51st Meeting of the HL-LHC Technical Coordination Committee – 07/06/2018

Participants: A. Apollonio, G. Arduini, C. Arregui, R. Bruce, F. Bertinelli, L. Bottura, O. Brüning (chair), H. Burkhardt, R. De Maria, B. Di Girolamo, P. Fessia, A. Foussat, H. Garcia Gavela, J. Gascon, F. Gerigk, M. Giovannozzi, T. Hakulinen T. Lefevre, M. Martino, F. Menendez Camara, E. Metral, M. Modena, Y. Papaphilippou, D. Perini, L. Rossi, G. Riddone, F. Sanchez Galan, F. Savary, D. Schoerling, J. Serrano, R. Van Weelderen.
Excused: M. Zerlauth.

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

O. Brüning opened the meeting by reviewing the minutes of the last TCC. There were no particular actions. The minutes were approved with the additional comment of F. Sanchez Galan regarding the vacancy of the WP7 deputy position. The agenda of the present meeting was presented.

Production Readiness Review of the TDIS and TANB, D. Perini - slides

D. Perini introduced his presentation by briefly describing the Production Readiness Review (PRR) mandate, documented in EDMS (doc. no 1892005). Its main scope is to assess the production readiness of hardware and the ability to start the production phase, but not to review the technical design of each system. The committee assessed six points, including clarity of work scope and interfaces, readiness and documentation of procedures, specifications and drawings, quality assurance, availability and logistics of components, tooling and production planning. The format of the meeting is simple and takes half a day of presentations covering the previously mentioned points, with preliminary conclusions given during the afternoon and a final report written within 7-10 days.
A list of the past and future reviews in 2018 is presented. Following a question of O. Brüning regarding the timeliness of the by-pass cryostat review, D. Perini answered that although the prototype may come very soon, the timing is adequate.
A description of the TDIS system and purpose is given. The review assessed the previously mentioned points and found the risk analysis, assembly procedure and manufacturing plan well addressed. In the case of schedule and procedures, the committee raised two points, one regarding the space problem for both storage and assembly and another regarding the potential risk of transporting high precision devices due to the distance between assembly area and metrology facilities. The committee also recommended to finalise drawings and documentation before the start of the manufacturing process.
O. Brüning asked about the follow-up of the committee's recommendations and D. Perini answered that to his knowledge, there is progress but the committee is not further involved.
G. Arduini asked about the option of coating of the TDIS, and D. Perini answered that, as mentioned, the committee is not treating technical issues. In principle, the project owner has to follow-up on this. O. Brüning added that the project has to follow-up the recommendation of the committee about the readiness of manufacturing. L. Rossi pointed out that technical issues like coating have to come to the TCC, whereas budget issues are treated by the PSM.
G. Arduini is questioning the readiness of a HW component, if certain technical issues are not

yet resolved. L. Rossi points out that sometimes certain equipment, as for example the 11 T dipoles are already in production phase, but it is still useful to go through this review early enough.
Regarding the TANB, the committee found that the progress was good and the production could start, provided that certain issues are addressed regarding documentation, namely the correction and release of the construction drawings, and the full documentation package, including the documentation folders. Following the comment of G. Arduini that he is surprised to see that the TANB does not cover the post LS3 nominal luminosity of $2x10^{33}$ s^{-1} cm^{-2}, B. Di Girolamo clarified that this point actually refers to the high-luminosity option. O. Brüning suggested to include the luminosity value in the slides for avoiding confusion.
In conclusion, the PRR committee provides a very useful final control, and its light format permits a minimum amount of work for the project engineers. For the TDIS and TANB, the review was positive for starting production, with a few minor points to be finalised.
O. Brüning stressed that the work of this committee highlights that the project is already moving towards construction and production of hardware.

