13th Meeting of the HL-LHC Technical Coordination Committee

Participants: C.Adorisio, A.Apollonio, A.Ballarino, I.Bejar Alonso, D.Berkovitz, C.Bracco, O.Brüning (chair), J.P.Burnet, S.Chemli, S.Claudet, D.Delikaris, R.De Maria, B.Goddard, R.Jones, A.Lechner, V.Mertens, D.Missiaen, Y.Papaphilippou, H. Prin, S.Redaelli, F.Rodriguez Mateos, L.Rossi, E.Todesco, G.Vandoni, U.Wagner, J.Wenninger, M.Zerlauth.

Excused: G.Arduini, M.Giovannozzi.

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

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

Indico link: https://indico.cern.ch/event/559124/

O.Brüning opened the meeting by reviewing the minutes of the 12th TCC. Comments and clarifications were received in particular on the quench heater tests and the benefits of collimator BPMs. S.Redaelli made an additional clarification to be included in the final version, on the heating of the wire embedded in the TCTs for the BBLR compensation: the location for which the wire temperature may raise to 200 C° is quite limited and just before the enlargement area at the edges. In the rest of the jaw, it does not exceed 60 C°.

There were no particular actions, but it is important to remind to all WPs that all contributions for the TDR update reflecting the re-baselining changes should be sent to I.Bejar Alonso by the end of August. I.Bejar Alonso stressed again that this will give just enough time for converging to an official updated version ready for the C&S review, by October 1st.

O.Brüning would like also to thank the different WPs for the iterations on the parallel program of the HILUMI collaboration meeting, in Paris. It was finally decided to keep 4 parallel sessions. The detailed organisation of the sessions is left to the WP leaders. An update of the program will be provided in September by C.Noels. L.Rossi stressed that there is the possibility for satellite mini-workshops during the last two days of the week (Thursday and Friday). In this respect, the local organisers at CEA should be notified ASAP. Regarding the participation, the revised lists, already reduced by the project, for respecting a rough quota of 100 CERN participants, have been sent to the department heads for a final iteration and approval.

Before the regular agenda, L.Rossi made an important announcement. The result of the re-baselining was presented by the project to the executive committee, in the presence of the DG and Scientific director. The executive committee accepted the present baseline. It was important though to clarify that the reduction of performance is only 5 % for the nominal parameters, and slightly more visible for the ultimate. Indeed, there is no global change of scope (which could implicate the need of approval from the council), as there are other means to recover the targeted 3000 fb^{-1}, (e.g. increased efficiency based on the 2016 LHC experience, reduced MD time and ion runs, etc.). In addition, the equipment which was removed from the baseline, as the rest of the CC or the new Q4 could be included in the machine in the future.

Optics constraints for LBDS, C.Bracco – slides

C.Bracco first presents the main optics constraints for IR6 and the LHC Beam Dump System (LBDS): i) Q4 gradient fixed within maximum of ± 1%, ii) phase advance of around 90° between MKDs and TCDQ, iii) minimum vertical beta higher than 200 and 145 m at the TCDS and TCDQ, respectively, whereas minimum horizontal beta of more than 630 m and horizontal dispersion lower than 0.2 m at the TCDQ, iv) constraints on the beta functions minima and beam area at the TDE v) unidirectional TCDQ movement during the squeeze and towards the beam, combined with degraded alignment precision which may necessitate redesign of the BETS, vi) phase advance of 0° or 180° from the MKD to the TCTs, and finally, vii) horizontal beta function limited below 175 m between the TCDS and MSD. R.De Maria asks if the TCDQ movement constraint applies to other collimators as well. C.Bracco replies that this constraint does not apply to the TCLG because of its smaller size. Concerning the phase advance, R.De Maria would like to stress that the present HL-LHC optics version 1.2 does not include the solution of S.Fartoukh applied to the actual LHC. A baseline optics achieving this would change the assumption about the collimator margin. He adds that today HL-LHC can work with any phase advance taking into account the retraction margin. Replying to a question of L.Rossi, C.Bracco clarifies that the normalised emittance used for the calculations is 3.5 μm.

