JT-60SA Newsletter
No. 70, 31 October 2015

Headline

Installation of cryogenic system complete

Figure 1: Group photo taken in front of the ACB

The installation of the cryogenic system for JT-60SA is a very good example of what has been achieved by the joint effort of Europe and Japan in the Satellite Tokamak Programme.

While the packages, with various components of the cryogenic system, were still on their way from Europe to Japan, JAEA finalised construction of a new 35 x 17 m warm compressor building, refurbishment of the cryogenic hall, preparation of the foundation for the gaseous helium storage vessels, and installation of the high-voltage transformers and water cooling towers (Figure 2). Immediately after the components arrived at the JAEA Naka site in April 2015, the refrigerator cold box (RCB), the auxiliary cold box (ACB), and 4 screw compressors with the oil removal system were moved to their final positions in the cryogenic hall and compressor building. The remaining components (approximately 40 crates) were stored in different areas to wait for assembly. The first challenge during installation was the precise positioning of the large RCB and ACB (around 70 t each) within a tolerance of a few mm. Thanks to the installation procedures, which had been worked out carefully in advance, and the joint effort by JAEA, CEA, Air Liquide Advanced Technologies (ALAT), and the transport company, this task was completed quickly without problems. It was necessary to keep this precision to install the vacuum and super-insulated cryogenic transfer line, with a diameter of 900 mm and a length of 8.5 m, between the RCB and ACB (Figure 3).

In May 2015, JAEA accomplished a logistical challenge. They successfully coordinated the special transport of 6 heavy helium storage vessels, with a volume of 250 m^3 each, from the port of Hitachi to the JAEA Naka site over several nights. The vessels were unloaded and installed on the foundations at the tank yard using a 550 t mobile crane.

Installation of the cryogenic system progressed impressively fast, thanks to its modular design by ALAT. As most of the subsystems and valve panels were delivered as prefabricated units, Air Liquide Japan (ALJ) and their local subcontractors had only to fabricate and install the interconnecting pipes, wires and supports on site. Nevertheless, the total length of piping which was installed on site was about 1,000 m. In the end there were around 1,350 welding points. All pipes were pressure tested and carefully checked for helium leaks after installation. Once the electrical wiring was connected, the pressures, temperatures and flow rates were monitored from the control system. All instrumentation could then be checked out with the control system as well.

In the beginning of September 2015, JAEA started to supply all utilities (electricity, cooling water, liquid nitrogen, gaseous helium) for pre-commissioning. As one of the first actions, all pipes underwent a blow test to remove any debris from manufacture, which could affect the performance of the delicate rotating elements and the cryogenic valves of the helium plant.

Installation of the cryogenic system, within a tight schedule of 6 months, was impossible without the well-coordinated actions, written procedures, careful preparation, interface controls, and good team spirit among the colleagues from JAEA, F4E, CEA, ALAT and ALJ. Most of the problems that occurred on site were solved quickly without bureaucracy.

Despite the rapid progress, quality and safety always had priority. ALJ´s safety officer carefully followed all rules and regulations, and checked whether the working area and all involved people were well protected. Every morning, the daily tasks and possible interference between the working groups were explained to all workers. In addition, if weather allowed, the workers joined the morning exercises outdoors to warm-up and keep fit for the day (Figure 4).

During the coming months, the cryogenic system will be started up unit by unit. It is expected that the final acceptance test as a complete plant will be finished by August 2016.

Figure 2: The high-voltage transformers and water cooling towers, gaseous helium storage vessels, and liquid nitrogen tank (from front to back)

