JT-60SA Newsletter

No. 118, June 2022

Headline

ECRF PS commissioning restarted

On 31 January 2020 activities on site to install and commission the power supply (PS) system for the electron cyclotron range of frequency (ECRF) were suspended in order to allow the preparation of existing gyrotron systems for the first plasma. At that time, the plan was to resume the activities after March 2021.

However, in April 2020, the pandemic hit the world and due to travel restrictions, European suppliers had no possibility to visit Japan for several months. This prevented JEMA, the Spanish supplier in charge of the ECRF PS commissioning, from restarting the on-site activities as expected.

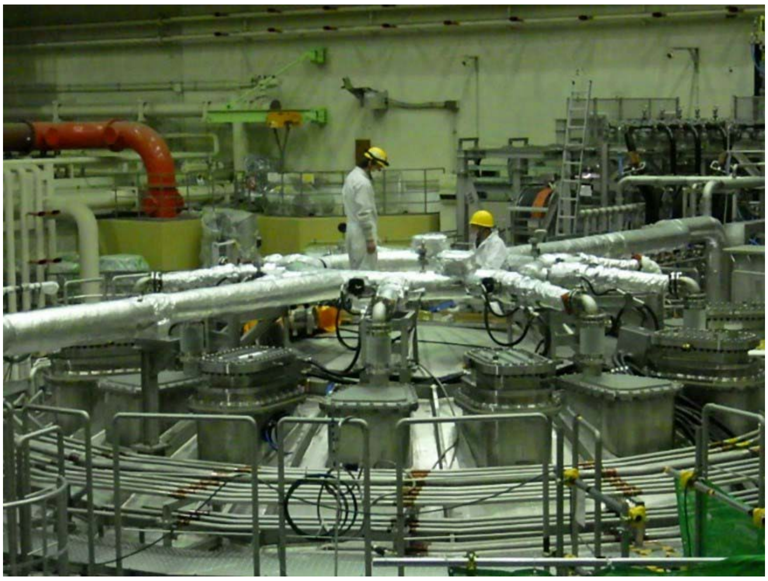
Flash forward then to 9 May 2022: more than two years later, three engineers from JEMA were able to resume the activities at the Naka site in order to gradually proceed with the finalisation of the commissioning and then the site acceptance tests.

The first main task is the verification of the correct functioning of the high voltage main power supply (HVMPS) after this long period in standby. Such verification is ongoing with particular care to assure a smooth restart. Activities will then proceed in stages and the overall schedule will be adjusted depending on the needs of the overall project.

QST, F4E and JEMA representatives working together on the commissioning

---

News

Installation of upper vertical ports completed

Installation of Upper vertical ports

Some activities originally planned for the Maintenance & Enhancement (M/E-1) phase following first plasma have been brought forward to help recover the overall schedule of the Satellite Tokamak Programme (STP) Project.

The installation of the upper vertical ports on the even number sections was completed in January 2022, and their welds were inspected by helium leak test and progressive penetrant liquid test.

The installation accuracy at the vacuum vessel (VV) side was ±10 mm. The installation accuracy at the cryostat side was ±2 mm.

News

Electrical Components PA signed in January 2022

The Procurement Arrangement (PA) for the Supply of the Components for the Alternative Grounding System of the Poloidal Superconducting Magnets, the Supply of the Components for the Voltage Ripple Reduction Filter for the Booster Power Supply (PS) and the Supply of the Diagnostic Wire for the Superconducting Magnets for the Satellite Tokamak Programme was signed by Fusion for Energy (F4E) and QST representatives on 14 January 2022.

This PA, whose long name is sometimes summarised in a shorter Electrical Components PA, mainly includes the procurement of two new systems by F4E, which will allow an improvement of the operation of the superconducting magnet power supplies.

The first system, defined as the Alternative Grounding System (AGS), is useful to reduce the voltage to ground seen by both terminals of each poloidal superconducting coil in all normal operating conditions. In fact, at present, the voltage produced by the switching network units (SNUs), by the Booster PS or by the Quench Protection Circuits is fully applied just to one terminal of the related superconducting magnet, while the other terminal is at ground potential.