Updated FLUKA simulations explored the impact of ultimate intensity at the TCDQs. In particular, a different type of erratic (type 2) was considered for distances closer to the beam. In that case, there is an increase of the energy density bringing its value close to the limit of 3 kJ/cm^3. L.Rossi asks why the energy density is used as the critical parameter. C.Bracco clarifies that it is not the brightness but the intensity that matters. O.Brüning asks about the lower intensity of 2.0e11 (versus the nominal 2.3e11) used in the BCMS parameters. A.Lechner replies that there was a mismatch between the parameters for qualifying the transfer line limits and the ones for the actual LHC and came up to the decision to use the LIU intensity of 2.0e11. In any case, as mentioned, what matters is the intensity and the worst case is for the HL-LHC nominal 25 ns parameters. S.Redaelli asks if there is a parameter change. B.Goddard clarifies that the BCMS parameters is within the brightness line capabilities at the exit of the SPS. O.Brüning concludes that there is no need to update the BCMS parameters.

C.Bracco continues by first describing the situation with the present collimator settings at 6.5 TeV (β^* = 40 cm). The present SIS interlock on local orbit is ± 1.2 mm. Taking into account the nominal setting at the TCDQ of 8.5 σ, minus 0.5 σ for set-up error (corresponding to 7.8 σ or 3.9 mm), the gap corresponds to 2.7 mm. With this gap, and scaling from FLUKA calculations, for a bunch population of 1.15e11, a maximum energy density of 2.2 kJ/cm^3 can be estimated and a maximum temperature of below 1000 C°. L.Rossi asks of the possibility to refer to the collimator gaps in mm, in order to remove uncertainties about the employed emittance. S.Redaelli replies that then it will be necessary to present hundreds of settings, as they are changing with the local beta functions.

C.Bracco proceeds by considering the HL-LHC case for the new minimum β* of 20 cm. Assuming a maximum allowed temperature of 1400 C°, the minimum gap is 3.6 mm. Taking into account 0.25 mm of setup error and the SIS interlock of 1.2 mm, a minimum of 5.05 mm is needed. This corresponds to a minimum horizontal beta function of 630 m. O.Brüning asks why in the HL-LHC case the TCDQ needs to be at 3.3 σ, whereas in the present LHC it can be located at 2.8 σ. S.Redaelli replies that this is due to the non-optimal phase advance for this HL-LHC optics version. O.Brüning stresses there are indeed 0.5 σ to be potentially gained, with an eventual phase advance optimization.

C.Bracco summarizes the main follow-up points for concluding on the TCDQ minimum beta, namely an assessment on the possibility to avoid a Type 2 erratic (or any worse case), the confirmation on the possibility to reduce the SIS interlock on orbit at the TCDQ and the performance of ANSYS simulations to assess if Graphite and CFC would withstand the beam. Then, a decision could be made for upgrading the TCDQ with more robust material which is not part of the baseline and may have a cost impact.

The parameters for the estimation of the dispersion at TCDQ are exposed, as compared to the LHC design, the HL-LHC design (see CERN-ACC-2014-0044) and based on experience from RunI. In particular, the total momentum deviation considered is the sum of the momentum offset, plus twice the momentum spread. The bottleneck in the machine during RunI was the TCDQM, whereas it is expected to be the TCLIM for HL-LHC.

The real horizontal cut is estimated versus the dispersion for different collimators and for the present machine. This cut contains optics and positioning errors during the setup, whereas the contribution of dispersion and the one for the local orbit at the moment of the asynchronous dump (up to ± 1.2 mm) are separated. In the present machine, everything is protected above 12 σ. There are issues with the TCSG and TCP collimator hierarchy (for higher local orbit during the asynchronous dump or dispersion higher than 0.9 m, respectively) but this is not present a machine protection issue.

