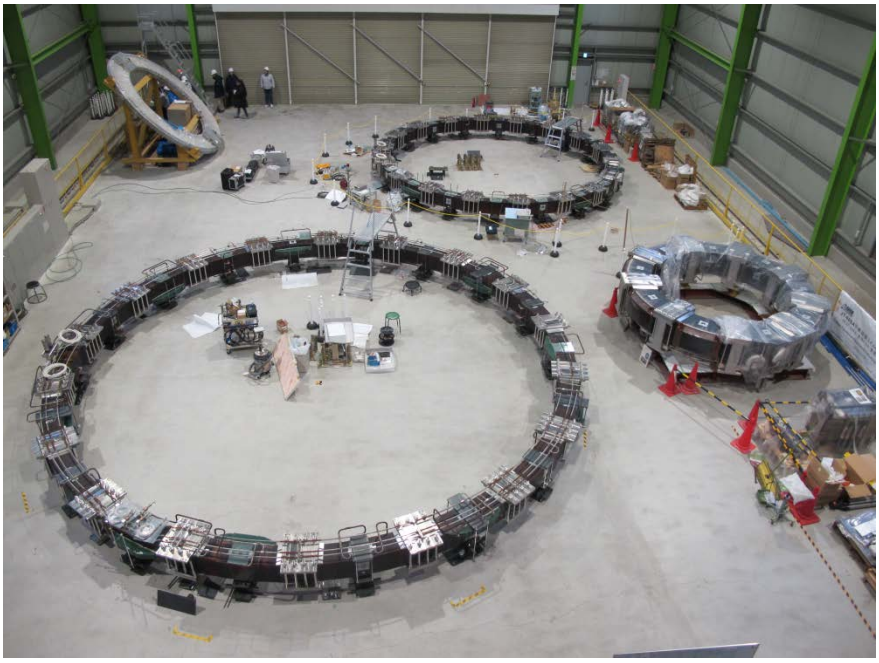


Figure 1: Completed EF6 (front) and EF5 (rear)

Figure 2: Rails from the outside to the inside of the entrance

The manufacture of the equilibrium field coils No.5 (EF5) and No. 6 (EF6) was completed at the beginning of 2014 (Figure 1). Now all the three lower EF coils including EF4, which was already manufactured last February, are ready to be brought into the torus hall as scheduled. EF5 and EF6 are the world's largest superconducting – pulsed - coils except for those for ITER. They need to be stood upright and transported through the newly constructed delivery entrance with a height of 14 m and a width of 2.6 m.

At the end of last year, rails were laid between the outside and the inside of the entrance to smoothly transport the coils into the torus hall (Figure 2). In addition, a transport jig, which supports the coils and runs on the rails, has also been completely assembled in front of the superconducting coil winding building. With this transport jig and the rails, the EF5 and EF6 will be transported into the torus hall. The EF4 will also be carried from the existing delivery entrance to the torus hall without using any special tools since its size is smaller than the other two.

Visits

PL's visit to ASG Superconductors S.p.A.

The PL together with ASG, ENEA and F4E representative in front of the first 4 DPs of the 1st coil already stacked onto the stacking bench with laser tracker inside

ENEA, the Italian Agency for New Technologies, Energy and Sustainable Economic Development, contributes in kind to the Broader Approach programme by manufacturing, among others, 9 JT-60SA toroidal field (TF) coils plus one spare. The supply is provided by the contract between ENEA and ASG Superconductors S.p.A. in Genoa.

In this context, S. Ishida, the JT-60SA Project Leader (PL), visited the ASG Company to personally verify the progress of the manufacturing activities of the TF coils.

The first phase of the contract between ENEA and ASG, consisting of the completion of the manufacturing drawings and procurement of the manufacturing tooling, was completed successfully during 2013.

The manufacturing operations officially started at the end of October 2013 after the accomplishment of the readiness review meeting between ENEA, F4E and ASG. These operations consist of several different steps. First the conductor is wound to its D shape to form a double pancake (DP). Then the DP is moved onto the DP ground insulation station where the DP insulation is applied and the electrical exits are formed. After that, the DPs are stacked on the stacking bench and the electrical inner joints and terminations are assembled, and the winding pack (WP) ground insulation is applied. The WP production is concluded with the vacuum pressure impregnation (VPI) in the VPI mould and the WP can be inserted in the steel casing structure for the final assembling of the instrumentation and of the He circuit. So far, ASG has manufactured the first 6 DPs that constitute the WP for the first coil.