With the introduction of the Alternative Grounding System, the voltage applied to the poloidal coils will be balanced between the two terminals of each coil. This means that during the operation of the SNU with 5 kV (for example), the voltage to ground of each terminal will be only 2.5 kV. A generous improvement in terms of voltage stress for the superconducting magnet system!

Figure 1: One AGS cubicle including the alternative grounding resistors for four poloidal coils, ready for factory tests

The second system, defined as the Voltage Filter for the Booster PS, allows drastically reducing the high frequency voltage ripple produced by the Booster PS. In fact, these types of PSs used to produce high voltage for a short time are obtained combining together some thyristor converters previously used for JT-60U. Their nominal voltage is higher than the 5 kV voltage actually required for the operation of JT-60SA, and even if their average voltage is controlled to remain under 5 kV, the transient peak voltage can reach up to about 8 kV with a frequency of a few hundred hertz. The installation of the new filters, which mainly consist of capacitors, inductances and resistors, will allow reducing the voltage peak applied to the superconducting coils to less than 5.5 kV.

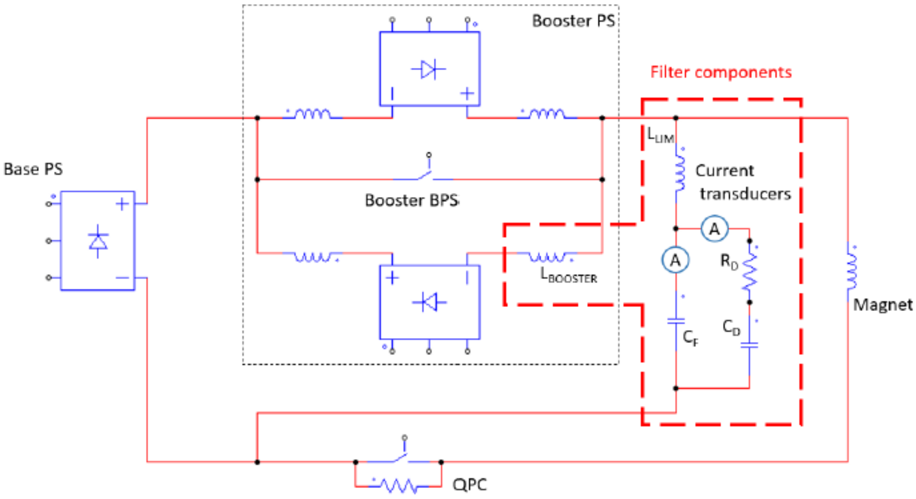


Figure 2: Scheme of the Voltage Filter for Booster PS

Once installed, the combination of the Voltage Filters and the Alternative Grounding System will allow reducing both the peak voltage and the voltage to ground applied to the poloidal superconducting magnets, significantly increasing the safe margin for their operation.

News

The Actively Cooled Divertor for JT-60SA

The Actively Cooled Divertor (ACD) will play a critical role in the long pulse operation of JT-60SA during the integrated research phase. The ACD will be suitable for steady state operation, being able to withstand continuous heat fluxes of 10 MW/m^2 during the long pulse of 100 s in JT-60SA, and being robust against short transients in excess of 10 MW/m^2 heat load.

The procurement of the ACD is associated with a set of three Procurement Agreements (PA) under the responsibility of F4E.