The same exercise applied for the HL-LHC reveals that, independently of the dispersion, the TCDQ is always above the 10.4 σ of the TCLM limit. In that case, either the SIS interlock should be reduced or ensure a larger machine aperture (without taking the phase advance of global bottleneck with respect to the MKD) or have the TCDQ closer (with a possible damage in case of type 2 erratic). For maximum absolute horizontal dispersion value of 0.2 m and the same 10.4 σ aperture limit, the SIS interlock should be at 0.6 m. For this maximum dispersion, the aperture bottleneck moves at 11.6 σ. R.De Maria thinks that constraints from the cold aperture of 12 should be taken into account. C.Bracco points that if the 12 σ of the cold aperture are taken into account, there is a stronger constraint in the phase advance. S.Redaelli also believes that some iteration should be done for fixing the numbers.

Using HL-LHCV1.2 and round optics, the fulfillment of the aforementioned constraints are tested during the squeeze. The non-fulfilled constraints are the dispersion maximum at the TCDQ (depending on the SIS interlock for local orbit @ TCDQ and TCDQ half-gap), the horizontal beta at the TCDQ only for SIS interlock of 0.6 mm and 9 σ half-gap and the fact that the TCDQ is moving away from both beams during the squeeze (from 4.5 mm to 5.5 mm, i.e. a 2 σ movement). O.Brüning asks if errors are included in these estimations. R.de Maria adds that optics beating should be indeed included. C.Bracco replies that in principle these are simulations for a machine with errors. O.Brüning adds that it would be desirable to understand of what is the deviation from the estimations depending on the size of the errors.

C.Bracco presents studies testing if the same optics constraints are satisfied during the squeeze for flavors of the flat optics, with quite similar conclusions as for the round optics, and in addition the non-fulfillment of vertical beta function minimum at the TCDS, for the HV case. She proceeds by presenting studies performed by C.Wiesner, who recently started as a fellow in TE-ABT, regarding the maximum beta functions at the MKD, (540 m and 216 m for the horizontal and vertical plane respectively), defined by the available aperture for the circulating beam at injection. R.De Maria points out that this beta function range is valid for a given alpha function. C.Bracco agrees and mentions that this is just a first exercise that needs further refinement.

She finally summarizes that most of the constraints were checked for the HL-LHCv1.2 optics, apart from the phase advance between MKD and TCTs. Most of them were found ok, pending some further refinements. The ones that were found problematic are: i) the minimum vertical beta at the TCDS for the HV flat optics (probably not critical), ii) the horizontal beta minimum at the TCDQ is below the limit of 630 m; this could be solved by reducing the SIS limit to less than 0.6 mm (the requirement drops to 490 m) and needs final confirmation through ANSYS simulations, iii) the TCDQ movement is not uni-directional and towards the beam during the squeeze; this could be mitigated by limiting the total displacement to below 1 σ and moving the TCDQ to the closest position before the squeeze, iv) the average absolute dispersion at the TCDQ exceeds the limit of 0.2 m but needs to be rechecked for consistency with the global aperture bottleneck considered.

Discussion

L.Rossi asks if the TCDQ material upgrade entails a change of the material. C.Bracco explains that it involves a change in the mechanical movement. O.Brüning asks whether the TCDQ movement depends on the type of optics. C.Bracco replies that the movement should be in one direction for both round and flat optics. B.Goddard adds that a discussion with the collimation team is necessary to find a work-around. R.de Maria points out that the situation may be critical for smaller beta*. At the beginning of the squeeze, though, the TCTs have a very large aperture providing quite some margin.

A.Lechner informed that the loads are being checked with ANSYS and will come back in autumn with a clearer picture. He believes though that at present, the worst case is being considered. On the other hand, if the optics changes dramatically a re-evaluation will be necessary. O.Brüning asks about the possibility to use the optics for solving the issue with the uniformity of the TCDQ movement. R.De Maria replies that it is relatively complicated, due to the large number of constraints. B.Goddard clarifies that the constraint is on the physical position, while the TCDQ itself does not move. O.Brüning concludes that a re-iterations needs to be made but it may be that there is no easy solution. S.Redaelli stresses that it is presently assumed that only the TCTs are moved but maybe different settings can be employed. He adds that the phase advance solution between MKI and TCT was found by S.Fartoukh for round optics, but flat optics are not yet studied. R.De Maria thinks that for flat optics some thinks could be shared for IR1 and 5, like the pre-squeeze as pointed by S.Redaelli. He adds that one could foresee to have the telescopic part without the crossing angle to verify also the TCDQ movement. S.Redaelli comments that for the SIS interlock, it is planned to implement the readings based on the BPMs of the collimators. In his opinion, it is important to be able to recover the 1 σ retraction settings of the LHC design report, as there is a danger that with the low impedance collimators, tighter settings may impact the beta * reach. He further questions if the dispersion limit criteria correspond to an off-momentum aperture bottleneck. C.Bracco answers positively but some clarification needs to be discussed off-line for the parameters chosen.

