



# 1<sup>st</sup> Meeting of the HL-LHC Technical Coordination Committee

---

**Participants:** C.Adorisio, A.Apollonio, G.Arduini, C.Arregui, V.Baglin, M.Bajko, A.Ballarino, M.Barberan, I.Bejar Alonso, C.Bracco, R.Bruce, M.Brugger, O.Bruning (Chair), H.Burkhardt, J.-P.Burnet, R.Calaga, O.Capatina, E.Cennini, F.Cerutti, S.Chemli, P.Chiggiato, S.Claudet, D.Delikaris, B.Delille, S.Fartoukh, P.Fessia, S.Gilardoni, B.Di Girolamo, R.Jones, J.Jowett, I.Laugier, T.Otto, Y.Papaphilippou, M.Pojer, H.Prin, S.Redaeli, F.Rodriguez Mateos, S.Roesler, A.Rossi, L.Rossi, F.Sanchez Galan, F.Savary, A.Siemko, L.Tavian, J.Ph.Tock, E.Todesco, R.Van Weelderen, D.Wollmann, A. Yamamoto, M.Zerlauth.

**Excused:**

The slides of all presentations can be found on the [website](#) and [Indico](#) pages of the TCC.

O.Brüning opened the meeting highlighting the main actions, as reported in the minutes of the 32<sup>nd</sup> TC. There was an action for H.Burkhardt to follow up the requirements for the background in the experiments. Another action involved the need for a-C coating also in the matching section (D2-Q6). A third action concerns WP2 for confirming that no displacement of Q6 is needed for the HL-LHC optics variants. G.Arduini mentioned that from some preliminary studies, it seems that the displacement is not necessary. Regarding the TAS integration, an update of the two options should be presented in a future TCC. Regarding the AOB, on the cooling of Q5 in P6, P.Fessia said that there is a first discussion with H.Prin and S.Claudet for reaching a conclusion.

O.Brüning proceeded by introducing today's agenda and AOBs.

## **Presentation of TCC: mandate and composition, O.Brüning-slides**

O.Brüning presents the mandate of the TCC. After the publication of the HL-LHC design report, the PLC meetings became less frequent and it was apparent that the two meetings (PLC and TC) should be merged in one. The new Technical Coordination Committee (TCC) will be bi-weekly and aims for a biannual review of the general HL-LHC parameters and layout. O.Brüning presents the approved mandate and the TCC composition, and the list of persons receiving the invitations for information. Any feedback for finalizing the composition and corresponding mailing lists should be given before the end of Chamonix 2016 (28th of January).

**Action: All WP leaders and group leaders should provide feedback for the membership of**

**the TCC, before the end of January 2016.**

## Updated HL-LHC Baseline, L.Rossi

L.Rossi recalled that the HL-LHC budget is approved and reflects the baseline, as presented during the C&S review of last March. The TDR\_v0, which was submitted as a deliverable for the EU Hilumi project, already contains baseline variations with respect to the PDR, for example, the drop of SC links in P7. However, other important changes, not included in the TDR\_v0 are under investigation. Some examples are the powering of D1 and D2 that could become one circuit (the baseline configuration foresees individual powering) or the temperature of Q6 (1.9 or 4.5K), for which a decision should be taken in the next weeks. All potential baseline changes should be consolidated and presented, in view of converging with a coherent picture for the C&S review of October 2016. I.Bejar Alonso will identify during this month with the help of the corresponding WPs, which are the hot points to review. Some changes (e.g. BBLR compensation which is currently not in the baseline) may have important cost and integration implications.

L.Rossi finally takes this opportunity to make some important announcements. The new structure of the project will be presented in quite soon in a future TCC, in particular some changes in the WP organization and leadership. O.Brüning will also present a summary of recent changes of HL-LHC hardware baseline (schedule for the next TCC of the 11<sup>th</sup> of February). The dates of three important meetings have been fixed: the US-LARP meeting at SLAC (18-20 May 2016, a week right after IPAC2016), the HL-LHC annual meeting at CEA, Paris (13-18 of November 2016) and the Cost and Schedule review at CERN (17-19 of October 2016).

## Project Breakdown Structure, I.Bejar Alonso – [slides](#)

I.Bejar Alonso introduces the project baseline, composed by the scope (Project Breakdown Structure - PBS), schedule (MS planning) and cost (Medium Term Plan - MTP) baselines. The present HL-LHC PBS v0 was prepared for the Cost & Schedule (C&S) review of last March. A new version will be prepared and issued for the next C&S review of October 2016. To keep track on eventual baseline changes, different versions will be issued every 6 months.

A master schedule and cost planning was prepared for the previous C&S review, representing as much as possible the PBS to allow the implementation of Earned Value Management (EVM). Before the next C&S review, new versions will be issued, including a detailed costing and scheduling for WP17 (it was initially just a line with a provision). The baselines will be changed periodically following an HL-LHC Engineering Change Request (ECR) approved by the TCC.

