JT-60SA Newsletter

No.40, 30 April 2013

Headline

Delivery entrance for EF coil completed

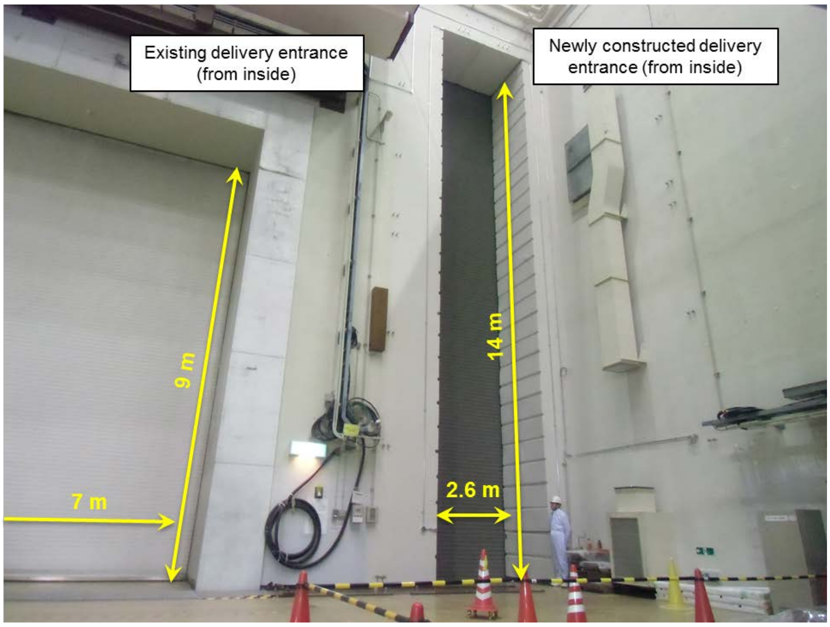


Figure 1: EF coil delivery entrance (from inside the torus hall)

A special delivery entrance for equilibrium field (EF) coils (height: 14 m, width: 2.6 m) has been recently constructed, since the existing delivery entrance size of the torus hall (height: 9 m, width: 7 m) was not large enough to admit some EF coils (e.g. EF1, 12 m in maximum diameter) through the entrance to the assembly hall (Figure 1).

In this construction work, the 1.74 m thick reinforced concrete wall was cut into blocks. The weight and size of the block pieces were limited to 2.7 t in weight, 0.5 m in height, 1.3 m in width and 1.74 m in depth per block as the construction location was too narrow for heavy machinery access.

The construction works took five months to be completed and a total of 56 concrete blocks were cut out. The construction of the delivery entrance for the EF coil was completed in March 2013. It has a roller shutter, which can open fully in three minutes. Consequently, the large size EF coil can be delivered to the assembly hall after passing through the new delivery entrance, along the planned transit route (Figure 2).