Figure 3: Top of the RCB and ACB connected by the cryogenic transfer line

Figure 4: Morning exercise by Japanese construction team

News

Celebration of TF Coil HTS CLs completion at KIT

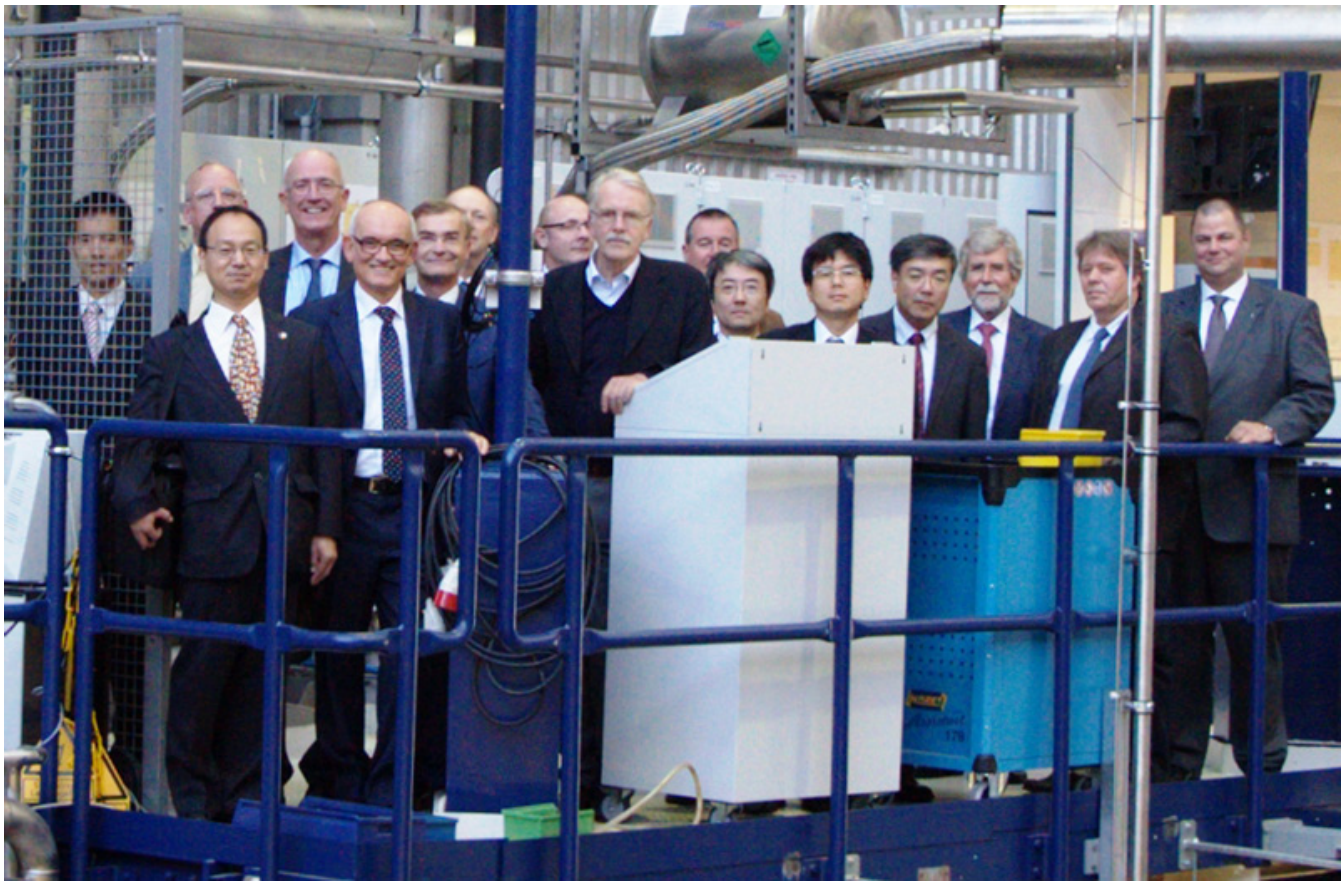


Figure 1: JAEA, F4E and W7-X guests of the colloquium

On 2 October 2015, the Karlsruhe Institute of Technology (KIT) in Germany held a colloquium “HTS Current Leads for JT-60SA". The seminar was to celebrate that the manufacturing and testing of the first 6 high temperature superconductor current leads (HTS CLs) for the toroidal field coils of the JT-60SA device had been completed successfully. These CLs form the electrical and thermal interface between the busbars at room temperature and the superconducting feeders to the coils at 4 K. They are required to carry a current of 25.7 kA with minimal thermal losses. The JT-60SA CLs are similar, in design, to 14 CLs, which were delivered to the Wendelstein 7-X (W7-X) stellarator project at the Greifswald branch institute of the Max Planck Institut für Plasmaphysik some years ago. The W7-X CLs have meanwhile been in operation for several months.