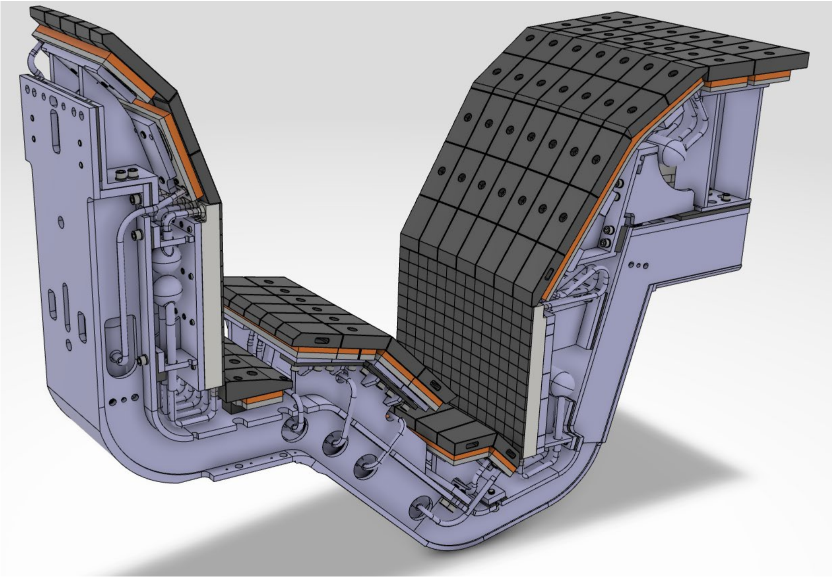


Figure 1: One of the 36 ACD units.

The first PA covers the supply and testing of 1050 High Heat Flux (HHF) elements. These are made of a titanium-zinc-molybdenum (TZM) heat sink to which fine-grain graphite armour tiles are bonded. A central cooling pipe with turbulence promoter (swirl tape) provides the active cooling. The procurement of these components will begin in the first week of June 2022, and the first high heat flux testing should be done, on small samples, before the end of 2022.

The second PA will cover the supply and testing of the Normal Heat Flux (NHF) and Cassette Frames (CF) components of the ACD. The procurement will be split in two supply contracts, one for the NHF and one for the CF. The NHF components consist of CuCrZr/SS heat sinks, with bolted graphite tiles and stainless steel supports and cooling pipes. The NHF components procurement has started, and the contract will be awarded in November 2022. The CF is made of a fabricated stainless steel frame and main water pipes. The CF procurement is going to start soon, and the contract will be awarded in October 2022.

The third PA will cover the supply of diagnostics, the integration and final testing of the 38 (36 nominal + 2 spares) ACD units. The preparation of the procurement documentation of this PA is currently ongoing and should be ready by the end of 2022.