Action: C.Bracco and the collimation team should clarify the parameters used for defining the dispersion limits at the TCDQ.

R.Jones asks if the ± 1.2 mm criterion comes only from movement of the orbit or there is also the BPM precision included. This is indeed a large offset for a position at the BPM and may need a local control for the orbit. In particular, one should consider the malfunctioning of the BPM. C.Bracco replies that ± 1.2 mm indeed corresponds to a software not a hardware interlock. R.Jones suggests to gain experience from observations on the present system as the electronics will be changed during the LS3, thereby providing the possibility for better control. O.Brüning adds that indeed HL-LHC will profit from a better orbit feedback system. Profiting from the BPMs that the collimators are equipped with, the HW interlock could be based on them. C.Bracco agrees that this will certainly relax for example the dispersion criterion to around 0.3 m. R.De Maria asks is there are BPMs on the TCDQ. S.Redaelli answers negatively as there is a jaw only in one side. O.Brüning concluded that the orbit tolerance needs to be re-evaluated. L.Rossi questioned the needed upgrade of the system, and whether it would be on the material or the mechanics side. A.Lechner answered that this will be known by the end of this year. L.Rossi stressed that until October and the Cost and Schedule review, the project cannot discuss any extra cost beyond the new baseline. There is indeed time after this to make a precise evaluation and take a decision.

Summary of D1 review, E.Todesco – slides

E. Todesco summarises the review on the separation dipole D1 by a panel of four persons from KEK (2), CERN and LBNL. He starts his presentations by some general remarks on the purpose of the new D1 which replaces its present resistive version for kick enhancement and radical magnetic length reduction, resulting on an increased space availability.

The D1 short model program involves the construction and testing of two 2-m long short models. The first was supposed to be tested in 2015, but this test was shifted by six months due to an iteration on the shape of the yoke. The second one is supposed to be built in 2016 and tested at the end of the year. The first short model was tested in April 2016. Although the nominal was reached, and had a good behaviour after a thermal cycle, the magnet did not manage to reach the ultimate current of 500 A. A clear sign from instrumentation shows that there is coil unloading at 8.5 kA (whereas the nominal is at 12 kA); a larger pre-stress loss than expected was observed during the cool-down. The quench performance of the magnet is further presented in a detailed plot from the KEK colleagues. L.Rossi points out that the problem is that the magnet seems not to be stable at the nominal current. An action was thus necessary and it was decided to disassemble the short model for testing, understand the field quality and delay the second model, thus providing enough time to include the new features. At present, the magnet is practically disassembled and by the end of the month the collared coil will be recovered.

Regarding field quality, the geometric b_3 is found to be 5 units, whereas zero is expected, but this is anyway a good result to be further corrected with shimming. What is not expected and not yet fully understood is the large contribution of the coil ends on the b_3 saturation in the straight part. In addition, the 3D modelling with ROXIE agrees better with the measurements as compared to the 2D model. L.Rossi claims that this may be expected due the fact that the magnet is relatively short. E.Todesco stresses that it seems that 30 units of b_3 are coming from the ends to the field integral, this is indeed quite surprising and calls for further scrutiny. L.Rossi asks if there will be further calculations and measurements. E.Todesco replies that 3D modelling of saturation is known to be complex, and an independent model with OPERA should also be used.