Representatives from several partners of KIT in this enterprise joined the celebration. R. Maschuw, former chief executive officer of KIT, welcomed some 70 guests from the JT-60SA Integrated Project Team in JAEA Naka, F4E Garching and KIT, as well as colleagues from IPP Greifswald (Figure 1). He gave an overview and history of the Broader Approach (BA) Agreement and the involvement of KIT as well.

After a general introduction to fusion technology, the following presentations were delivered:

- the BA Agreement and the JT-60SA project by W. Fietz (KIT),
- design, manufacturing and testing status of the HTS CLs for the JT-60SA project by R. Heller (KIT),
- cooperation between the different partners, and progress and achievements of the project to date by H. Shirai (JT-60SA Project Leader),
- highlights of European contributions to the JT-60SA project by E. Di Pietro (Deputy Project Manager of the EU Home Team),
- overview of the successful commissioning of W7-X by H.S. Bosch (Director of W7-X operation),
- future developments in the HTS area by W. Fietz.

An interesting tour through KIT’s workshops and CultKa CL test facility (Figure 2) then took place. The guests saw 4 CLs, which had already been packed and made ready for shipment to the JAEA Naka site, as well as 4 out of 20 CLs for the poloidal field coils, which meanwhile had been successfully tested. These HTS CLs will be delivered to the JAEA Naka site in 2 batches, in 2016 and 2017.

The guests enjoyed a lunch and a variety of delicious cakes prepared by team members of the Institute of Technical Physics after the tour. The relaxed atmosphere triggered fruitful conversations among the colleagues from different institutes.

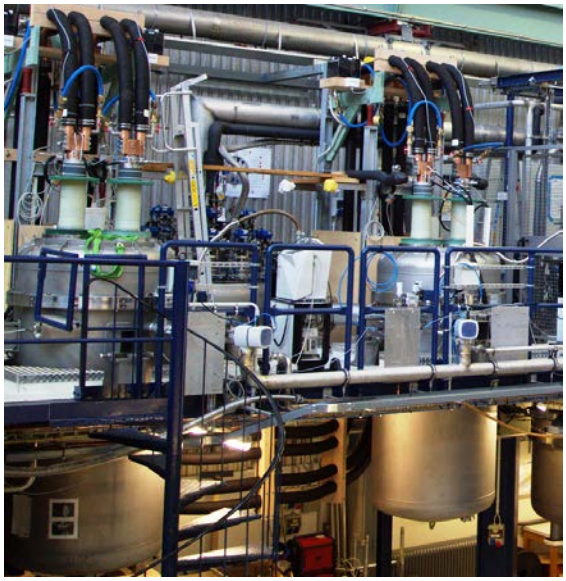


Figure 2: CultKa test facility with 4 HTS CLs mounted

News

NBI horizontal port assembly scenario verified

Unlike other vacuum vessel (VV) ports, 3 horizontal ports (P3, P4 and P16), which the neutral beam injectors (NBIs) use, require the assembly and mounting of port extensions on site. This is because the NBIs are already installed around the ports at the time when the extensions are mounted, and there is therefore not enough room to position and insert pre-assembled extensions.

In particular, even with on-site assembly, the P3 horizontal port for the negative-ion-based NBI (N-NBI) has too small a space around it even to permit welding of the extension completely from the outside. However, it has now been verified that the extensions can be installed securely with an entire seal-weld inside and a partial reinforcement weld outside (Figure 1). In addition, the mounting process of the NBI beam line between the port extension and the N-NBI has been examined. It has been confirmed that the same welding scenario is applicable there also, in order to achieve a secure beam line installation (Figure 2).