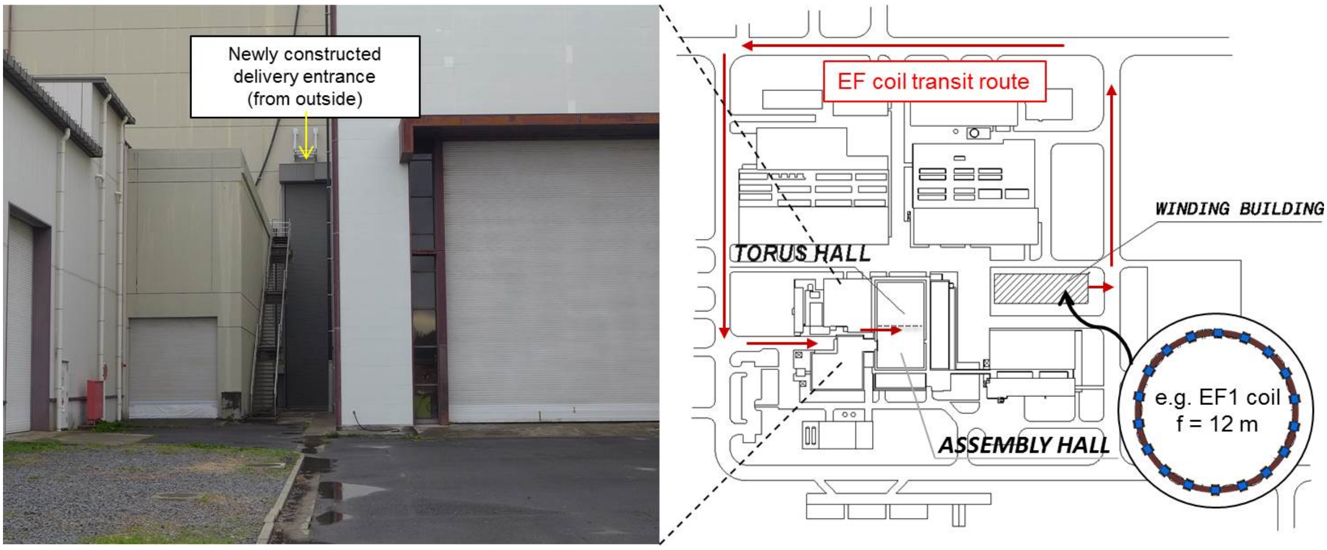


Figure 2: EF coil delivery entrance (from outside) on the left and EF coil transit route on the right

News

Progress on switching network units for central solenoid

Figure 1: Discussion during progress meeting held in February

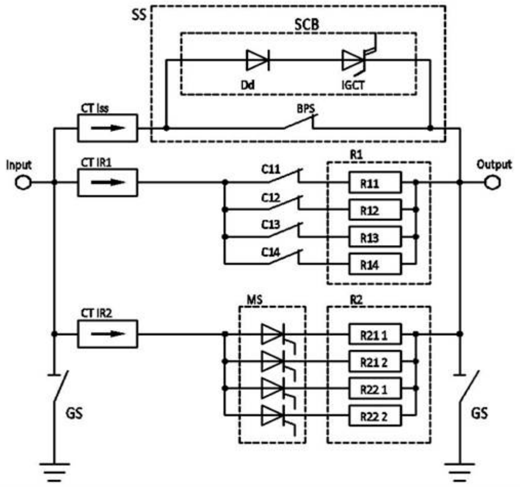


Figure 2: Design structure and main components of the SNU

Figure 3: The selected IGCT component

A procurement contract for the switching network units (SNUs) for the central solenoid was signed in October 2012 between ENEA and the industrial supplier OCEM Energy Technology. The delivery of the SNUs to Japan is expected in 2016. The industrial design is currently in progress at the OCEM premises in S. Giorgio di Piano (Bologna), Italy.

Several technical issues have been faced and addressed (Figure 1): characteristics of the new bypass switch (BPS), accuracy of breakdown resistors, protection by overcurrents and control strategy, reflective memory mapping, layout and interface points, uninterruptible power supply (UPS) ratings, cooling system, temperature measurements and grounding switches for maintenance operations (interlock strategy).

The main novelty of the proposed design (Figure 2) is in the implementation of the SNU main switch by means of an electronic static circuit breaker (SCB) in parallel with the electromechanical BPS. The SCB and the supporting elements can limit the opening stresses and the arc phenomena of the BPS, improving the expected component lifecycle and reliability. Furthermore, the global power losses are limited as the current flows mostly through the BPS which is characterized by lower conduction losses with respect to an electronic switch. The inadequate velocity and repeatability of the BPS is virtually hidden by the SCB operations.

The main electronic component of the SCB is the integrated gate commutated thyristor (IGCT) (Figure 3), a gate-controlled turn-off switch which turns off like a transistor but conducts like a thyristor with the lowest conduction losses. Every SCB is implemented by a stack of 8 IGCTs, with their supporting protection diodes, snubbers, filters and clamping circuits.

In the proposed design the SNU making switch is implemented by four silicon-controlled rectifiers (SCR), allowing a better flexibility and protection capability, in addition to the required speed and repeatability.

The status of the design is consistent with the time schedule, and the detailed design of the SNUs is about to be completed.

