



28th Meeting of the HL-LHC Technical Coordination Committee – 13/4/2017

Participants: M. Alcaide Leon, A. Apollonio, G. Arduini, R. Bruce, O. Brüning (chair), R. Calaga, S. Claudet, R. De Maria, B. Di Girolamo, D. Delikaris, B. Delille, A. Foussat, G. Gascon, R. Jones, R. Kersevan, T. Lefevre, S. Le Naour, E. Metral, L. Rossi, L. Tavian, R. Van Weelderen, D. Wollmann, M. Zerlauth.

Excused: -.

The slides of all presentations can be found on the website and Indico pages of the TCC:

HL-LHC TCC homepage: <https://espace.cern.ch/HiLumi/TCC/Default/Home.aspx>

Indico link: <https://indico.cern.ch/event/590418/>

O. Brüning recalled the actions from the 27th HL-TCC. These regard:

- The need for a trim in Q1A
- Report on the results of HiRadMat tests for collimator materials
- Vacuum non-conformity discovered on the TCSPM before launching series production

Short AOBs will be scheduled in the coming meetings to address and close these actions.

No additional comments were given to the minutes, they were therefore approved.

Executive summary of crab cavity review (A. Yamamoto - slides)

A. Yamamoto recalled the mandate and charge of the review panel, focusing on the verification of the soundness of the design and the readiness of the components and of the procurement plan. In addition, the status of the integration for the SPS tests and the first plan for HL-LHC were reviewed.

A. Yamamoto reported the main comments from the executive summary, stating that the reviewers were impressed with the progress, both for the preparation of the SPS test and the prototype performance. He mentioned that both crab cavity designs (DQW and RFD) are mature and that the committee agreed on keeping two complementary designs as options. Additional comments can be found in slides 6 and 7.

A. Yamamoto then summarized the committee recommendations (slide 8). O. Brüning concluded from the given recommendations that excellent work has been carried out following the previous review. For the SPS test the schedule seems tight, but the identified plan is feasible. O. Brüning also mentioned that the acceptance criteria for crab cavities could be discussed and finalized during the US-LARP. In addition, a list of tests to be performed in the SPS should be defined, together with the related 'success criteria'.

ACTION: R. Calaga should report on the outcomes of the US-LARP discussions on the acceptance criteria for the crab cavities.

ACTION: A list of tests for the crab cavity SPS test should be defined, together with the related 'success criteria' (WP2 and WP4).

L. Rossi congratulated A. Yamamoto, the reviewers and all the people involved in the technical development of the crab cavities for the excellent work. He suggested adding also technical considerations, if any, in the report for possible follow-up at CERN.

Update on alternatives for cryogenics upgrade (S. Claudet - slides)

S. Claudet recalled the HL-LHC baseline for the cryogenic system in LHC point 4, based on an additional refrigerator to improve the cooling capacity of the present LHC configuration. The additional capacity should cover any RF upgrade and potential new systems (200 MHz RF system, e-lens).

As reported in Chamonix 2017, the cryogenic group launched a feasibility study to identify the most suitable solution based on the cooling requirements in point 4, possibly not requiring the installation of a new refrigerator, but just an upgrade of the existing one. Tests of existing equipment were carried out in March 2017 to explore the present cooling limitations.

S. Claudet recalled the need to fix the requirements for cooling capacity of the crab-cavity. Presently the HL-LHC baseline foresees 275 W for 2 MV per cavity. According to S. Claudet this could be still modified (e.g. to 2.3 MV per cavity to have margins for HL-LHC operation), but an agreement should be found before June 2017. D. Delikaris stressed that in case of an upgrade of the present configuration, it is very important to fix these numbers.

S. Claudet presented the preliminary results of the cooling capacity tests carried out in March 2017. The measurements seem consistent in terms of trends across the sectors, however some systematic error is believed to persist in the measurement setup as the absolute measurement shows too low cooling capacity (something which however has already been proven to be according to specifications during cryo-plant commissioning, but never properly checked in operation).

A moderate upgrade of the refrigerator of S34 (to 2 kW) would be sufficient to cope with the RF heat load for HL-LHC.

S. Claudet reported on the feasibility study: the request is to have additional 2 kW cooling power at 4.5 K. If this turns out not to be possible, three variants could be considered (slide 13). L. Rossi commented that at least for variant 3 there shouldn't be obstacles. S. Claudet confirmed this impression, but added that dedicated studies will be carried out for a final confirmation. A feasibility study by a senior expert in Linde has been launched, a final answer on the feasibility is expected for July 2017.

ACTION: S. Claudet should come back in June/July with the outcomes of the feasibility study for the cryogenic system upgrade for S34.

S. Claudet recalled the timeline for the work on the cryogenic system and mentioned that summer 2017 is the limit to make a formal decision for works to be carried out in LS2. If the need of a new cryo-plant is confirmed, the fall-back solution could be to postpone the work to LS3, which implies an additional workload on the cryogenic group.

R. Calaga asked more details about the 2.3 MV per cavity mentioned in the presentation. S. Claudet replied that this was an estimate provided by P. Baudrenghien and G. Arduini to allow for operational margins for HL-LHC.

L. Rossi asked if in case of need of a new refrigerator this would need to go under the same tendering process as the other cryoplants for HL-LHC, with may be advantageous in terms of cost. S. Claudet explained that this is not the case, as these are completely different designs.