The heat exchangers are placed at 90° in D1, where saturation is lower, whereas they are placed at 45° in the triplets. Recently, it has been realized, due to issues with the interconnection, that the heat exchangers in the triplets and in the D1 have to be in the same longitudinal position. This implies putting the holes at 45° (larger saturation) and redesign the iron, with the holes being very close to the shell. But the KEK model diameter is 45 mm shorter than the triplet, imposing a yoke diameter increase. This is a major change that could be foreseen for the series magnets but not for the short models.

E.Todesco summarizes the reviewers recommendations: the coil design is adequate but the possibility to increase the yoke diameter and to shorten the coil ends should be considered. It should be also considered the possibility of having 2-m-long copper wedges instead of several pieces, thus preventing the risk of leaving large gaps. The present design should be kept for the first model and any modifications from the knowledge of the tests should be implemented to the second short model. As a first step, the first model should be reassembled with larger pre-stress, taking care of the head shimming. Regarding the field quality, an OPERA model is needed for further assessing the 3D saturation issue and to be compared with the existing models. Regarding the measurements and tests, it was suggested to have an antenna for refined quench localization and improve the coil mechanical characterization to be able to model the pre-stress loss.

Discussion

O.Brüning asks if the model ends are too long. E.Todesco replies that this is the choice of KEK. They could be indeed shortened but this is not considered to be critical. O.Brüning further asks if there is a limit. E.Todesco answers that reducing the number of spacers may allow for shorter ends. He adds that presently it is not clear where quenches occur. It may be due to the lack of pre-stress in the central part or in the ends.

R.De Maria stresses that the integrated field requirement of 35 T·m will be fully used. He asks if there are possibilities of increasing this kick. E.Todesco replies that this is not possible at the moment, since a field increase would reduce the margin to unsafe limit (below 25%), and a longer magnet would not fit the KEK test station. L.Rossi adds that the magnet could be split in two modules but this is quite a radical change and will certainly raise cost. If an integrated field of e.g. 40 T·m is needed, the split of the magnet may be necessary. E.Todesco points that if the magnet becomes longer rather than splitting in two, we should renounce to the test in KEK. L.Rossi concludes that the message to the optics team is to avoid any increase of the strength.

Presentation on powering implementation, A.Ballarino – slides

A.Ballarino begins her presentation by reviewing the powering history, as it was until mid 2015 and presented in the C&S review and how it evolved up to the circuit review of last March. The integration drawings present the new caverns with cryostats and the current leads distribution feed box. From the initial 250 m, there is a total length of about 80-90 m per link (as answered after a question of O.Brüning). The drawings show the link feeding the current to D1 and the triplets, and the one feeding the matching sections with the interconnection cryostat. A.Ballarino clarified that the interconnection cryostat (DFBMJ), between D1 and D2, is needed for the MgB_2 to NbTi splices of D2, Q4, Q5 and Q6. If the powering layout will require a new link only for D2 in the matching sections, the interconnection cryostat, much reduced in size and functionality, could be attached – or close to – the cryostat of D2. The length of the NbTi links going from the DFBMJ to Q4, Q5 and Q6 are 90 m, 120 m and 140 m, respectively. L.Rossi and O.Brüning ask if the link for D2 is directly attached to the DFM and its length is 140 m. A.Ballarino replies that it can be attached to D2 or it can be located near-by (optimization studies started by V. Parma). S.Claudet points out that there is already a secondary link for the DFM and D2 and questions the chosen location of the DFBMJ. A.Ballarino answers that there is room at the present location between D1 and D2. L. Rossi asked if there would be space near D2 – possible new baseline. He proposes that to organize a meeting with the integration team (A.Ballarino informed that the meeting took place during the week after this TCC). A.Ballarino underlines that a connection box near D2 would be needed in any case also with the present baseline (NbTi to NbTi splices and lambda plate). A study is needed for confirming that the presently reserved space is sufficient for the re-baselining.

A.Ballarino shows an overview of the circuits as presented during the circuit review: the changes included the reduction of the triplet current from 20 kA to 18 kA, the reduction of the Q4, Q5 and Q6 current from 16 kA to 6 kA, and the reduction of the currents for the D2 and Q4 orbit correctors from 2 kA to 600 A. The triplets, D1 and corrector packages could be powered with 38 units of cable with a current of 2 times 68.5 kA and the matching section with 48 units with total current of 2 times 54.8 kA, per IP side.