During his visit, on 19 December 2013, the PL, together with ENEA and F4E representatives, had the chance to look at four DPs already stacked on the stacking bench in ASG with the associated termination and internal electrical joints already assembled. Moreover, the PL could assist at the application operation of the DP ground insulation of the 5th DP and in the final winding operation of the 6th DP.

The PL together with ASG, ENEA and F4E representatives in front of the tooling for insertion of the WP into the casing components

In his tour of the ASG workshop, ASG showed the PL the latest tooling installed in ASG for the operation of insertion (and subsequent welding) of the WP into the casing components.

After the completion of the first coil, in which most of the manufacturing process will be tested for the first time at full scale, the manufacturing will proceed at a rate of one coil every four months.

News

100 s extraction of N-NBI demonstrated

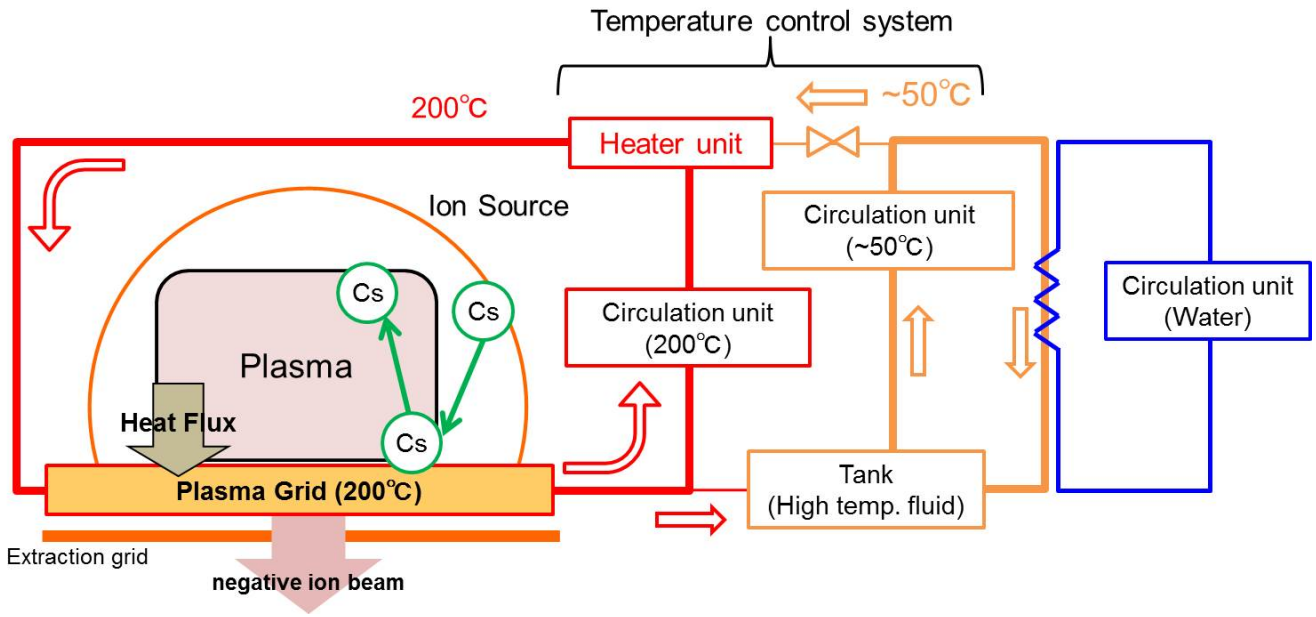