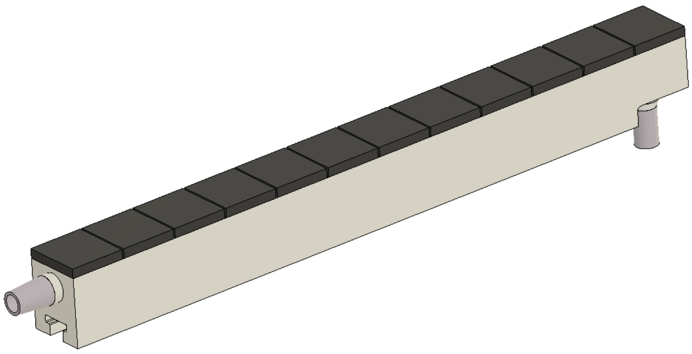


Figure 2: One of the HHF elements of the vertical targets

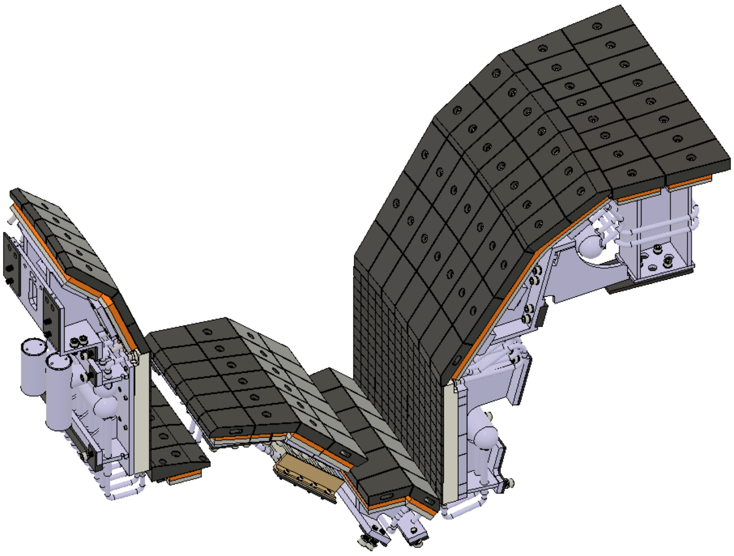


Figure 3: The NHF components of an ACD unit

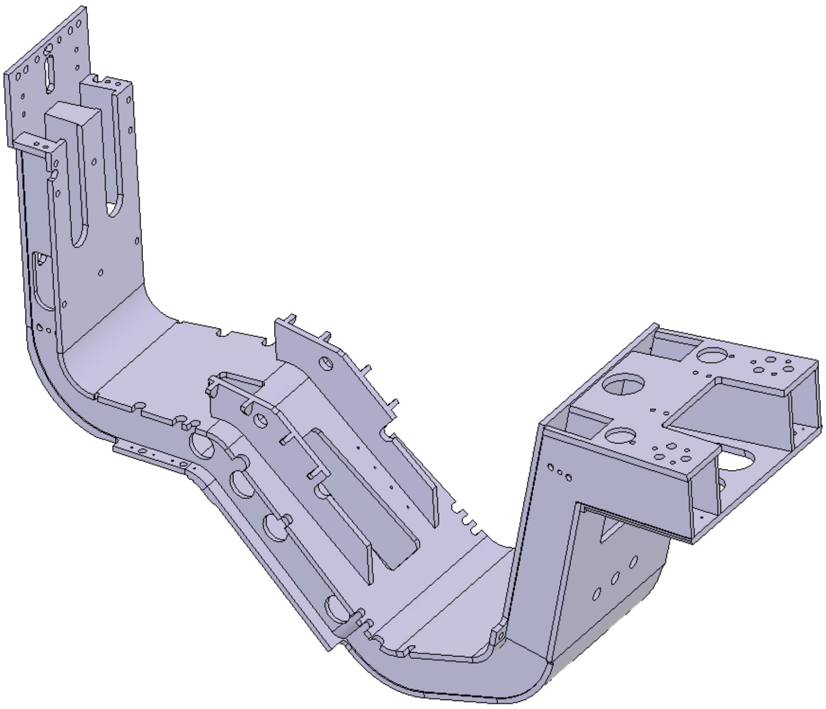


Figure 4: The CF of an ACD unit (pipes not shown)

All ACD components will be thoroughly tested at the end of their manufacturing, prior to the final integration. These tests always include dimensional control, non-destructive examination (NDE) of all welds, pressure, leak testing, and hot leak testing. Moreover, for the HHF elements, high heat flux tests will be performed for a set of full-scale mock-ups, prior to the manufacturing of the series.

Meeting

37th Technical Coordination Meeting via videoconference

TCM-37 via videoconference

The 37th Technical Coordination Meeting (TCM-37) was remotely held on 1-3 December 2021 via videoconference from Europe and Japan. A total of 103 experts attended the meeting: 43 from the European Home Team (HT) and Univ. Padova, 48 from the Japanese Home Team, 8 from the ITER Organization and 4 from the Project Team.

At the beginning of the plenary session, H. Shirai, Project Leader (PL) expressed his thanks to all participants. He explained the overall schedule towards the restart of the Integrated Commissioning (IC) and the Long-Term Project Schedule to be submitted to the 28th Broader Approach Steering Committee (BA SC-28).

E. Di Pietro, the EU Project Manager (EU PM), presented the “Achievements by EU HT since TCM-36”, including the effort for the equilibrium field (EF) 1 incident recovery which involved the active support of EU experts with the ITER Department of F4E, EU laboratories and the ITER Organisation (IO). The EU HT has maintained the machine enhancement activity with EUROfusion and the support to maintenance and commissioning.

K. Takahashi, the JA Deputy Project Manager (JA DPM), presented the “Achievements and Plan by JA HT since TCM-36”. He summarised these as follows. Insulation repair of the coil feeder systems are in progress. Other systems (power supply, diagnostics, etc.) for the commissioning restart are under preparation as scheduled. The subsystems needed for Maintenance & Enhancement (M/E-1) are under procurement as scheduled.