Executive summary of LRBB workshop and MD plans (A. Rossi - slides)

A. Rossi presented a summary of the LRBB workshop, covering hardware, optics, measurements and simulations and MD plans for 2017.

The collimators with embedded wires have been installed in IR5 and the commissioning has been finalized in April. The interlock logic was approved at the 144th MPP (hardware and software). The commissioning of the software controls and interlocks is ongoing.

A. Rossi reminded about the observables to monitor the efficiency of the beam-beam compensation and the available diagnostics (slide 5-8). O. Brüning asked if the Schottky monitors will be available, R. Jones confirmed this is the case.

A. Rossi summarized the considerations related to the optics presented by S. Fartoukh (slides 10-11). With flat beam optics, the crossing plane is reversed between IP1 and IP5 and the wire (mounted on the H plane around IP5) could not perform the compensation. Round/oval beam optics shall be used to demonstrate beam-beam compensation.

X. Buffat reported in the workshop on the collimator settings to be used during the tests, distinguishing settings for the strong beam and the weak beam. No effect is expected on impedance down to 2σ gaps.

A. Rossi summarized the status of measurements and simulations for beam-beam wire compensation. Without major changes to the machine configuration, simulations show a severe beam lifetime degradation (down to below 1h) due to long-range begins at separations of $<6 \sigma$. Even with the present hardware limitation, a 2-wire scheme is believed to show a measurable benefit to lifetime. During the 2016 run losses of dynamic aperture were measured while reducing the crossing angle from 185 to 140 μ rad.

A. Rossi explained the main goals of the MDs for 2017 and the required beam parameters and machine configuration for the tests. The goal is prove the effectiveness of beam-beam wire compensation with respect to beam lifetime drops associated to a controlled reduction of the crossing angle. The corresponding MD procedure is already available.

The request for the MD was to have 3 slots of 8 h, one in each MD block, starting already from the first MD period. O. Brüning asked if the outcome of the MD day is already known to have a confirmation for these tests. G. Arduini commented that a final answer was not given yet, as the MD day rather focused on the understanding of MD requests. O. Brüning agreed on the approach of divide the tests over different MD blocks, to allow for time for repair in case of hardware problems and time to understand and interpret the first results.

A. Rossi mentioned the plans to install more collimators in point 1 during the YETS 2017-2018. She mentioned that depending on whether we go for flat or round beams in 2018, also in point 1 horizontal collimators would be required. R. Jones commented that installing H collimators would be easier since it would not require any modification to the collimation system. Adriana commented that she is contacting Yannis and Stefano to see what is the best way to come to a decision reasonably soon.

Logistics and civil engineering at point 1 and 5 for HL-LHC (B. Di Girolamo - [slides](#))

B. Di Girolamo recalled the fact that significant civil engineering works will be carried out for the HL-LHC project out starting in 2018 and until 2023. Some of these activities can be invasive (as the new connection to the existing tunnel) and potentially interfere with other LS2 activities.

B. Di Girolamo gave an overview of the underground and surface works in point 1 and 5 and focused on the possible interactions with other activities. He mentioned it would be ideal to have access to worksite and evacuation independently from the in-out in point 1 and 5. A more general concern regards dust, so first discussions were started with EN/CV on the subject.

The impact of new technical galleries is significant, especially in point 5. Nevertheless also some constraints in point 1 have to be clarified considering the possible interaction with other LS2 works. Connections of technical galleries must be finished before LS2 in order not to disrupt existing services (e.g. power converters for SPS in point 1).

O. Brüning asked if the announced works for the 'esplanade des particules' will have any impact on the plans. B. Di Girolamo explained that the related works should be finished before, so there should be no impact.

Some works might also have an impact on existing premises. In these cases the HL-LHC project covers the displacement of items (e.g. containers in point 1) to new locations.

B. Di Girolamo mentioned that the most complicated discussion regards the connection of the new HL technical galleries with the LHC tunnel. A proposal was made to try minimizing the impact on services in the tunnel, but this was refused by HSE as constraints are also imposed by personnel safety considerations (e.g. intervention of fire brigades). The discussion is now focusing on the impact of the tunnel openings, trying to limit large openings only to the tunnel far ends. The choice has implications on the cooldown and shutdown schedule, three options are under evaluation. The one currently being explored consists in executing the openings at the beginning of LS2.

O. Brüning asked if the temporary safe room at the end of the tunnel which was under discussion has finally been discarded as an option. B. Di Girolamo confirmed this is not anymore an option.

O. Brüning asked when the decision among the three options for the opening should be taken. L. Taviani mentioned this is not critical, as it will not be included in the same tendering as other HL-LHC works. This will be another contract, to be signed with people already experienced with works in the LHC environment.

AOBs

G. Arduini reminded about the need to operate with the nominal gradient of Q7 (200 T/m) for ATS optics for HL-LHC, in order not to be limited in β^* reach. As far as he could find out, Q7 was tested to nominal current during the first hardware commissioning campaign in 2008, but not afterwards, so he suggested to test this during the ongoing hardware commissioning. E. Todesco communicated by email that he supports this test. S. Le Naour commented that in 2013, before LS1, all IPQs went to nominal current. O. Brüning suggested verifying the history of this magnet, but stated that if the test was not carried out before, then the HL-LHC TCC would support the proposal to have it during the this hardware commissioning campaign. The proposal should then eventually be approved by LMC.

O. Brüning announced the next meeting of the HL-LHC TCC on 4th May. T. Lefevre will confirm if the cost estimate for the octagonal BPM design will be available by then for comparison with the old design.