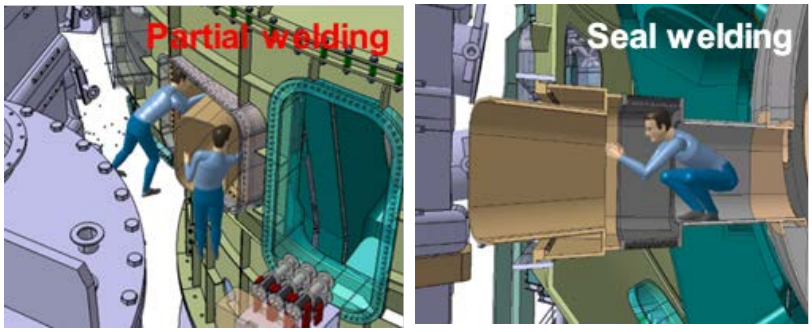


Figure 1: Installation of the N-NBI port extension

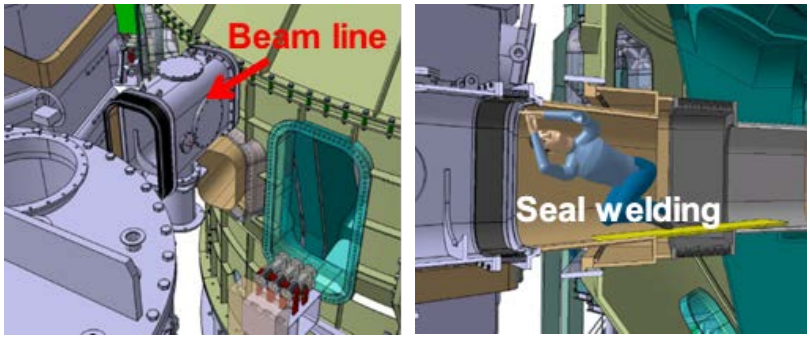


Figure 2: Installation of the N-NBI beam line

Meeting

TCM-23 held in Genoa

The 23rd Technical Coordination Meeting (TCM-23) was organized by the Italian National Agency for New Technologies (ENEA), and held in Genoa, Italy on 29 and 30 September 2015. The venue was close to the premises of ASG superconductors S.p.A. (ASG), where 9 toroidal field (TF) coils were being produced as an Italian contribution. 57 experts in total participated in the meeting: 21 from the JA Home Team, 33 from the EU Home Team and 3 invited from Japan. The participants from Italy, France, Germany, Japan and Spain attended in person or via video-conference.

The Project Leader (PL), H. Shirai opened the meeting, and underlined how steadily the overall project was progressing. In particular:

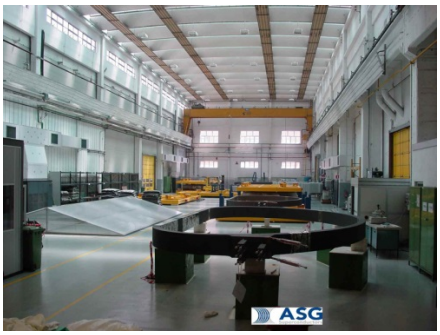
- completion of the quench protection circuit procurement,
- delivery and installation of the cryogenic system,
- integration of 340° vacuum vessel torus,
- fabrication of the coils, high temperature superconductor current leads, cryostat, and power supply systems.

In addition, the PL pointed out that the fabrication of TF coils had been accelerated remarkably by the efforts of the European Implementing Agency, Voluntary Contributors, and related manufacturers.

On the first day, interfaces among the cryogenic system, magnet shared components, vacuum vessel, cryostat, thermal shield and TF coils were discussed, taking their design and manufacturing progress into accounts. At the end of the session, the completion of 9 winding packs (WPs), procured by ASG for ENEA, was highlighted, followed by a technical tour around ASG's workshops. During the tour, the attendees observed the completed 9 WPs, and the first TF coil being made ready for the final embedding impregnation.

On the second day, the status and issues on procurement of the poloidal field coils, electron cyclotron resonant frequency system, supervisory control system and data acquisition system, power supplies, assembly, and commissioning were discussed.

The PL confirmed that the next TCM-24 would be held in Naka on 3 and 4 February 2016, and the TCM-25 would be held in Madrid on 6 and 7 July 2016. He expressed his gratitude for all the assistance and hospitality by ENEA staff.



