JT-60SA Newsletter

No. 64, 30 April 2015

## Headline

# Ceremony for JT-60SA


On 20 April 2015, JAEA held a “Celebration of the delivery of main components and start of their on-site installation by EU, and completion of initial assembly of the vacuum vessel of the JT-60SA tokamak” to report the progress of JT-60SA device development and to promote further partnership among the government, the related organizations, institutes and companies in both Japan and Europe as well as local governments, which strongly support and contribute to the JT-60SA project. More than 200 guests attended. The following people (listed in programme order) delivered speeches:

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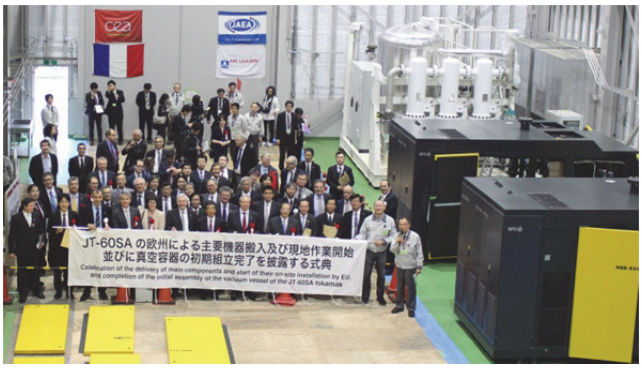
| Mr. Masahiro MORI | Director General of Naka Institute, JAEA |
| Mr. Toshio KODAMA | JAEA President |
| Mr. Motoyuki FUJII | State Minister of MEXT, Japan |
| Mr. Eisuke MORI | Member of the House of Representatives of Japan, Secretary-general of LDP's union to help promote the nuclear fusion R&D |
| Mr. Viorel ISTICIOAIA-BUDURA | Ambassador of the European Union to Japan |
| Mr. Thierry DANA | Ambassador of France to Japan<br>(the speech given, on his behalf, by Mr. Paul-Bertrand BARETS, Minister Consular, French Embassy in Japan) |
| Mr. Domenico GIORG | Ambassador of Italy to Japan<br>(the speech given, on his behalf, by Mr. Alberto Mengoni, Embassy of Italy, Science and Technology Attaché) |
| Mr. Hans Carl FREIHERR VON WERTHERN | Ambassador of the Federal Republic of Germany to Japan<br>(the speech given, on his behalf, by Mr. Stephan Grabherr, Minister Consular, Economic and Scientific Affairs, Embassy of the Federal Republic of Germany in Japan) |
| Mr. Gonzalo DE BENITO Secades | Ambassador of Spain to Japan<br>(the speech given, on his behalf, by Mr. Santiago HERRERO AMIGO, Cultural Consular, Spanish Embassy in Japan) |
| Mr. Akimasa ISHIKAWA | Member of the House of Representatives of Japan |
| Mr. Mikito KUSUDA | Deputy Governor of Ibaraki Prefecture |
| Mr. Toru UMINO | Mayor of Naka City |

Since the JT-60SA construction started on 28 January 2013 by installation of the cryostat base fabricated in Spain, the project has been making steady progress toward the start of fusion plasma experiments in 2019. In September 2014, quench protection circuits, a power supply system made in Italy, were delivered to JAEA Naka site, and their on-site installation and commissioning by European workers began and continues to the present. In March 2015, components of the cryogenic system made in France were delivered, followed by the start of their installation work. The first pair of high temperature superconductor current leads for the toroidal field coils, made in Germany, also arrived on the site. In the torus hall, beginning in 2014, the vacuum vessel sectors manufactured in Japan have been mounted on the cryostat base and are now almost all welded together, forming 340 degrees of the torus.






The culmination of all these activities, along with the occasion of the 16th BA Steering Committee meeting and the 22nd JT-60SA Technical Coordination Meeting in the same week, made this an ideal occasion for a celebration of the progress so far.

## News

# Components of cryogenic system arrive in Japan

After a two-month-journey from Antwerp and some 10 intermediate stops, the vessel “Annemieke” arrived at the port of Hitachi on 21 March 2015 (the Spring Equinox Day, a national holiday in Japan). Within about 7 hours, the 41 packages, with a total weight of 250 t, were lifted from the vessel onto the pier.