For allowing traceability, the changes are categorized as: i) not affecting the configuration baseline, ii) affecting the baseline and iii) affecting the present LHC. The first ones do not imply any real change on budget and schedule, but it is important to trace decisions through the Template for decisions reporting. These changes are internally discussed in the WPs and brought to the TCC for final validation. The changes that affect the baseline have to be

discussed in the TCC, where decisions and actions appear in the minutes. The HL-LHC ECR will be used from now on to collect all the relevant information and to track the actions until they are achieved. Regarding the changes that affect the present LHC, the usual LHC ECR template is used and they should be approved by the LMC. In some cases, both ECRs (LHC and HL-LHC) should be issued. A “Strengths, Weaknesses, Opportunities and Threats” (SWOT) analysis document is also issued for putting the pros and cons together and evaluating the “objectivity of the decision”.

The procedures depend on the type of change: when a change is internal to the WP and not affecting the baseline, the WP leader fills the Template for Decisions report that contains the analysis and the reason of the desired decision and sends the report to the TCC secretariat that adds it to the AOBs of the next TCC, where it receives the final approval. When a change affects several WPs or the baseline, the requester WP leader informs the project office (PO, <mailto:HI-LUMI-LHC-PO@cern.ch>) that evaluates the request, provides the required support documents and fixes with the TCC chairman the date for the discussion. When a change affects the LHC machine, an ECR is submitted using the normal LHC ECR circuit. All decision documents and ECRs are stored in EDMS.

I.Bejar Alonso stresses that the evolution of a concept towards a specification (technical or functional) is not considered a change, and can be also covered by a new version of the conceptual specification (e.g. moving from version 1.0 to 1.1). When there is a change in the baseline, the HL-LHC ECR will complement the Conceptual or Technical Specification until a new version is issued (for example moving from version 1.1 to 2.0). Changes in the schedule that do not affect the critical path do not need an HL-LHC ECR or a decision report. When the change is motivated by a delay, the PO together with the WP leader analyzes it and may prepare a decision report. Changes to the budget are traced by memos issued by the Project Budget Officer (B.Delille). The re-baselining is used to consolidate the changes in the different documents. L.Rossi asks if the D1 and D2 powering is a functional specification change. I.Bejar Alonso replies negatively, this is a real baseline change and necessitates an HL-LHC ECR.

E.Todesco points out that during the preparation of C&S reviews, there are changes in budget estimates and asks for which case a memo should be prepared. I.Bejar Alonso explains that this will be the responsibility of B.Delille and L.Rossi and it will be refined in practice. O.Brüning mentions that the update of the MTP in March gives the scale for which type of changes should be reflected in memos.

I.Bejar Alonso finishes her presentation providing some details on the cost and schedule re-baselining exercise, which will allow a correct MTP and the implementation of EVM during the summer. Its scope includes a revision of the conceptual specifications and the timing for functional and technical specifications for several components. During the C&S preparation exercise, a list of HL-LHC ECRs and decision reports will be prepared with the WP leaders to consolidate implemented changes as described in the TDR but not yet documented (e.g. change of Q4, number of crab cavities installed during LS3, number of 11T and installation staging). WP leaders will be contacted by the PO over the coming weeks, with the goal of getting a first iteration on the budget planning by March, in time for the MTP revision.

## Discussion

S.Chemli points out that the logic is completely in line with what is going on with current machines. In addition, whenever an ECR is issued for a current machine affecting the HL-LHC project, the corresponding WP and the PO will be put in the loop. E.Todesco asks if for the triplet circuit, an HL-LHC ECR should be issued. I.Bejar Alonso answers positively. S.Redelli also asks about the necessity to issue an ECR for the removal of the 11T dipoles for ion collimation. L.Rossi answers that the new baseline assumes, a collimator in the dispersion suppressor, for which an HL-LHC ECR should be issued.

## Executive summary of the workshop/review of the CC cryo-modules, A.Yamamoto – [slides](#)

A.Yamamoto reports the outcome of the review committee for the CC cryo-modules, chaired by him between the 11-15 November 2015. He first describes the boundary conditions and the charge to the reviewers, focusing on SPS cryo-modules components design, physical and functional interfaces and prototypes. This included six specific points, namely whether the design is detailed enough meeting all the functional requirements, covering all important issues and ready for manufacturing, or there are areas where extra design effort is needed. The review had to assess also if there are risks associated with the design that could or must be removed or mitigated. Finally, the review was asked to judge if the proposed schedule related to SPS tests is realistic but also whether the general plans and criteria for cryomodule development past the SPS application and into the HL-LHC period (post-2024) are correctly defined.