Figure 1: Design of temperature-controlled plasma grid

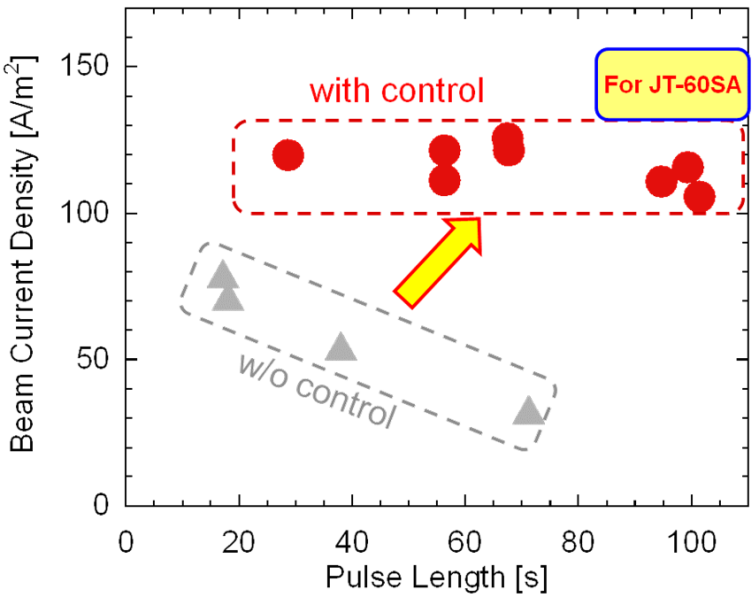


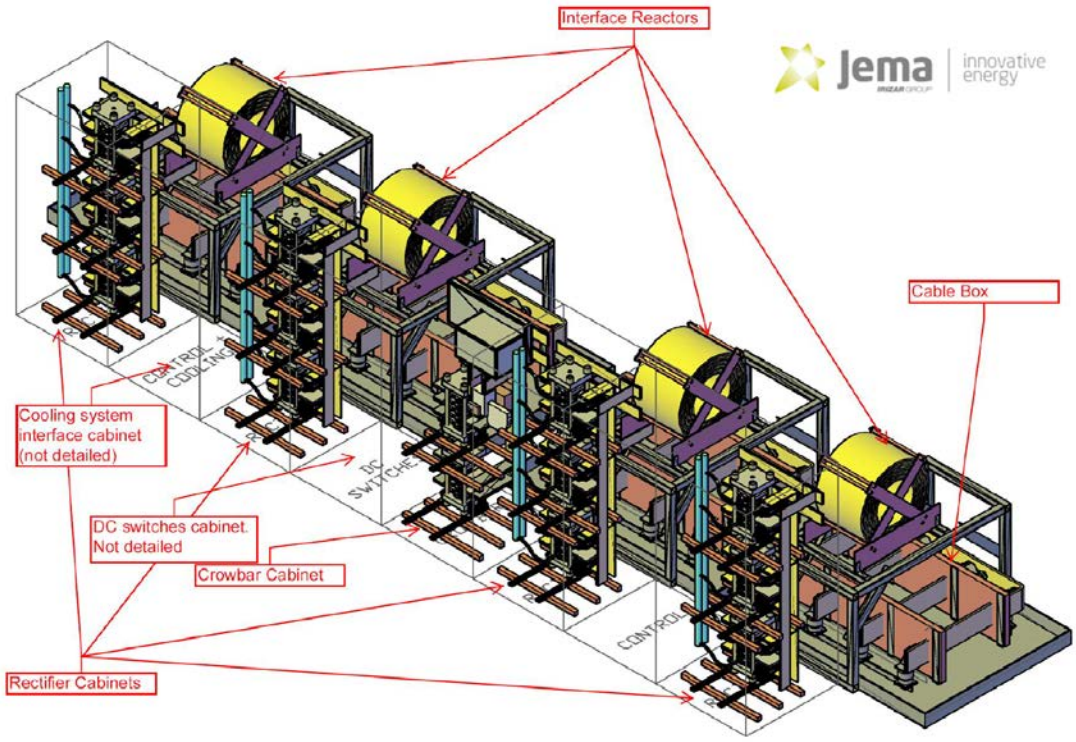
Figure 2: Long pulse capability of negative ion production with and without (w/o) temperature control using Galden

A negative-ion-based neutral beam injection (N-NBI) ion source has been developed by JAEA in Naka to produce high-power negative ion beams. In a caesium-seeded negative ion source, negative ions can be produced by forming a suitable thickness of the caesium layer on the plasma grid surface. The efficiency of negative ion production depends on the thickness of the caesium layer. The thickness of the caesium layer with the most effective production of negative ions can be obtained by setting the plasma grid temperature at 200~250℃. However, the temperature of the plasma grid is liable to increase with discharge time due to the heat load from the arc plasma. To solve this problem, a new technology, which keeps the optimum plasma grid temperature over a long time, needed to be established.