D2 14m long shell manufacturing solution, A. Foussat - slides, EDMS document

A. Foussat recalls the scope of building a new Nb-Ti recombination dipole D2, double aperture magnet in a cold mass with a length of around 13 m. A short model is being built, and will be followed by a prototype. Both tasks are within the collaboration agreement with INFN. The series is of six magnets including two spares.
The first CM version of last year, was composed from two 14 m-long half cells, made of 316LN stainless steel. These half shells were longitudinally MIG welded under press, based on experience from past MB cold mass with limited preload. There are very tight tolerances on concentricity, edge planarity and circumference. Only for the series production, shaping is done using an industrial brake press tool.
The raw stainless-steel plates procurement turned out to be difficult, as from the eight suppliers contacted only one replied, with an offer five times higher than the usual cost, due to the heat treatment to be implemented. Even this company discarded the offer a month later. The same occurred for the procurement of SS316LN 14-m long half shells, with only one company amongst eight replying with an offer but for an extra cost of around 800 kEuros.
In this respect, a decision was taken to study an alternative manufacturing route with butt welding between semi-finished CM cylinders by automatic orbital TIG, with further requirements in the assembly, sequence of manufacturing and qualification.
Anticipating the difficulties with the previous baseline, a test of this orbital welding was done already in November 2017 involving an industrial partner, showing good results. The tooling is compatible and in order to characterize the weld, a qualification test will be done with EN-MME during next month and, in parallel, an investigation with an ISO standard.
The technical development has an extra cost of 455 kEuros (see TCC EDMS form for details), with extra man-power of 1.4 FTE-year. The impact on schedule for this additional operation is 1.5 months per CM. The new CAD model is ready, including the orbital welding. Finally, the next steps are summarized with the final CM prototype expected to be ready by the end of 2019.

Discussion

O. Bruning and L. Rossi questioned if the additional manpower and cost was already included in what was discussed during the last C&S review. A. Foussat replied that these are not yet implemented. P. Fessia suggested to document a cost breakdown affecting the HL-LHC and LMF budget. L. Rossi adds that this should be discussed in the PSM. Triggered by P. Fessia and

L. Bottura, a discussion took place on the geometrical reference of the CM with respect to the cold bore. Although the procedure needs further refinement, F. Savary and A. Foussat replied that the idea is to check the geometry before and after welding, and the final alignment is done with the CB tube. They added that this is a very clean process unlike the longitudinal weld.
O. Brüning asks if for other future HF magnets a different weld is used and A. Foussat answers positively, mentioning some ongoing development on friction steering welding to be used between half cylinders to cover needs of long shells. L. Bottura asked about the tolerance on straightness, and R. De Maria answered that there is margin for the transverse offset. A tilt though introduces a vertical kick and the 1 mrad specification for the triplet is a good baseline assumption for D2 as well. As the main issue is the long half-cell, G. Arduini asked whether it could help to separate the cold mass from the corrector. A. Foussat thinks that this may require extra space of 1 m, and P. Fessia added that this may even be optimistic, so there is indeed impact to the layout. L. Bottura agreed and adds that this may be a completely new design. G. Arduini and L. Rossi suggested that this may be a useful check, but P. Fessia disagreed as there is a lot of impact on the layout, including the location of the CC. R. De Maria explained that when the separation of the two beams is reduced, it becomes difficult to accommodate the stroke of TCLX. In fact, 1 m of D2 length increase corresponds to around 2 mm loss of separation and presently there is zero margin. L. Rossi stressed that this means that the separation is increased in expense of the field. G. Arduini pointed out that the change in magnetic field is in the 1 % level. R. De Maria added that this helps to reduce energy deposition, as well.