There is a number of additional modifications since May 2016: first, for the triplets and D1, there is a small reduction in the total number of units (from 38 to 36) and the total current is reduced from 68.8 kA to 52 kA. There are no changes with respect to the integration in the tunnel, i.e. the DFX box is still located near the D1 which receives the link coming from the new caverns in the underground area. There are also no changes from the point of view of the current leads, DFH and DFX design, and the SC link layout. There are seven concentric cables of 2 kA and cables for the smaller circuits, rated at 200 and 120 A. They are housed in a semi-flexible cryostat, with external diameter of 220 mm, whereas the external diameter of the cable is 65 mm, with a mass of 10 kg per m.

There are two dedicated spare triplet cables integrated in the cryostat to be used in case of problems and there are also 8 spares for smaller cables. The spare leads will be available in the laboratory but not the tunnel. The design of the system foresees exchangeability of the leads in the tunnel. O.Brüning questions the absence of available splices in the tunnel in case of failure. A.Ballarino answers that the interconnection boxes at the level of the leads (DFH) are conceived in such a way that one can open and access in-situ the leads to MgB_2 joints (and re-make them). E.Todesco asks why 8 spares are foreseen for the 200 A cables and nothing for the lower ones of 120 A. A.Ballarino answers that the higher current spares can be used also for the lower ones. H.Prin comments that there seems to be an inconsistency in the presented tables. Actually, by summing up all the lines, multiplying by two the one of MCBX and including the three triplet trims, there is a 2 kA line missing. F.Rodriguez Mateos replies that there should be a typo in the table, the nominal rating for the trims is 0.2 kA. L.Rossi asks that the table is updated and F.Rodriguez Mateos replies that this will be indeed corrected.

Regarding the matching section, the situation is more complicated. D2 is fed by a 12 kA circuit as before, while it has been proposed for Q4-5-6, to use the existing DFBL and associated DSL. A.Ballarino mentioned that discussions in dedicated meetings were initiated with V.Parma and S.Claudet to have also a closer look to the existing link. L.Rossi comments that all necessary efforts should be made for keeping the existing DSL and a piece of the QRL for cost savings. S.Claudet replies that indeed to keep a piece of the QRL is possible, and also the use of the existing DFBL. Regarding the DSL, there is a position conflict of the interface with the magnet and its integration place with the QRL connection, but there is on-going work to solve this problem.

A.Ballarino focuses on the D2 powering which is feasible, if there is no interaction with other magnets, and the same concept of DSH provides a very flexible system to connect the cryostat and line, and thereby suppress the presently big DFM. A line powering directly D2 is possible, as discussed and agreed with V.Parma and S.Claudet. The current leads will be in the new underground tunnel and the SC link will be approximately 130 m long. The box is attached or located near D2. L.Rossi questions the position of the collimators in the area. He points out that just before the D2 is the TAN and it is not a simple area from the radiation protection point of view. It is important to discuss the integration aspects of this solution. S.Claudet comments that it was thought to put the new DFM close to D2 because of its small size. L.Rossi suggests that A.Ballarino arranges a meeting with all interested parties including integration and RP to clarify the issue (the meeting took place on the week after, as mentioned also above). H.Prin asks if the use of the service module on the other side of D2 would be more appropriate. O.Brüning stresses that there is space reserved still for the full integration of the crab cavities. L.Rossi adds that no irreversible actions should be taken for the implementation of the full upgrade as it was foreseen before the re-baselining. S.Claudet points out that this was not fully understood by all WPs. O.Brüning stresses that these aspects that are important for integration should be frozen as soon as possible. M.Zerlauth asks if it makes sense to leave the D2 with the existing link. A.Ballarino wonders if there is a problem from the cryogenics point of view for separated triplets and the matching section. In addition, the link for the triplets is heavy and there is no room for additional cables. S.Claudet answers that this could be a possible solution, suggesting that the SC link to be close to the DFX and have a secondary link for D2. A.Ballarino stresses that even with the present baseline an interconnection box near D2, for the Nb-Ti splice and the lambda plate, is necessary.