Although the refrigerator cold box and the auxiliary cold box (each 12 m long, 4.2 m wide and 4.1 m high) are huge enough to occupy most of the cryogenic building of JAEA Naka site, they appeared like toys on the big vessel (see figure below left).

Upon unloading, all packages were jointly checked for damage by AL-AT, CEA, F4E and JAEA representatives. With signatures on the inspection record, the responsibility of transporting the boxes was transferred to JAEA. During the first 2 weeks of April, the boxes were moved the last 7 km from the port to their final destination at JAEA Naka.



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## News

# Manufacturing of the 1st TFC casing components in Italy

ENEA contributes to the Broader Approach activities by manufacturing 18 casing components of the toroidal field coil for JT-60SA. They are provided under a contract with Walter Tosto (WTO) SpA in Chieti, Italy. In this framework, the JT-60SA Project Leader (PL) Hiroshi Shirai, and Project Team and JAEA staff, visited WTO on 9 March 2015 (see Figure 1) to verify the progress of manufacturing activities.

WTO presented the status of procurement. The design, engineering and qualification programme had already been completed, and manufacturing activities, after forging material replacement, were just beginning to progress regularly. The components of the first 4 coil casings were under fabrication at each manufacturing stage, and 2 of them had almost been finished. The dimensional survey of the first straight leg was completed and it was ready for shipment as shown in Figure 4. CEA and ALSTOM, as well, had a chance to visit WTO premises just before the delivery of the straight leg (see Figure 3). Most of the components were ready for assembly, while the elbows were being prepared according to the completion sequence of the casings. The first 8 coil casings are foreseen to be delivered to the 2 coil manufacturers - 4 casings to ASG Superconductors Spa in Genoa, Italy and the others to ALSTOM in Belfort, France - by the end of 2015.

Technical discussions highlighted the issues WTO had encountered and the improvements they had adopted during the manufacturing process. The lessons learned during the machining of the first 2 coils will consolidate better the definitions and strategies of work for the next casings.

The visit of the PL was concluded with a tour of the WTO workshop involved in the final machining phases of casing components, viewing such processes as final chamfering, vibration stress relief (see Figure 5) and laser tracker dimensional survey.

Figure 1: PL, PT and JAEA staff, F4E, ENEA and WTO representatives in the factory

Figure 2: Internal part of the straight leg with the welded helium pipes

Figure 3: Representatives of ENEA, F4E, CEA, ALSTOM and WTO in front of the first straight leg

Figure 4: First straight leg packed into the transportation frame ready for delivery

Figure 5: Representatives of ENEA, JAEA, F4E and WTO with PL and PT staff witnessing vibration stress relief on a curved leg

## CVBCS fabrication status in Spain

The fabrication of the cryostat vessel body cylindrical section (CBVCS) is progressing adequately with minor delays. The last progress meeting was held at ASTURFEITO premises in March 2015. The JT-60SA Project Leader (PL) together with a PT staff and JAEA members, F4E and CIEMAT attended the meeting.

Figure 1: PL with JAEA/F4E/CIEMAT and ASTURFEITO colleagues during the visit

After a short introduction plus an overview of the company, all attendees had a workshop tour, including the blasting and painting cabins, and inspected the status of fabrication. The upper sector 2-3_1B was positioned on the large milling machine, and was almost ready for the cutting of holes/openings corresponding to the ports. The welding activities were still in progress on the lower sector 2-3_3B and the sector 2-3_2B with all the ports had already been welded, and was waiting for the helium leak test on manhole 1.

The latter sector 2-3_2B was machined to final dimensions by the end of March, and will be taken as a pattern sector for the final machining of remaining sectors. During the final machining of this first sector, the average temperature in the workshop was recorded in order to take it into account in the final machining of other individual sectors, to compensate for the nominal dimensions of the sectors due to the temperature difference during the machining of each particular sector compared to the pattern, so as to maintain tolerances within the specified values.