In the meeting, preparations for the restart of integrated commissioning (IC) and improvements following the EF1 incident were presented including the plan and schedule for inspection, repair and testing. Also, the present status and plans were reported for magnet system, tokamak device, cryoplant, power supply system, diagnostics system, data access, experiment database system and control system. The global high voltage and Paschen testing procedures were introduced.

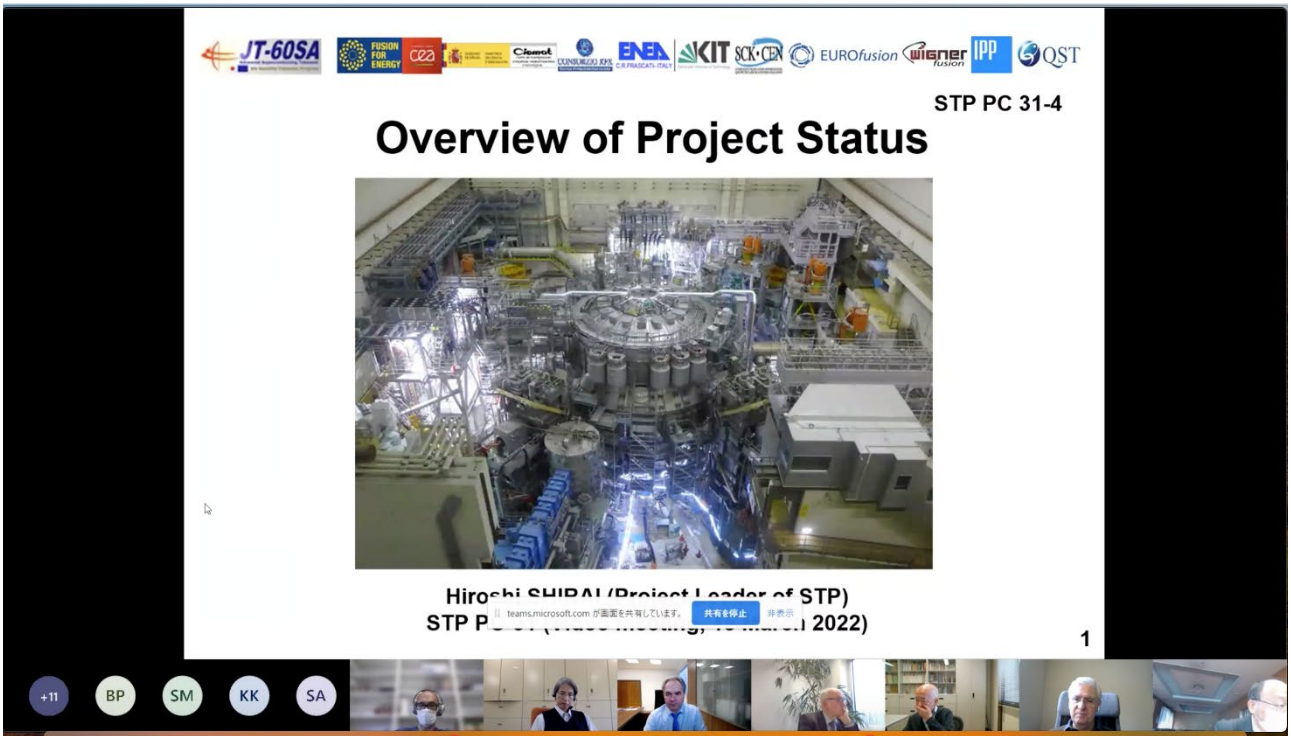
Machine enhancement items were presented including in-vessel components (stabilising plate, upper first wall, first wall heat sink, pedestal for First Plasma Protection Components (FPPC) and Error Field Correction Coil (EFCC), divertor cassette, resistive wall mode control coil, divertor cryopump, pellet launching system), control system, heating and current drive systems (electron cyclotron range of frequency (ECRF) system, ECRF transmission line and Neutral Beam Injector (NBI)), power supply systems (error field control coil power supply, 1st and 2nd ECRF power supply) and diagnostic systems (such as Thomson scattering and VUV divertor spectrometer). Further enhancement hardware was also explained for the fast ion loss detector (FILD), actively cooled divertor, fast ion D alpha (FIDA), X-ray imaging crystal spectrometer (XICS) and possible new diagnostics.