Recently, the following new technique has been developed and it is expected to be introduced into the N-NBI in JT-60SA (Newsletter No. 47). Using the N-NBI ion source, a high-temperature coolant called Galden (a fluorinated fluid), whose boiling point is 270℃, flows inside the cooling pipes within the plasma grid to keep the grid temperature at 200~250℃, thereby allowing to continuously maintain the high efficiency of negative ion production (Figure 1). As a result, 90% of the negative ion current density (120-130A/m^2) required for JT-60SA was extracted from a limited area of the plasma grid for 100 s (Figure 2). Based on this successful result, the technique will be applied to the whole extraction area of the plasma grid aiming to achieve a full beam extraction with a negative ion current of 22 A and a pulse duration of 100 s for N-NBI operation in JT-60SA.

Meetings

Design Review Meeting on SCMPS (CEA)



Preliminary layout of EF PS proposed by JEMA

The toroidal field coil power supply (TF PS) and four equilibrium field coil power supplies (EF2, EF3, EF4 and EF5 PS) for JT-60SA are being procured by CEA through a contract signed in March 2013 with the industrial supplier JEMA Energy SA.

JEMA is performing the detailed design of components, in close collaboration with CEA, F4E and JAEA, and the next milestone of the contract is the release of the first design report, describing the main features and the technical solutions resulting from the design of power supplies.

On 2 December, a Design Review Meeting (DRM-MPS16) took place at the CEA Cadarache site (France), with the direct participation of 14 experts from JEMA, CEA, F4E and JAEA.

During this meeting JEMA presented a draft version of the first design report, focussing on control section and layout, receiving first comments by CEA, F4E and JAEA. Additionally, some pending technical issues were discussed.

This was a very fruitful meeting where many technical clarifications were made. An upgraded version of the first design report is being prepared by JEMA, taking into account the comments received, and its approval is expected in the first quarter of 2014.

Meetings

Design Review and Progress meetings on SCMPS and SNU (ENEA)

Attendees at the SCMPS DRM

ENEA contributes in kind to the Broader Approach program by manufacturing, among others, two relevant power supply procurements for JT-60SA:

- 8 superconducting magnet power supply (SCMPS) and 6 transformers for part of the JT-60SA poloidal field coils (CS1, CS2, CS3, CS4, EF1, EF6 and FPPCs).
- 4 switching network units (SNUs) for the JT-60SA central solenoid (CS).

The SCMPS systems are being procured by ENEA through a contract signed in August 2013 with the industrial suppliers POSEICO and JEMA in a joint venture. The first Design Review Meeting (DRM-MPS17) of the contract was held in Busalla (Genoa, Italy) at POSEICO's premises on 4-5 December 2013 together with ENEA, F4E and JAEA. During the two-day meeting the preliminary contents of the SCMPS first design report were presented by POSEICO – JEMA and discussed in depth.

The meeting was attended (in person or by videoconference) by representatives of ENEA, F4E, JAEA, POSEICO and JEMA. At the end of the DRM all those present visited the POSEICO plant in Busalla, including the power converter production line and the power converter testing facilities.

POSEICO and JEMA took into account all considerations made by participants to the DRM with a view to including them in the SCMPS first design report. The review process of this report is expected to be concluded soon with a formal approval process.

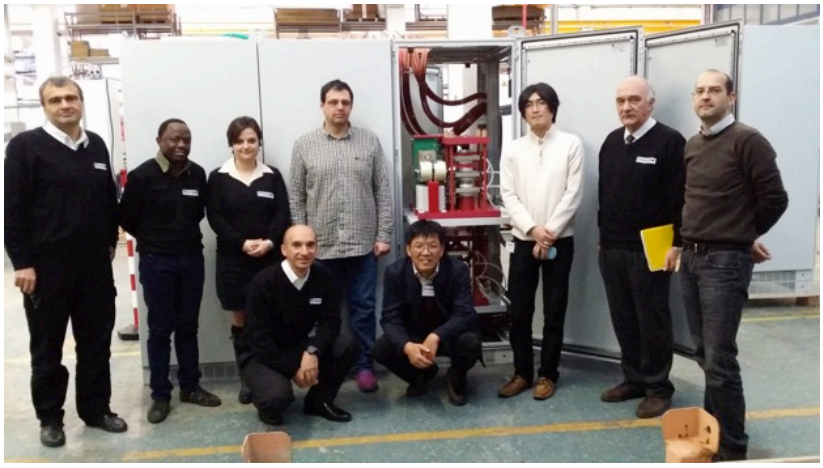
The 4 CS SNUs are being procured by ENEA through a contract signed in October 2012 with the industrial supplier OCEM Energy Technology. OCEM Energy Technology completed the SNU detailed design under ENEA supervision according to the expected schedule, and to the conceptual design developed by ENEA and included in the SNU technical specifications. The SNU first design report was approved by the Project Leader in August 2013, representing the achievement of the first important milestone of the SNU Procurement Arrangement.