News

Contract for TF and EF2 to EF5 magnet power supplies awarded

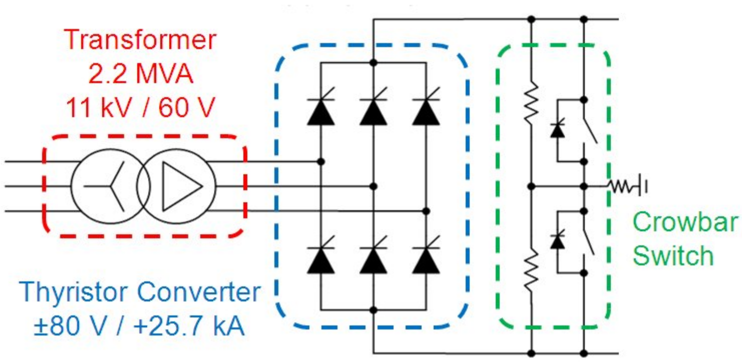


Figure 1: Schematic of TF PS

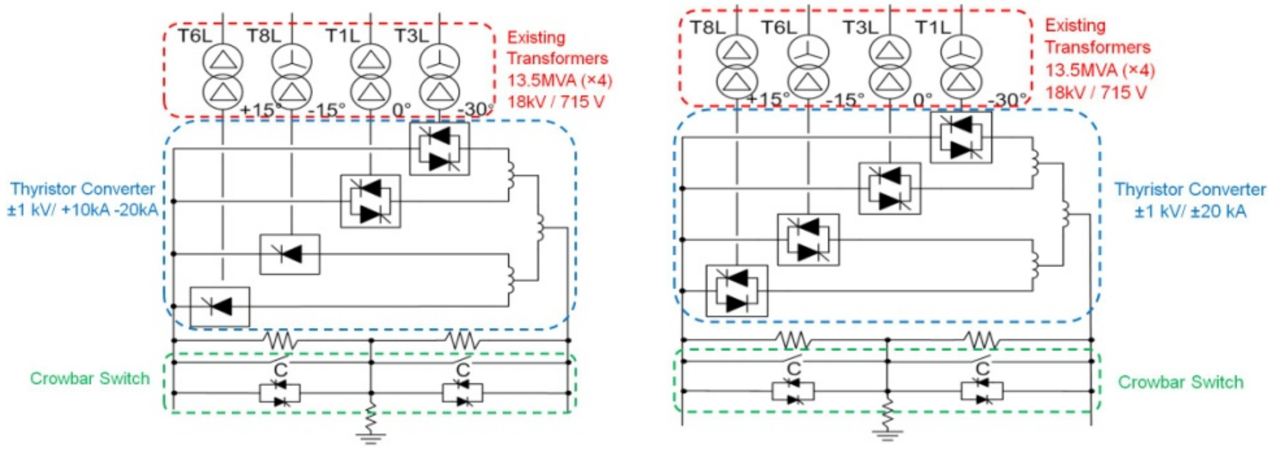


Figure 2: Schematic of EF PS (EF2 and EF5 left, EF3 and EF4 right)

The contract for the procurement of the JT-60SA superconducting magnet power supplies (SCMPS) has been awarded by CEA to the industrial supplier JEMA Energy SA on 13 March 2013.

JEMA is a Spanish company located in Lasarte-Oria (Spain) with large experience in supplying custom power converter systems not only for industrial applications but also for nuclear fusion research experiments such as JET and MAST. For CEA, JEMA is already manufacturing the power supply (1.5 kA/+3 V and -0.7 V) for the superconducting coil Iseult (11.75 T) that is part of the high resolution magnetic resonance imaging system NEUROSPIN.

The signed contract includes the design, manufacturing, transportation, installation and commissioning of the toroidal field coil power supply (TF PS) and of four equilibrium field (EF) coil power supplies (EF2, EF3, EF4 and EF5 PS). Furthermore, in order to reduce technical risks on site, a complete set of tests at full power will be carried out in the factory before transportation to Japan.

The TF PS is rated for a continuous direct current of 25.7 kA, with an output voltage of about 80 V that allows charging the TF magnets up to their nominal current in about 25 minutes. The four EF PSs are rated for a nominal current of ±20 kA (EF3 and EF4) or +10 kA/-20 kA (EF2 and EF5) and a nominal voltage around ±1 kV. In order to be able to reverse the coil current without difficulties, circulating current operation between reverse and forward bridges is foreseen at low coil current.