The configuration control models, Plant Integration Document (PID) updating status, and updates of the action list were reported and summarised.

Finally, the PL showed the schedule in 2022 to discuss the date of TCM-38. Because of the uncertain progress with integrated commissioning, it was difficult to decide the date. It was agreed to continue the discussion of the date at following Project Coordination Meetings (PCMs).

Meeting

31st STP Project Committee Meeting



The 31st Meeting of the Satellite Tokamak Programme Project Committee (STP-PC) was held on 15 March 2022. A total of 24 participants joined the meeting via a Microsoft Teams meeting. There were 6 members from the Project Committee, the Project Leader (PL), 5 experts from the Project Team, and 12 experts from the EU and JA Home Teams (HTs).

In this meeting, the PL, the EU Project Manager and the JA Deputy Project Manager reported on the progress of the STP project and the insulation repair/reinforcement of coil feeder joints.

The STP-PC expressed satisfaction with preparation and improvement for the restart of Integrated Commissioning (IC) as well as the achievements and the progress in both EU and JA procurements since the last STP-PC Meeting. These include the progress of repair work of feeder joint insulation based on the results of the mock-up tests, reinforcement of insulation of high temperature superconductor (HTS) current leads and replacement of insulated quench detection wires.

The STP-PC strongly encouraged both Implementing Agencies (IAs) to implement suitable tools, such as framework contracts or other legal arrangements, which would allow the project to react to unexpected incidents in a timely manner, maximising the availability of the facility for experiments and minimising the time and effort required to arrange unexpected work, such as repairs.

The STP-PC recommended the “Annual Report 2021”, the “Project Plan” and the “Update of Project Team” for approval by the BASC. The STP-PC took note of the schedule on the restart of IC in October 2022 to be continued up to the end of February 2023, where the remaining coil energisation tests and plasma operation would be implemented.

The STP-PC decided that the next STP-PC meeting (PC-32) would be held on 19 October 2022.

Meeting

29th BA Steering Committee Meeting

EU and JA BASC representatives

On 28 April 2022, the 29th Broader Approach Steering Committee (BASC) meeting was held at Naka Fusion Institute (Naka, Japan) with attendance of representatives and experts from Europe and Japan. They confirmed the progress of all the activities and approved the 2021 Annual Reports and the updates of the Project Plans for the three projects (IFMIF/EVEDA, IFERC and Satellite Tokamak Programme (STP)).

Concerning the STP Project, the Project Leader (PL), H. Shirai, reported (1) the overall status of repair since the EF1 incident including the insulation of all joints for feeders and the replacement of high voltage instrumentation wire, (2) the preparation for the Maintenance & Enhancement (M/E-1) phase, and (3) the collaboration with ITER and the US.

The BASC commended the STP PT and both implementing agencies (IAs) for the strenuous and continuous efforts for the on-site repair work to meet the restart of Integrated Commissioning with the continuous remote support of the EU Home Team. The BASC noted the importance of the repair work as Return of Experience for ITER and praised both IAs for their efforts to communicate with the ITER team.

The next BASC meeting will be held in Padova, Italy on 15 December 2022.

Calendar

19 October 2022
32nd Meeting of the STP Project Committee (PC-32)
Naka, Japan

15 December 2022
30th Meeting of the BA Steering Committee (SC-30)
Padua, Italy

23–28 April 2023
15th International Symposium on Fusion Nuclear Technology (ISFNT-15)
Hefei, China

Contact Us

The JT-60 Newsletter is released by the JT-60SA Project Team.

Suggestions and comments are welcome and can be sent to newsletter@jt60sa.org.