JT-60SA Newsletter
No. 47, 29 November 2013

Headline

Start of TF coil manufacturing

The DP wound from JTF-002 (background) and JTF-006 (foreground) at ASG

Nineteen (18 + 1 spare) toroidal field (TF) coils will be manufactured for the JT-60SA device. Of these, 10 (9 + 1 spare) will be supplied by ASG, Genoa, under the responsibility of ENEA, Italy, and the remaining 9 will be supplied by Alstom, Belfort, under the responsibility of CEA, France.

The TF coil consists of six D-shaped double pancakes, stacked on top of each other, then wrapped with ground insulation, forming the winding pack. The winding pack is then impregnated and inserted into the TF coil casing structure, which is welded shut prior to final testing of the coil at 4.2 K.

Much work has been carried out in the last year by both manufacturers, with the main focus being on the manufacture, installation and commissioning of the winding line equipment. This equipment produces the double pancakes, and is conceptually similar for both coil manufacturers, hence the main parts of the winding procedure are also the same. The conductor is mounted on the machine in a spooled configuration. To carry out the winding, a fully automated process is followed where the conductor passes through a series of straightening rollers, followed by bending rollers. The software controls the location of the rollers at different positions along the length of the conductor, ensuring that the bent conductor meets the specified geometric requirements. After the conductor is bent, it is then sandblasted for resin adhesion, electrically insulated by wrapping insulation tape around the conductor, and lowered onto a winding form, allowing a dimensional check using a laser tracker on the double pancake prior to proceeding to the next stage of winding pack manufacture. With the exception of the dimensional check, all of these activities are automated, hence the produced double pancakes are very consistent both geometrically and in relation to the applied insulation.

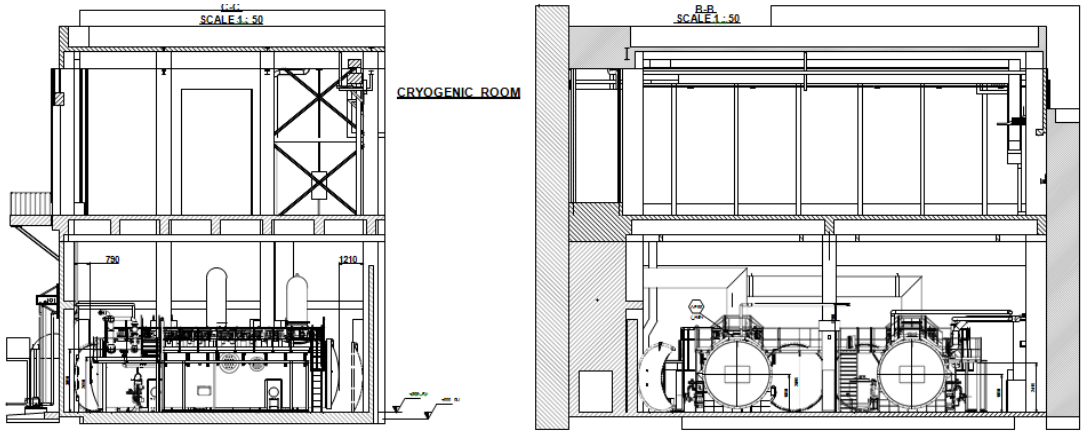
At both manufacturers, the winding equipment has now been installed and commissioned, and many winding trials have been completed. This includes the bending of many straight lengths to set up the original parameters of the machine, followed by the production of a trial double pancake at both manufacturers. In both cases, the tight geometrical requirements for the double pancakes were met, and the consistency of the insulation is as expected. During November this activity completed the last stage of the qualification activities so that the Production Readiness Reviews (PRRs) for both winding lines could be held and manufacture of the coils could proceed.

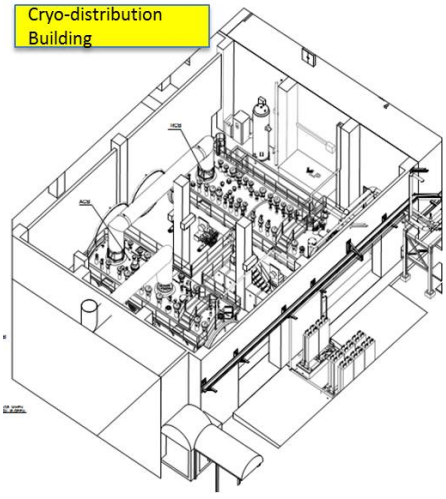
Winding line with the first wound single pancake at Alstom

Production winding activities are now progressing, with the first complete winding pack expected to be ready at ASG (Italy) by the end of this year, and the first winding pack at Alstom shortly thereafter.