AOB: ECR for 11T introduction during LS2, D. Schoerling- slides

D. Schoerling presents the list of people who checked the ECR. L. Rossi stressed that the comments should be given quite soon and D. Schoerling asked to have them by the end of the week.
An introduction is given for the purpose of the ECR, namely the replacement of two standard LHC MBs with an assembly consisting out of a pair of 5.5 m-long 11 T dipoles to make room for a central bypass cryostat hosting the TCLD collimator. The integration study has been done. All issues were solved during the edition of the document. The open points are treated in the interface meeting. Regarding beam dynamics, the exact position has to be agreed and MAD-X files updated. There is no major impact for vacuum and corresponding tables have been updated, including the cryogenics modifications and the number of valves to be installed. To the comment of L. Rossi that the consideration of five DN200 insulation vacuum release valves with certain requirements for their distance and the hydraulic sector length has to be carefully reviewed, P. Fessia answered that this is indeed an open point for integration.
The geometry and alignment are very similar to what is done for the MBs. The circuits are detailed. Following a question of L. Rossi on the inclusion of the quench detection modification, D. Schoerling answered positively. L. Rossi further asked for the impact of the stray field on vacuum equipment, and D. Schoerling answered that he will check with vacuum colleagues. Regarding protection, there are no open points, only some minor clarifications. The cabling is detailed and the drawings of LHC updated. The impact on cost is described with the associated budget codes of WP11. Regarding the installation schedule, it is on the critical path for LS2. For the impact on performance, there is some feedback missing on impedance but there is no major issue. G. Iadarola checked that there is no issue for e-cloud. Regarding machine protection, the flux jumps are under investigation but no particular issue is expected. On safety aspects, T. Otto commented to include some text on the hazards of the TCLD for cryogenics. P. Fessia and L. Rossi pointed out that there will be another ECR for the TCLD

where these comments can be included. O. Brüning added that another safety document is under preparation and the corresponding ECR will be presented in the TCC.
Regarding worksite safety, S. Le Naour will have to trigger the "Visite d'Inspection Commune" (VIC) and create the IMPACT. M. Martino commented that looking through the distribution list he did not find anyone from TE-EPC. D. Schoerling will add him and the WP leader. L. Bottura commented regarding the electrical discontinuity that it is not only essential to be monitored locally but also for the rest of the arc. D. Schoerling answered that this is being studied by the quench protection WP. Regarding the timeline for approval, he confirmed that the document will be sent at the beginning of the following week. P. Fessia asked that the VSC colleagues read and approve the document. L. Rossi would like to stress that this is one of the most important equipment of HL-LHC to be installed during LS2 and he would like to congratulate WP11 and the people involved.

AOB: ECR LHC safety system modifications Due To HL-LHC during LS2 – T. Hakulinen – slides , link to ECR

T. Hakulinen presented the ECR for the safety system modifications for HL-LHC, including access system, doors, fire detection, etc. O. Brüning asked if the red telephones are part of this. T. Hakulinen answered positively and that they are indeed installed in radiation sensitive areas. Regarding the access system, there are four new sectors, where new extra instrumentation has to be installed, doors, patrol boxes, etc. Four new racks are also installed at the top of the pits of SD1 and SD5. New doors and shielding will be installed by WP17, including over-pressure and fire-resistant ones. Mobile shielding will be installed at the top of UA, and the timeline of the installation needs to be checked with CE.
Regarding ODH, there are several detectors and flash signals installed. Regarding fire detection, the confirmation from RP is needed that the radiation levels at the UPRs are compatible with the position of sampling units, for cost optimisation. Two sirens and two buttons are placed for evacuation, and the positions will be decided with the help of the DSO. Two red telephones are foreseen, one at the bottom and one at the top in UPR.
Some of the equipment will be connected to the existing CERN safety alarm monitoring and it is not foreseen to extend the service. The radiation monitoring is further detailed with one monitor and flash signals. Emergency lighting and AUG is to be installed in the UPRs.
Regarding firefighting equipment, a tractor and fire intervention trailer is foreseen but it will not to be installed until LS3. Further details are given for the CV equipment, networking. The estimated cost for HL-LHC totals approximately 800 kCHF. O. Brüning is surprised by the high cost. He reminds that the ECR should be finished as soon as possible. T. Hakulinen will check the distribution list.

AOB

O. Brüning reviews the agenda of the next meeting. G. Arduini mentions that the presentation for the new optics version will be moved for after the summer, as it is important to synchronise this work with integration.

The next TCC meeting will take place on the 21st of June 2018.