Regarding the matching section, the cables are pretty compact and the lead is underground. The Q4-5-6 could be connected with the same SC link. The current leads are located in the existing DFBL. There are 11 leads of 6 kA and 12 leads of 120 A. Considering the present powering layout, 16 links of 120 A are needed, which is exactly the available number. For the DSL, 12 links of 6 kA and 48 links of 600 A are needed. From the powering scheme and summing up the links, there are 12 of 6 kA but reduced to 9 as in the present LHC using the existing DFB. There are also 16 links of 120 A. A. Ballarino underlines that, in addition to the current leads and the DSL, the current rating of the Nb-Ti bus-bar in the DFBL shall be verified. On the other hand, 8 links of 600 A, including leads and cables are not available. H.Prin points out that from his understanding, for the present consideration for the Q4 (it will be an MQY with the same current), the number of correctors will remain the same but the current will be reduced as confirmed by R.De Maria. L.Rossi stresses that if there are changes, they will not impact the project cost, but are considered as part of consolidation. On the other hand, it is important to understand the details in order not to run into irreversible situations in the future. A.Ballarino says that according to the June baseline , the 600 A circuits are still there. F.Rodriguez Mateos clarifies that this is no longer the case due to the re-baselining –it was presented in a meeting by mid-July. A.Ballarino explains that changes will be solved with another off-line iteration.

A.Ballarino suggests to have a web-site where all updated circuit information is available. F.Rodriguez Mateos replies that it is indeed under construction. For the time being, his latest presentation in the TCC should be taken as the reference. M.Zerlauth adds that the information was passed to EN-EL for producing a visual schematic drawing of the circuits. F.Rodriguez Mateos informs that he is presently waiting for their feedback.

A.Ballarino finally summarizes the powering of the matching section, with the only outstanding point the missing powering of 600 A for the Q4 orbit correctors, i.e. a total of 8 leads. E.Todesco comments that the old Q4 (i.e. the one that will not be replaced), includes two horizontal and two vertical correctors. These are critical correctors with redundancy so eventually they correspond to two circuits. A.Ballarino agrees that indeed two leads can be saved but there are 8 needed. L.Rossi mentions that eventually the Q4 with new correctors could be replaced but at present and until March 2018, the cost should be contained to the approved one.

A.Ballarino finishes her presentation by summarising the WP6a activity: The procurement of six semi-flexible cryostats each of 60 m long was launched and 3 different companies are producing two variants with and without thermal shield. The delivery is scheduled for September. L.Rossi points out that the ones without thermal shield are more compact, more flexible and cheaper. A.Ballarino explains that thanks to the length reduction, it is possible to achieve the same temperature with a less performing cryostat. A collaboration with the main workshop was launched for the manufacturing and assembly of two 18 kA prototype current leads. The raw material was procured and the work will be completed by the end of 2016. For the production of full triplets and D1 current leads, a collaboration with the main workshop was initiated. The manufacturing and assembly will be done at CERN in the main workshop. L.Rossi asks who are the contact persons from the main workshop. A.Ballarino answers that her contacts are A.Dallochio and A.Bertarelli, who should be thanked for the very fruitful collaboration. Several companies were contacted for the manufacturing of MgB_2 wire (18-wire cable with flexible Cu core). The answers are expected by the end of August 2016. An R&D contract on MgB_2 was signed, with scope the reduction of cost of MgB_2 wire via production of longer lengths. The procurement of 200 km of MgB_2 wire to be delivered in unit lengths of up to 2 km was also launched. The results from R&D contract will be implemented and the opening of the offer is scheduled for this coming Monday. A.Ballarino visited with L. Bottura and M. Benedikt a Russian laboratory in Moscow (VNIIKP, R&D Cable Institute). She was very pleased to see machines that they are capable of assembling the SC link. There was also progress on the design of the DFX cryostat for triplets (with C. Ferrer and V. Parma). In addition, a mock-up of routing of MgB_2 cables for the DFX cryostat and splicing was done by the SCD team. The assembly of a small DFH prototype designed by SCD for the test of a system in the SM-18, will be completed in the Main Workshop by the end of August 2016. There was progress on the production and qualification of MgB_2-MgB_2 and MgB_2-NbTi high-current electrical joints, with measurements in He gas and in liquid He. There were discussions on the strategy for testing the 60 m long and the series SC Links (with SM-18 and cryo teams). Electro-mechanical measurements of MgB_2 wires and cables were performed, including electrical insulation tests. Moving towards series production, two orders were launched in industry: for the procurement of 60 m long cryostats for the link (three companies, two variants of cryostats from each company) and cabling of MgB_2 in industry. Launched procurement of 300 km of MgB_2 wire. Finally, there should be space available in building 927, needed at the latest by mid Sept 2016, in time for the delivery of 60 m long cryostats for starting the qualification tests.