News

Cryogenic systems layout issued for site and building preparation





2D drawings of cryogenic systems for building

On 23 October, 2013 the layout of the entire JT-60SA cryogenic system was formally issued for site and building preparation. With its approval on 1 November, 2013 an important milestone (MS2 of the Procurement Arrangement EU-CRYO) for the procurement of the cryogenic system has been achieved actually with more details than originally planned. The layout is based on a set of comprehensive drawings, allowing

- JAEA to finalise the design in order to start the procurement contracts for the restructuring of existing buildings and the construction of the new building for the compressors, and of the infrastructure (e.g. the foundations for the gaseous He vessels, the compressor cooling towers, and the liquid nitrogen storage tanks);
- F4E to start the procurement procedure for the manufacturing and shipment of the six 250 m^3 gaseous He storage vessels;
- CEA to prepare with AL-AT (the main supplier of the cryogenic system) for the Final Design Review, which will release the manufacturing of all components.

With this milestone the procurement of the cryogenic system is kept on schedule. The shipment of the main components (compressors, refrigerator cold boxes, and auxiliaries) is planned for March 2015 and the start of commissioning of the plant by December 2015.

News

World's highest dual frequency gyrotron performance achieved

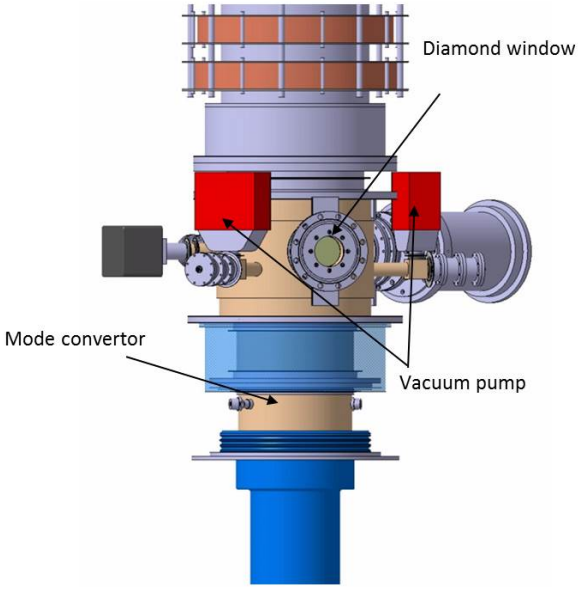


Figure 1: Dual frequency gyrotron

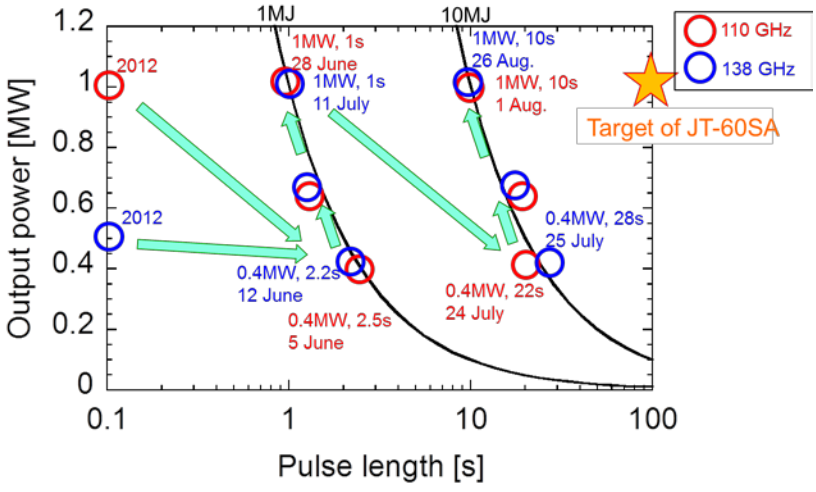


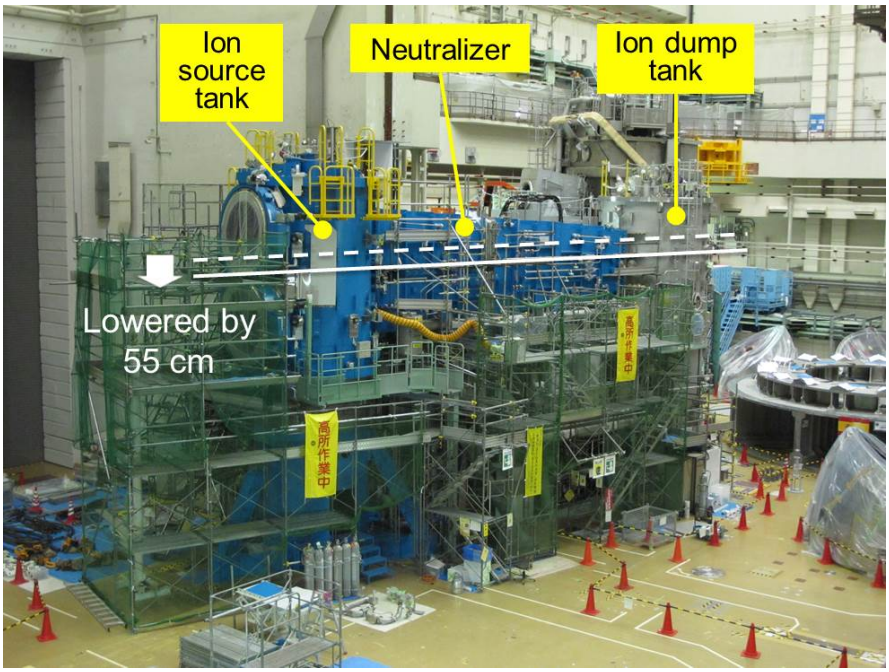
Figure 2: Progress of output power and pulse length

The dual frequency gyrotron (Figure 1) is being developed so that two radio frequencies (110 GHz and 138 GHz) can be chosen to properly select the position of electron cyclotron heating (ECH) in the plasma even when the magnetic field strength, confining the JT-60SA plasma, is changed. Technologies and experience acquired in the gyrotron development for ITER and JT-60 are being used to obtain a high efficiency at both frequencies. A combination of frequencies and a window thickness equal to an integer times the half wave length were selected to increase the transmittance of the output window. Dimensions of the cavity resonator were designed to facilitate microwave oscillations at both frequencies with a high efficiency. In addition, a mode converter with a small power loss at both frequencies was also designed.

