Minutes of 134th Collimation Upgrade Specification Meeting

Participants: C. Accettura (CA), G. Azzopardi (GA), A. Bertarelli (AB), N. Biancacci (NB), R. Bruce (RB), M. Calviani (MC), F. Carra (FC), M. D’Andrea (MDA) (scientific secretary), J. Daricou (JD), M. Di Castro (MDC), A. Fomin (AF), L. Gentini (LG), J. Guardia Valenzuela (JGV), A. Kurtulus (AK), I. Lamas Garcia (ILG), D. Mirarchi (DM), N. Mounet (NM), E. Neubauer (EN), J. Oliveira (JO), M. Patecki (MP), J. B. Potoine (JBP), S. Redaelli (SR) (chairman), B. Salvant (BS), A. Waets (AW).

Indico link

Actions from this meeting

- No actions identified.

1 Overview of LS2 production (I. Lamas Garcia) [slides]

Summary of the presentation

ILG gave a chronological overview of LS2 production, in preparation for his report at the upcoming TCC meeting. The goal of the project was the production of TCSPM, TCPPM and TCLD units for HL-LHC. The search for suitable companies to provide the components started in 2016. The first TCSPM and TCLD prototypes were manufactured, assembled and tested internally at CERN. This phase was important to define the process for industrial production. Finally, at the end of 2017 CINEL (based in Padua) was selected for industrial production, with the contract set to start at the beginning 2018. Raw material and commercial components were procured, and an infrastructure was put in place in order to share documentation and general information with the contractor. Mo-coated MoGr was chosen as the material to be used for the collimators and was successfully tested in HiRadMat experiments, with coated CFC and coated graphite considered as alternatives. The addition of NEG cartridges was also considered as an option. Machatronics components were procured during 2018 with the aim to cover future LS3 installations as well. At the same time, prototype validation continued in order to identify potential issues that would require a change in the design. The definition and risk assessment of the installation procedures were carried out. The greenlight for pre-series production for TCLD and TCPPM units was given to CINEL, with the first TCLD delivered at CERN at the end of 2018. Surface and installation activities started being planned. In 2019, CINEL received the greenlight for TCLD series production. At the same time, the first TCPPM jaws were delivered at CERN for validation and to be used as reference for flatness conformity of MoGr batches in an extensive metrology campaign. A non-conformity was observed in the Ti BPM buttons during the assembly of the first two TCPPM units, which were replaced with stainless steel buttons. The units were delivered with a delay of three months, requiring a new schedule. Two additional units were scheduled to be delivered shortly after, but a vacuum leak was identified in one of them, leading to a series of delays. While a repair strategy was discussed, the TCLD production was prioritized instead, and all units were delivered at CERN during 2020. Despite the issues caused by the COVID-19 pandemic, CINEL managed to continue production of TCSPM and TCPPM units, which were able to be delivered and installed in the second half of the year. NEG cartridges were finally included in order to have vacuum-compliant collimators.
Discussion

- FC asked if coated graphite was indicated as “plan C” in the presentation because the coated CFC was originally considered “plan B”. AB confirmed that this is the case, even though CFC was later found to be not coatable and as such that option was discarded. Still, it is important to recall it as part of the learning process and for future reference. AB also clarified that the addition of NEG cartridges was never strictly considered as a ”plan B” since that option was foreseen from the very beginning of the project.

- After congratulating ILG and the whole team in production and STI for their accomplishments, AB asked more details on the qualification procedure of the companies for the production of the units. ILG clarified that two of the four pre-qualified companies did not qualify for the surface treatment and vacuum brazing.

- FC clarified that the “concerns” for TCSPM with Mo-coated MoGr are related to production and not to operation in the machine and also mentioned that the conductivity of coated graphite is still an open point.

- RB commented that it might be worth mentioning that the TCLDs will finally not be installed in LS2 since the installation of the 11 T dipoles was postponed. ILG agreed and added that this decision indeed triggered a reschedule of the production.

- AB asked if any specific lessons learned can be mentioned with regards to the production phase at CINEL. ILG replied that indeed a clear maintenance schedule was not defined for the testbenches, which should be mentioned and taken into account for the future.

- SR advised ILG to touch base with the TCC team to check how much time is allocated for this report. In particular, SR suggested that the first part of the presentation could be optimized to save some time.

2 Recap of MoGr production: powder changes and their vacuum validation (F. Carra) [slides]

Summary of the presentation

FC recalled the change in graphite powders which was decided during the production of the MoGr blocks and their vacuum validation. Nanoker was originally using Asbury 93002 powders for the first batches. However, good reproducibility could not be guaranteed by Asbury, and the new lot showed a high level of impurity. It was then proposed to use 93004 instead, which is a more controlled and high-quality material. The validation process of the new powders showed:

- Slightly higher density, which additional UHV tests.
- Slightly lower electrical conductivity, deemed acceptable since the coating brings it back to its original value.
- Higher outgassing by a factor 2, with a higher air content, which is tolerable but close to the limits.
- Significantly better thermomechanical and dimensional stability.

In future productions, the availability of enough raw material at the supplier to cover the full production needs to be validated among the initial milestones. Further studies to understand the different UHV behavior between the two powders are ongoing or planned, and possible additional improvement to the pumping system are to be discussed.
Discussion

- AB asked if the possibility to increase the processing temperature even further in the future is considered, since previous observations of worse vacuum behavior may not apply to the new powders. FC replied that additional tests are being thought of. However, it would be wise to try to stick with a set “recipe” given the sensibility to the parameters of the process.

3 Bench impedance measurements of low impedance collimators (A. Kurtulus) [slides]

Summary of the presentation

AK presented the outcome of bench impedance measurements on TCSPMs, TCPPMs and TCLDs, as well as the results of coating resistivity measurements. In order to avoid the risk of contamination of the low impedance jaw material, only probe measurements were performed. To assess the presence of low frequency resonant modes, both straight and loop probe measurements were performed, which couple mainly to electric the electric field and the magnetic field of possible resonant modes respectively. Very low-Q and low-frequency modes are observed for a half-gap of 10 mm, suggesting resonances mostly in the tank. Similar modes were measured in the TCSPM installed during Run 2, with no relevant issues detected in operations, so the devices can be accepted for installation. Simulations are currently in progress to benchmark these results. The resistivity of Mo-coated MoGr was measured on separated jaw samples with a resonator, and the results are inline with specs.

Discussion

- AB commented that the TCSPM and TCPPM frequency plots do not show major differences and asked if the effect of the jaw material could be hidden by the rest of the structure. AK confirmed that this is the case, since the resonating modes are related to the geometry of the collimator, which is similar. Wire measurements would allow to measure the beam impedance, but were not performed. ILG commented that these tests also give a good idea of the reproducibility of the collimators.