Figure 3: Discussion at the kick-off meeting

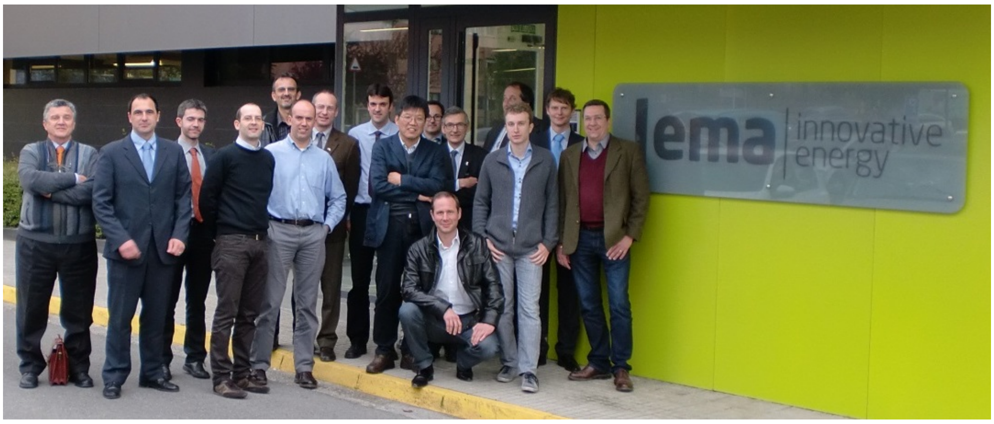


Figure 4: Participants at the kick-off meeting

The contract kick-off meeting took place on 11-12 April at the JEMA premises, with the direct participation of CEA, F4E and JAEA experts. During the meeting the project organization of JEMA was presented, the scope of procurement was confirmed and the supplier quality plan was discussed. Moreover some technical points related to the preliminary design of converters were discussed. They will be more deeply analysed during the detailed design phase that will start within a few weeks and that will lead to the issue of the first design report by the end of 2013.

News

Signature of the contract for the procurement of the OIS and its kick-off meeting

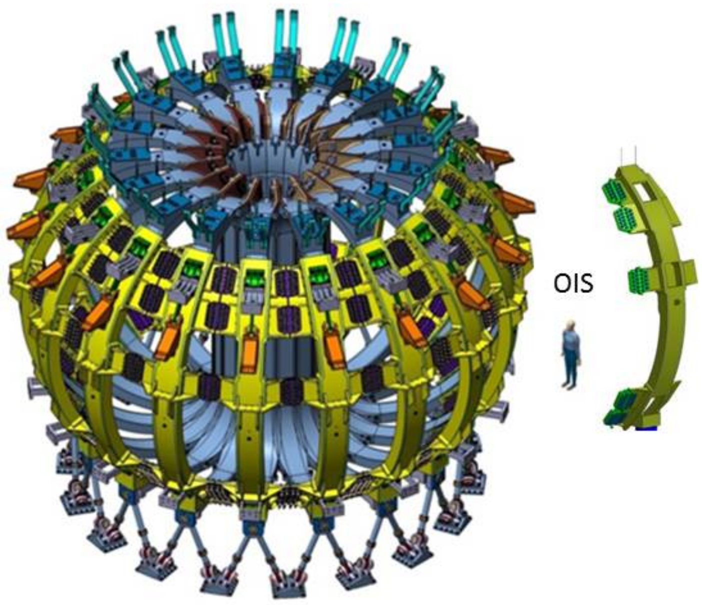


Figure 1: JT-60SA magnetic system assembly conceptual design of OIS

Figure 2: Kick-off meeting for the OIS contract, Saint-Romans on 26 March, 2013

The contract for the manufacturing of the outer intercoil structures (OIS) for JT-60SA was awarded to the SDMS Company, Saint-Romans, Isère, France. This contract was signed jointly by Gabriele Fioni head of the CEA/DSM and Olivier Besancon President of SDMS on 25 March 2013. The kick-off meeting for the OIS manufacturing contract was held on 26 March at Saint-Romans, with CEA, F4E and SDMS representatives.

The SDMS Company is well known for its high level of competence in the field of advanced mechanical applications for research, nuclear and space industries, among others. In the field of thermonuclear fusion SDMS has a long partnership with CEA. For instance, SDMS provided for Tore Supra two major components that are the supporting structure of the toroidal pump limiter (LPT) and the actively cooled passive-active-multijunction (PAM) launcher for the lower hybrid current drive system. In the framework of the Broader Approach SDMS provided also a superconducting cavity for the IFMIF-EVEDA accelerator.