To obtain high efficiency microwave generation with a long duration, a commissioning operation to degas inside the gyrotron was performed while properly adjusting the magnetic field strength and the gyro-motion energy of the beam electrons. As a result, a rated output electric power of 1 MW was successfully generated at both frequencies for 10 seconds (Figure 2). Not only was the world's highest output performance achieved by the dual frequency gyrotron but also it was confirmed that the power loss and the heat load during mode conversion were as small as designed. Consequently, it is expected that the 1 MW output power for 100 seconds required for JT-60SA will be achieved in the near future.

News

Completion of N-NBI modification for off-axis injection



In the middle of October, lowering of the beamline injection position of the negative ion based neutral beam injection (N-NBI) system, part of the construction work for JT-60SA, has been completed by reinstalling all the major components, which were temporarily removed for this construction (see Newsletter No. 45).

Originally, the beamline injection position was planned to be lowered by approximately 60 cm from the equatorial plane to drive the plasma current off-axis. In the end, it was lowered by 55 cm by adjusting the structural supports. Leak tests for the whole beamline will be performed and the magnetic shielding will be installed in November to complete the work.

In another facility at the Naka institute the N-NBI ion source has also been improved to produce the continuous injection of 10 MW for 100 seconds required for JT-60SA. The latest technology, Galden (a fluorinated fluid), has been introduced into the N-NBI ion source as a cooling fluid for the plasma grid surface on which negative ions are generated. The cooling pipe cross-section should be as large as necessary to obtain sufficient cooling performance for the plasma grid. For this task, the plasma grid thickness needs to be increased. In this test, the optimal value, which makes negative ion currents increase by approximately 10 % with a 9 mm thick plasma grid, was found as a result of measuring the amount of negative ions by changing the thickness of the plasma grid. This measurement result will be reflected in the future negative ion production to achieve larger currents.

News

BA brochure published

November saw the publication of a fold-out brochure in English describing the progress of work being undertaken in the scope of BA activities. The brochure gives an overview of how the BA projects operate and are managed, and for each project showcases the most recent hardware and testing developments. It is mainly aimed at stakeholders and their governments, to inform them about the implementation of their commitments to the projects.