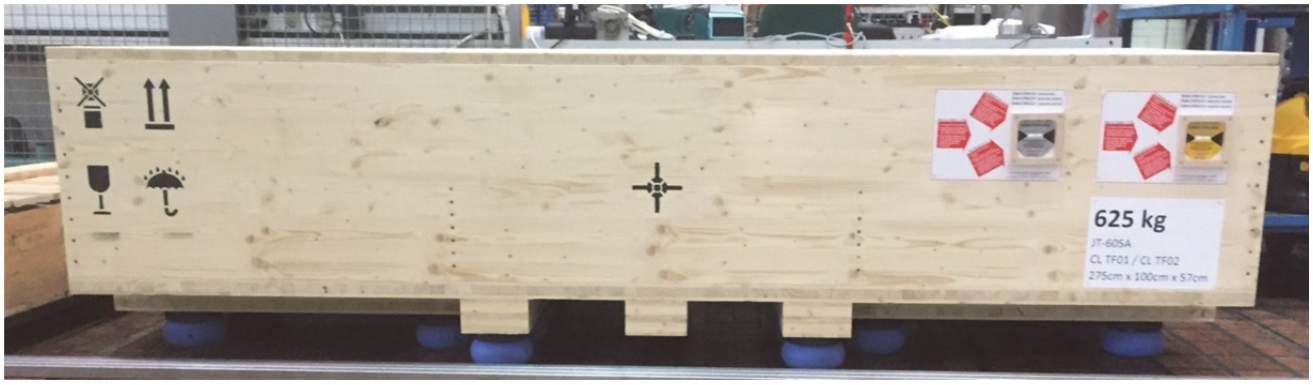
Among others, the manufacturing schedule and assembly issues at the factory/Naka-site were discussed in detail. ASTURFEITO presented a new manufacturing schedule with a delay of 2 months, which was considered acceptable for the project. Regarding the assembly at the factory, which should reproduce the assembly conditions at the Naka-site, due to the differences between the cryostat base dummy piece (on which the CVBCS would be assembled at the factory) and the actual cryostat base (on which all the coils, vacuum vessel, thermal shield, etc.) will be loaded, many assembly issues were still to be studied carefully.

Figure 2: Upper sector 2-3 at the milling machine

Figure 3: Lower sector 2-3_2B fully welded

## News

# First pair of HTS-CLs for TFC delivered to the Naka site




On 20 March 2015, a box including the first pair of high temperature superconductor current leads (HTS CLs) for the toroidal field (TF) coils left the Karlsruhe Institute of Technology (KIT) for Frankfurt airport for a comfortable ride by airplane to Narita (Japan). They passed through Japanese customs and arrived safely at the JAEA Naka site on 27 March.

Well protected in a wooden box, supported by elastic shock absorbers, supervised by a series of sensitive acceleration and tilting sensors, decorated with several handling marks (see figure above), and accompanied by a report demonstrating their compliance with European export regulations, the HTS CLs got ready for the trip to their final destination. This was the 1st pair of a series of 26 HTS CLs which will be provided for the JT-60SA project by the German voluntary contributor, KIT.

Before being sent to Japan, the HTS CLs successfully passed a series of stringent tests at cryogenic temperatures. These tests comprised leak and high voltage tests, a functional test at the nominal current of 25.7 kA, and safe reaction checks against failure modes. After the final check of all sensors and documentation, F4E declared them ready for transportation. The comprehensive documentation included covers all phases of the HTS CL construction and includes drawings, material specifications, manufacturing certificates, test records and instruction manuals.

The pair of HTS CLs in a wooden box for transportation

## Progress of magnet power supply preparation activity

JT-60SA's superconducting toroidal field (TF) coils, superconducting poloidal field (PF) coils, and plasma heating devices, require an AC power supply system. The power for the TF coils can be taken directly from the commercial electricity utility, as their power supplies are operated in steady state and need a low DC current. However, the PF coils and the plasma heating devices demand huge amounts of power periodically. This would cause too many and high loads and serious disturbances to the electricity utility network. Therefore, the H-MG, a flywheel power generator in the Naka site, is used to balance the power loads and to prevent a leak of power (in case of failure) back to the network. The AC output distribution system was originally designed for the former JT-60 project. It is being upgraded suitably to satisfy the requirement of JT-60SA operation.

Figure 1: New resistors to suppress the current surge at the 18kV main AC power distribution line of the power distribution system

Figure 1 shows the discharge resistors to prevent a magnetizing current surge, which were additionally installed as part of the booster power supply for plasma startup. These 2 separated power input systems prevent damage by excess current on the transformers and the generators.