Meeting

DRM for RWM PS

Following the signature of the Procurement Arrangement on 21 April 2015, the procurement of the power supply (PS) system for the resistive wall mode (RWM) control coil made another step forward recently. Specifically, the Technical Specification, to be used for the procurement call for tender, was fixed in the design review meeting (DRM) on 17 September 2015.

The RWM PS system includes an ac/dc conversion stage and 18 fast inverters, which supply power to 18 in-vessel sector coils individually. In order for the coils to suppress the RWM instabilities effectively, each inverter, with a maximum output current of 300 A and an output voltage of 240 V, must achieve challenging dynamic performance: 3 kHz bandwidth and 50 μs latency.

The National Research Council of Italy, acting through Consorzio RFX, will procure the RMW PS by means of a contract with an industrial supplier. The scope of the contract will include design, manufacture, factory test and delivery to Japan.

The European and Japanese experts on PS system, magnet design and plasma physics participated in the DRM. They agreed on the Technical Specification, in detail, which Consorzio RFX is going to use for its call for tender. The successful outcome of the DRM allowed the RMW PS procurement to proceed.

Meeting

IRMMW-THz 2015 Conference

The 40th International Conference on Infrared, Millimeter, and Terahertz Waves (IRMMW-THz 2015) was held at the Chinese University of Hong Kong in Hong Kong, China, from 24 to 28 August 2015. Approximately, 600 presentations (327 orals and 272 posters) were given during the conference.

T. Kobayashi from JAEA delivered a keynote invited talk on "progress and status of the gyrotron development for the JT-60SA ECH/CD system". He presented the successful results of the gyrotron development for JT-60SA, such as demonstration of 1 MW/100 s oscillations at either 110 GHz or 138 GHz, and 1 MW/1s oscillations at 82 GHz with a single gyrotron. In addition, the internal and transmission losses of the gyrotron, evaluated in experiments, were discussed in details.

The presentation attracted many participants and was received well.

Local

Genoa – a city in front of the Mediterranean

Figure 1: Panoramic view of Genoa city and port

Figure 2: Statue of Christopher Columbus

Figure 3: Fountain in the Ferrari plaza

On 29 and 30 September 2015, the 23rd Technical Coordination Meeting was held in Genoa.

Genoa is the sixth largest city in Italy, with a population of about 600,000. Facing the Mediterranean Sea (Figure 1), it has the largest seaport in Italy, where the quench protection circuit (QPC) was shipped eastward to Japan in August 2014. Christopher Columbus, who explored the westward seaway from Spain to Asia in the 15th century, was born here (Figure 2).

Forming a triangle area with Milan and Turin, Genoa is one of major economic centres of Italy. A number of leading Italian companies are based in this city, including Ansaldo Energia, Ansaldo STS, ASG superconductors (ASG), Costa Crociere, Edoardo Raffinerie Garrone, Piaggio Aero and Selex ES. ASG was established in 2001 as an extension of the magnets unit of the Ansaldo industrial group. Today, ASG designs and manufactures conventional and superconducting magnets for high-energy physics research, nuclear fusion, optimization of electricity grids, and medical applications. They are now manufacturing 9 toroidal field coils for the JT-60SA device as well. They are world leaders in terms of design, fabrication and testing capabilities of superconducting magnet systems.

From the 13th century to the present, the area around the Ferrari plaza, known as the “City” by Genoeses, is the centre of Genoa. There are many historical palaces and building such as the palace of the Doges, which was firstly built in 1251 and restored in 1992 for the 500th anniversary of Columbus’s discovery of America. The famous fountain, a symbol of Ferrari plaza, was restored in recent year. Its water was coloured blue at the time TCM-23 was held (Figure 3).

Calendar

3 – 6 Nov 2015
25th International Toki Conference (ITC-25)
Toki, Japan

11 Dec 2015
17th Meeting of the BA Steering Committee (SC-17)
Padua, Italy

14 – 18 Dec 2015
10th Asia Plasma and Fusion Association Conference (APFA 2015)
Gandhinagar, India

3 – 4 Feb 2016
24th Technical Coordination Meeting (TCM-24)
Naka, Japan

16 Mar 2016
18th Meeting of the STP Project Committee (PC-18)
Naka, Japan

Contact Us

The JT-60 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/.