The final brochure design and layout was made by the public information team of F4E in Barcelona, and was printed for F4E through the EU Publications Office. It has been distributed to all the organisations contributing to the BA work, from which copies can be requested.

Meetings

9th Asia Plasma and Fusion Association Conference

The 9th Asia Plasma and Fusion Association Conference (APFA-9) was held at the Hilton hotel in Gyeongju City, South Korea from 5 – 8 November 2013 organised by the National Fusion Research Institute. There were over 200 participants and 183 papers, of which 40 were presented orally and 143 were presented as posters. About 70 young researchers, who would lead the future fusion research, attended the conference.

On 5 November, S. Ishida, the JT-60SA Project Leader (PL), presented an overview talk entitled “Present Status and Future Prospects of the JT-60SA Project”. After presenting the current activities, the PL concluded "the project is progressing right on track in both Europe and Japan along the project schedule to start operating in March 2019, pursuing its challenging mission for the realisation of fusion energy. After the successful manufacturing of the cryostat base in Spain, the first major EU component was delivered from Europe to Japan. The project has now started the tokamak assembly with the cryostat base in January 2013 as scheduled. No delays of procurement affecting the critical path in the schedule are foreseen either in Europe or Japan. In 2014, the assembly work on the EF coils and vacuum vessel will start in the torus hall and the second major EU components (QPCs) will be delivered to Naka". The presentation was well received by the audience.

The conference was successfully ended with a comprehensive view of the fusion research and development in Asia, including H-mode experiments with detailed diagnostics data in KSTAR and EAST and the restart of SST-1. The APFA-10 will be held in Ahmadabad, India from 14 – 18 December 2015 or 11 – 15 January 2016 to be organised by the Institute of Plasma Research.

Local

Belfort, the city of the lion

Figure 1: ALSTOM Winding line, Building 21, Belfort, 31 May, 2013
© Alstom, Belfort

The conjunction of history, technology and monumental art is a key feature of Belfort City, beloved by French people as a symbol for freedom, willingness and resistance. This was acknowledged by the French government in 1880, which offered to the city an impressive statue of a lion, 22 m long, 11 m high, in memory of the defenders of the city.

This lion, made of red sandstone, was designed by Frederic-Auguste Bartholdi, an Alsacian native. The lion is placed, as the gatekeeper, at the lower entrance of the impressive citadel of Belfort (Figure 2). This citadel was built in the 17th century by the great French military architect Sébastien Vauban. The name of Belfort means, by itself, “strong fortress”. A little brother of the lion, manufactured from bronze, can also be seen in Paris, at Place Denfert-Rochereau (Figure 3).

Figure 2: Belfort, The Lion, red sandstone, 11m high
© Ville de Belfort

Figure 3: Paris, The Lion, Place Denfert-Rochereau
© Jebulon/Wikimedia commons

Figure 4: New York- Ellis Island
© USFG/ Wikimedia commons

Figure 5: Paris- L'ile Aux Cygnes
© Greudin/Wikimedia commons

Figure 6: Tokyo-Odaiba Island
© Rob Fahey/ Wikimedia commons

Frédéric-Auguste Bartholdi, with the assistance of Gustave Eiffel, was also responsible for the design and manufacture of the famous "Statue of Liberty" offered by France to the USA for the celebration of the first century of the United States Independence (Figure 4). This gift is a sign of the indestructible friendship between the two nations. This monumental statue - 93 m high, including the pedestal - is made of thin hammered copper foil fixed on a steel pillar. She was inaugurated, at Ellis Island, New York City, on 28 October, 1886. A visit of the statue remains forever free for Alsace's native people!

At least three "Statues of Liberty", as three sisters enlightening the World, can be seen around the world. The largest is in New York City, Ellis Island, the second is at Paris, at the Ile Aux Cygnes : "Swans Island" just in front of the Eiffel Tower (Figure 5), and a third is in Tokyo, at Odaiba Island, which means "Citadel Island" (Figure 6). You are welcome in Belfort!

Calendar

December 3-6, 2013
30th Annual Meeting of the Japan Society of Plasma Science and Nuclear Fusion Research (JSPF)
Tokyo, Japan

December 17, 2013
13th Meeting of the BA Steering Committee (SC-13)
Saclay, France

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

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/