The last slide of the presentation summarises the schedule as presented during March 2016. It is planned to have the prototype for design and construction of a SC link for the triplet. At that time, it was 80 m but now it is reduced to 60 m, due to the available space in SM18. Everything is moving according to the plan with the first test of a system scheduled towards the beginning of 2017. The prototype work of the matching section will start in 2017 and will be finalised by the end of 2017, in order to start with the test in 2018. L.Rossi points the importance of the red crosses in the planning, which correspond to the system tests.

Discussion

O.Brüning stresses that some action should be taken for the missing 600 A circuits, as the revised TDR is due very soon and this point should be settled before. A.Ballarino needs to clarify with F.Rodriguez Mateos the numbers and add the leads which are not available. L.Rossi states that A.Ballarino and F.Rodriguez Mateos should work into this issue as it is urgent. He believes though that it is more for consistency of the picture, than for the cost or schedule impact. O.Brunning mentions that at least the space reservation should be clarified with the integration WP.

Action: A.Ballarino and F.Rodriguez Mateos need to converge on the matching section circuits for presenting a consistent picture on the TDR revision. A.Ballarino should iterate with integration for the space needed for the SC link of D2 (A meeting was organized by during the week after).

S.Claudet asks about the construction of the prototype DFX which started, according to one of the last slides of the presentation. He asks if this is a mock up to cool down the link or this is the final DFX for the tunnel and, in that case, if vacuum aspects are taken into account. A.Ballarino replies that what has started is not the production of the DFX, but the production of the DFH, the cryostat with the leads connected to the link of SM18. L.Rossi further explains that this is a short model test not of the whole system. A.Ballarino clarifies that it will be the first test of a system (with fewer leads than in HL-LHC).

AOB: ECR for SPS crab cavity test stand, G.Vandoni – slides

G. Vandoni presented the ECR describing the crab cavity cryomodule and related infrastructure in SPS LSS6 for the upcoming EYETS 2016-2017. This ECR follows another detailed document for the space reservation request, which contains a complete overview of the project. An additional ECR will be released in September concerning requirements for surface buildings.

G. Vandoni gave an overview of the activities foreseen to take place in the EYETS 2016-2017, focusing in particular on the cryogenic distribution line installation, the modification of the vacuum layout and the rail for handling in TA6. A change of the vacuum layout will be required for the installation of the beam bypass chamber (including a fast valve and a sector valve plus two pumping units). Carbon coating will be applied to reduce the dynamic gas load to the crab cavities vacuum requirements.

After LS2 a new TPSG shield protect (movable device for septum protection) will be installed, therefore all modifications in the area should take this into account. The document will be therefore co-signed by the SPS approval list.

For the installation of the new cryogenic distribution line a series of U-shaped supports are going to be installed in the tunnel vault. In TA6, the removal of the present blue mezzanine structure is required to install a rail for the future cold box.

G. Vandoni recalled the comments received on the document. L. Rossi recommended to have ‘HL-LHC’ in the title of the document, as this test serves as a proof of concept for LHC equipment, even if installed in the SPS. For the same reason, the ECR should be presented both in the IEFC and in the LMC.

A more detailed description of the cryogenic distribution line should be added and a discussion on the necessity of having sectorization valves with RF fingers should be carried out. No blocking comments have been received so far.

The next TCC meeting will take place on the 1st of September.