The DC power supply system consists of stepdown transformers, thyristor converters, a quench protection circuit, the high voltage generation circuit for plasma heating (the switching network unit or the booster power supply), etc. The current feeders are the final and most important item to connect them up and to complete the DC power supply to the magnetic coils. The feeders for the TF coils have to satisfy specifications for continuous 25.7 kA operation, while the PF coils are to be operated for a pulse length of 250 seconds every 30 minutes. The voltage drop has been designed to be at a minimum, so that the room temperature and energy consumption is kept low during long pulse operation. Figure 2 shows the 20 kA DC feeder layout on the 1st floor of the JT-60 rectifier building.

Much of JT-60SA's power supply equipment requires cooling water because the plasma current is active for about 140 seconds. The thyristor converter circuit has a junction temperature limit and the aluminium busbars also have a shorter thermal time constant. Therefore, a pure water-cooling system specifically designed for such aluminium devices is needed. 2 sets of brand-new cooling systems have been designed and their installation was finished in February 2015. The heat exchanger for the PF coils and the circulator pumps were installed on the ground floor of the rectifier building (Figure 3).

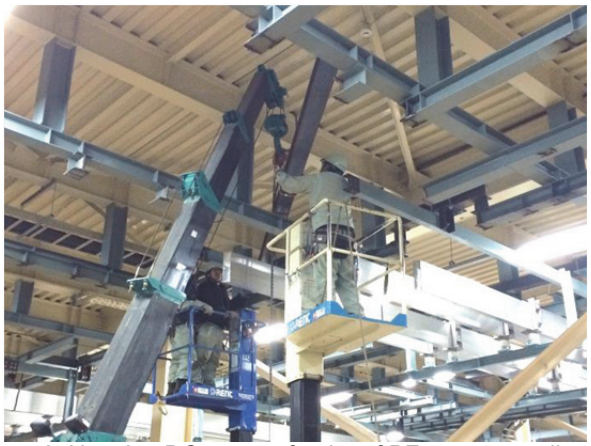


Figure 2: Hanging DC current feeder of PF power supplies

Figure 3: Demineralized water-cooling system for PF coil PSs

## Meetings

# The 16th STP Project Committee Meeting


On 17 March 2015, the 16th Meeting of the Satellite Tokamak Programme Project Committee (STP-PC) was held between Japan and Europe. A total of 31 participants joined the meeting also by videoconference. There were 4 members from the Project Committee, the Project Leader (PL), 4 experts from the Project Team and 22 experts from the EU and JA Home Teams.

At the meeting, the PL overviewed the project status, and presented the "Annual Report 2014" and "Project Plan" to be submitted to the 16th Broader Approach Steering Committee held on 21 April 2015 at JAEA Naka site. The latest status of procurement and assembly was also reported in detail by the Project Managers of the EU and JA Home Teams.

The STP-PC expressed satisfaction at the achievements and progress in both EU and JA procurements as well as the assembly activities. Such accomplishments included activities such as toroidal field (TF) coil winding and impregnation, commissioning tests of the TF coil cold test facility, fabrication of high temperature superconductor current leads for TF coils, shipment of components of the cryogenic system from Europe to Japan, installation and commissioning of quench protection circuit components, winding of PF conductors for EF1 & EF2 coils and CS1 & CS2 modules, completion of the magnet power supply water cooling system, installation and welding of 9 vacuum vessel sectors on the cryostat base forming 340-degree torus, and so forth.

## Calendar

May 17 - 21, 2015
23rd International Conference on Nuclear Engineering (ICONE-23)
Chiba, Japan

May 31 - June 4, 2015
26th Symposium on Fusion Engineering (SOFE-26)
Austin, USA

June 22 - 26, 2015
42nd European Physical Society Conference on Plasma Physics (EPS-42)
Lisbon, Portugal

September 9 - 11, 2015
15th International Workshop on Plasma Edge Theory in Fusion Devices (PET-15)
Nara, Japan

September 14 - 18, 2015
12th International Symposium on Fusion Nuclear Technology (ISFNT 12)
Jeju Island, Korea

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## 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/