Visit to the POSEICO plant in Busalla

Flags on the OCEM entrance to welcome the Japanese and European guests

On the basis of the approved design, OCEM Energy Technology built the first SNU (prototype) through Autumn 2013. The status of this prototype was monitored by ENEA. The main specifications of the CS SNU are a nominal voltage of 5 kV, a DC current interruption up to 20 kA, and an opening/closing time shorter than 1 ms. The SNU opening produces across a resistor bank R1 the high voltage necessary for the plasma breakdown. Moreover, in order to support plasma current ramp-up after successful breakdown, the SNU resistance value can be reduced by a make switch (MS) connected to a resistor bank R2. The key part of the SNU is the 20 kA DC circuit breaker, implemented by the parallel connection of an electro-mechanical by-pass switch (BPS) and an electronic static circuit breaker (SCB) based on integrated gate commutated thyristor (IGCT) components.

The status of the procurement was presented to the partners during a Progress Meeting (PM9) held in the OCEM premises in San Giorgio di Piano (Bologna, Italy) on 6 December 2013. The meeting was attended (in person or by videoconference) by representatives of ENEA, F4E, JAEA, and OCEM. The SCB and MS components and cubicles were already assembled in the final configuration. The R1, R2 and BPS cubicles were in the premises of the sub-supplier Microelettrica Scientifica for the requested type and routine tests. Some tests have already been performed on all the devices. The official tests at full current and full voltage on the SNU prototype are expected to be performed in Spring 2014. The manufacturing of the remaining 3 SNUs will proceed after the success of such tests.



ENEA, F4E JAEA and OCEM representatives with the SCB cubicle

Meetings

Symposium at 30th Annual Meeting of the JSPF

The 30th Annual Meeting of the Japan Society of Plasma Science and Nuclear Fusion Research (JSPF) was held in Tokyo from 3 - 6 December 2013. On the last day of the meeting, a symposium on "Progress of procurement in JT-60SA and EU & JA Cooperation", was held to promote mutual understanding through a discussion on the points of view on International collaboration, on machine construction, and on the shape of domestic structures for international projects, and about 90 people attended.

The symposium began with an explanation of the purpose of the discussion by Y. Kamada from JAEA, and the latest status of the assembly and component procurement was presented by Y. Ikeda from JAEA and P. Barabaschi from F4E. Subsequently, M. Yoshida from JAEA presented the activities of the "JT-60SA Research Plan", which have been jointly developed by over 300 researchers from Europe and Japan, emphasizing the importance of the JT-60SA Research Unit activities up to the first plasma. In addition, G.Giruzzi from CEA also introduced the approach to JT-60SA research in Europe and expressed high expectations in Europe for the JT-60SA project in its support of ITER and DEMO. It was clearly stated both by the audience and panel members throughout the presentations that a relationship based on mutual trust, the most important aspect for international cooperation, is being built.

Lastly, based on the above presentations, Y. Ueda from Osaka University presented the future domestic exploitation structure. It was stressed in particular that it was a very important issue to improve the structure so that young scientists could actively take part, since combining the research/development on the synergetic use of JT-60SA and ITER with establishing a human resource development process would be a key element towards an ideal domestic structure.

Calendar

February 26-27, 2014
19th Technical Coordination Meeting (TCM-19)
Garching, Germany

March 18, 2014
14th Meeting of the STP Project Committee (PC-14)
Naka, Japan

April 10, 2014
14th Meeting of the BA Steering Committee (SC-14)
Rokkasho, Japan

May 26-30, 2014
21th International Conference on Plasma Surface Interactions (PSI-21)
Kanazawa, Japan

June 4-5, 2014
20th Technical Coordination Meeting (TCM-20)
Naka, Japan

Contact Us

The JT-60SA Newsletter is released monthly by the JT-60SA Project Team.
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For more information please visit the website: http://www.jt60sa.org/