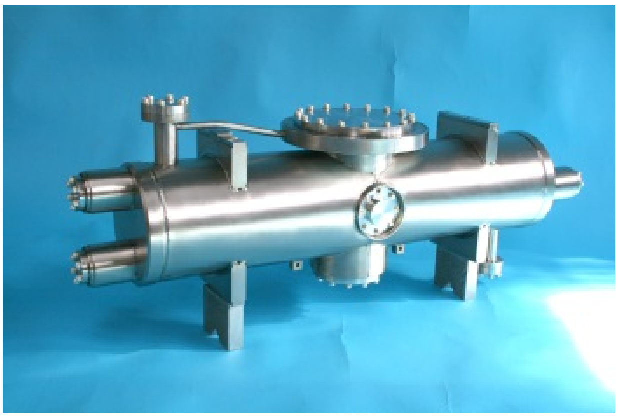


Figure 3: Accelerator cavity for IFMIF, SDMS (2011)

Figure 4: Support structure for the LPT of Tore Supra, SDMS (2000)

The 18 OISs are welded structures of large dimensions: 7 m long, 1.8 m wide, with a unit weight of 5 t, manufactured to submillimetre accuracy. They are designed to withstand intense forces exerted on the toroidal magnetic field coils and are linked together by insulating bolted junctions. CEA has completed the detailed design studies and the associated technical qualifications from the conceptual design developed by F4E. Manufacture of the 18 OISs will last 30 months from the contract signature. The first OIS will be ready for shipment in March 2014.

News

First production pancake for central solenoid manufactured

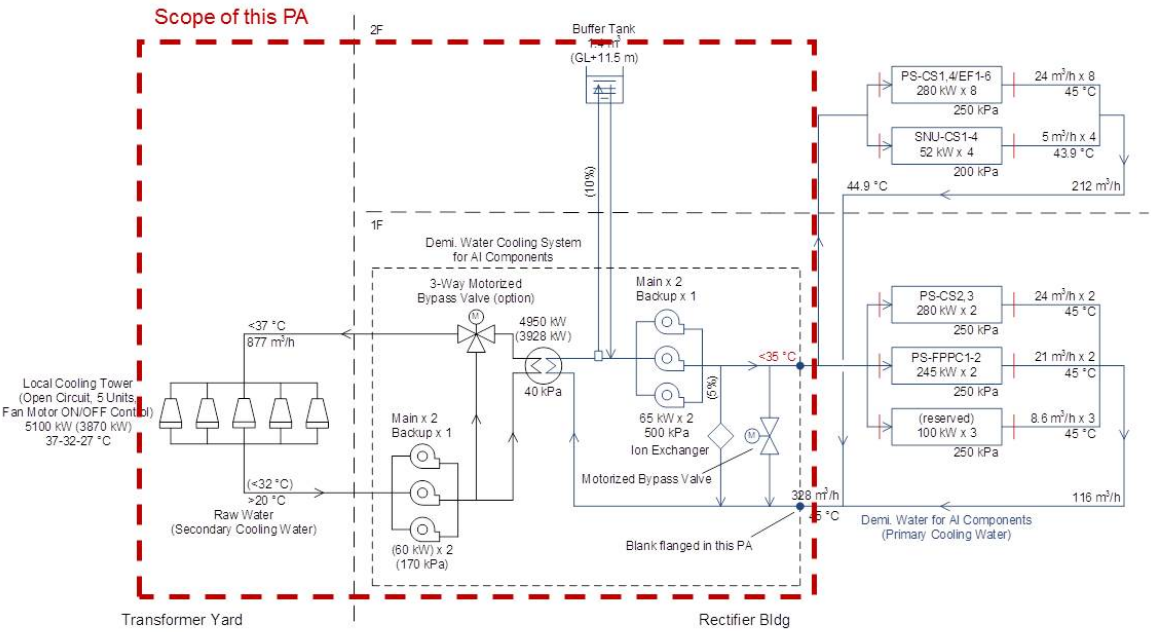
Completed first production quad-pancake

The central solenoid (CS) system of JT-60SA uses a Nb_3Sn conductor similar to that for the ITER CS and a strand identical to that for the ITER TF conductor. The conductor contains a circular Nb_3Sn cable in a square conduit cooled by supercritical helium. The JT-60SA CS consists of four independent coil modules, each consisting of one quad-pancake and 6 octa-pancakes.