Several presentations were given during the review and, during the 2nd day, R.Calaga and O.Capatina provided two additional presentations on the request of the reviewers. The executive summary of the reviewers was particularly positive for the level of the presentations and all the documents provided. The crab cavity (CC) and cryomodule (CCCM) team activities for the engineering design work and for the SPS test preparation are impressive. The review found that the engineering design presented is sound and the current design concept should be kept, in particular the idea to accommodate two complementary CC designs of Double Quarter Wave (DQW) and RF Dipole (RFD) into those CCCMs, so as to provide common interfaces to RF power and cryogenic system layout in the accelerator tunnel.

The main concern of the committee is regarding the general plan/schedule, which is very challenging to realize the SPS beam test within the LHC Run-2 period before the end of 2018. In particular, the installation of a new dedicated cryogenic system for the SPS test planned in the technical stop of 2017-18 will be the most critical issue, and this has to be managed well. The review committee recommends that the basic CCCM design is kept as achieved and a preparation plan should be established to be robust enough to ensure that the SPS tests are successful, including backup plans defining the minimum goals to be achieved for declaring success.

A point-by-point answer to the specific charges of the committee is further given. The committee suggests that the CC design team clarifies “the minimum functional requirement/goal” for the SPS CC test to be prepared in case of difficulties. A decision on the implantation/location of the refrigerator cold box (at ground level or in tunnel) needs to be urgently taken. The critical components such as FPCs and tuners shall be individually reviewed in timely manner. O.Brüning asks about the progress on the refrigerator cold box integration for the SPS tests. S.Claudet answers that there is quite some progress on the issue, although a decision was not yet taken. There is a clear preference for including it in the tunnel. Meanwhile, the procurement of the refrigerator was launched with Finance (Departmental request, agreement for MS and IT to come) and should be delivered in 2017. To avoid risks a standard “out of the shelf” refrigerator will be procured. The schedule is tight but the approach and the decisions taken aim at complying with this schedule.

Coming back to the review comments, A. Yamamoto points out that the CC system integration workflow, including efficient tooling, fixtures, and intermediate tests must be studied in greater detail, especially in respect of contamination (dust) prevention, in particular for accessing the coupler. A cryogenic-safety and the extreme failure-mode analyses should be performed, considering the specific SPS test environment to be well prepared. The committee further advises the design team to consider reinforcing the stiffness of the supporting system while, at the same time, limiting forces on the FPCs. O.Brüning asks whether there was any discussion for the screwed or welded helium vessels, which came up as a concern during the last LARP meeting. O.Capatina answers that there was a dedicated review and all steps were analyzed showing that there is no issue. A.Yamamoto adds that the reviewers did not go into these details, as they trust the thoroughness of the design team on that matter. He proceeded, stressing the committee’s recommendation to take a fast action for ordering the cryogenic refrigerator (already considered as S.Claudet pointed out), as well as tracking closely the milestones of the project schedule and working out mitigation paths in case of delays. Finally the review asked the design team to provide clear documents for the general plan, at least for the goal of the CC-CM test at SPS with various scenarios including the minimum requirement to be achieved. They appreciated a lot the immediate reaction of R.Calaga providing a detailed list with a minimum test program. A.Yamamoto finishes his presentation with a summary of the main review recommendations.

## Discussion

L.Rossi asks a question related to the recommendation for establishing a minimum SPS test scenario. He thinks that once you have installed such a device in the SPS, one should exploit as much as possible the opportunity for doing any kind of test. On the other hand, one should come up with beam tests in unfortunate scenarios, such as, for example, if one cavity is not properly working. O.Brüning interprets that the recommendation of the review suggests a prioritization of some key tests, as this is the unique chance the project would have before LS2, where the series production of the CCs should take place. G.Arduini and R.Calaga mention that some tests are necessary for validation of the CC technology and operation with beam and other are less important but still good to have, for gaining experience. A.Yamamoto points out that during the review this was not clear. R.Calaga adds

that a half-day meeting was organized with ABP, BI, OP, RF and others exactly for discussing on the CC SPS test program. A summary will be prepared including a subset of minimum goals. A.Yamamoto finally points out that the 10-page [review report](#) attached in the indico page includes much more detail, regarding the different findings and recommendations.

## **AOB**

O.Brüning announces that the next TCC meeting will take place on the 11<sup>th</sup> of February. G.Arduini mentions that it will collide with the consolidation day but also with the HR public meeting. O.Brüning regrets that this is the case, but tends to believe that the date should be kept, as the previous and subsequent Thursdays are equally busy. L.Rossi asks if the meeting scheduling appears in the HL-LHC agenda. O.Brüning answers that this was indeed done by C.Noels.

The next TCC meeting will take place on the 11<sup>th</sup> of February.