After the winding test for the CS using a copper dummy conductor, carried out in 2012, a copper dummy pancake was insulated with glass-cloth wrapping for turn-to-turn and ground insulation and vacuum impregnation. The CS model coil was transferred to the NIFS (National Institute for Fusion Science) test facility for a cryogenic energising test (Newsletter 37). Using the manufacturing tools for the CS, which were qualified in manufacturing the copper dummy pancake and the CS model coil, the first production quad-pancake has now been successfully completed (see Figure). The winding of the octa-pancakes for the CS has also started during April.

News

PA signed for magnet PS water cooling systems



Design example of heat and water flow of the MPS-WCS for the JT-60 rectifier building (for PF MPSs and FPPC PSs)

Cooling water is essential for the operation of the JT-60SA magnet power supply (MPS) systems, being procured by Europe. In addition, the water has to be demineralised to preserve electrical insulation, and tailored for use with aluminium components in order to avoid corrosion due to dissimilar metals. For this purpose, the Procurement Arrangement (PA) for the supply of the magnet PS water cooling systems (MPS-WCSs), for which Japan is responsible, was signed in March only after a protracted discussion on the technical specifications including the interfaces between Japanese and European procurements.

Most of the MPS components are planned to be installed in two areas. One is the active beam line PS room (to be renamed the TF MPS room) on the 3rd floor of the JT-60 experiment building extension, and another is the JT-60 rectifier building. The former is for the TF MPS, and the latter is for the PF MPSs and the fast plasma position control (FPPC) coil PSs. Under this PA, therefore, two independent MPS-WCSs are to be provided according to the locations. Their net cooling capacities for the demineralised water are 400 and 4,820 kW, respectively. Both the MPS-WCSs are based on almost the same internal system configuration that consists of a demineralised water cooling system for primary cooling and dedicated local cooling towers for secondary cooling, although their cooling capacities are quite different. The figure shows a design example of the heat and water flow diagram of the MPS-WCS for the JT-60 rectifier building.

Local

Ume Blossom Festival in Mito, Japan

Figure 1: White and red ume in full bloom at Kairakuen Park

The Japanese plum (called “ume” in Japanese) blossom festival was held from 20 February to 31 March 2013 at Kairakuen Park in Mito, located about 15 km south of the JAEA Naka Institute. An ume tree is one of the city symbols of Mito.

Kairakuen Park (meaning “Park to be enjoyed together”), one of the three great gardens of Japan, was built in 1842 by Nariaki Tokugawa (1800-1860), the ninth lord of Mito in the late period of Edo.

Within the 13-hectare spacious interior, there are over 3,000 ume trees of 100 varieties, and they all bloom together and give off a sweet-smelling fragrance during the ume blossom season in spring (Figure 1). The garden is in harmony with the surrounding nature and features ume and bamboo groves, and natural forests. In particular, in the ume grove, the beautiful white and red ume blossoms and the gracefully-shaped branches create a magnificent atmosphere. The ume fruits are also processed into a pickle, liquor, and Japanese sweets and they are popular souvenirs in Mito.

Figure 2: Kobuntei

Figure 3: View from ume grove

Besides the garden, there is a historical building called "Kobuntei" whose simple architectural design reflects the style of the "Mito Samurai" (Figure 2 and 3) in the park. From the 3rd floor of this building, a spectacular view of Kairakuen and the nearby Senba Lake (circumference: 3.1 km) can be enjoyed.

There are many events at the festival that visitors can take part in, such as the outdoor tea ceremony, an outdoor concert with traditional Japanese instruments on each Sunday during the plum blossom festival, and photo opportunities with Mito's Ume Taishi wearing Japanese kimono (young ladies chosen to represent Mito and its famous plum blossom festival and welcome Kairakuen visitors).

For more information: http://www.koen.pref.ibaraki.jp/foreign_language/en/index.html

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Calendar

May 28-29, 2013
17th Technical Coordination Meeting (TCM-17)
Grenoble, France

June 10-14, 2013
25th Symposium on Fusion Engineering (SOFE-25)
San Francisco, USA

July 1-5, 2013
40th European Physical Society Conference on Plasma Physics (EPS-CPP-40)
Espoo, Finland

July 14-19, 2013
23th International Conference on Magnet Technology (MT-23)
Boston, USA

September 16-20, 2013
11th International Symposium on Fusion Nuclear Technology (ISFNT-11)
Barcelona, Spain

October 9, 2013
13th Meeting of the STP Project Committee (PC-13)
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/