

2nd CERN MAC Cost Review Report on the LIU and HI-LUMI Upgrade for the LHC

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Introduction and General Description

The review began with a plenary session providing an overview of CERN activities and plans, a presentation of the LIU and HL-LHC project as well as a general overview of the CERN planning and budgeting process. After breaking up into five subgroups for the next day and a half the review finished with a close-out presentation on the afternoon of Wednesday, October 19, 2016. The detailed program can be found in: Appendix 2: Agenda.

The goal for this review was to assess the development of the baseline since the first Cost Review, which was performed in March 2015. Subject of the review were again the LHC Injectors Upgrade (LIU) and the High Luminosity LHC upgrade (HL-LHC). Previous as well as updated documentation was provided to the review in advance of the meeting, which was very helpful to the committee. The presentation and the documentation can be found at: <https://indico.cern.ch/event/542864/>. Neither the ongoing consolidation project (CONS), nor the upgrade of the detectors for LHC were part of the scope of the review, which is consistent with the previous review.

The Charge

The charge was given to the review team by Frederick Bordry, Director Accelerators at CERN. The following items were addressed:

1. Is the projects' status and progress, in particular the identification of critical pieces of hardware, on schedule and within cost as foreseen?
2. Are the baseline changes since the previous C&S review and the reasons for these changes, as well as their impact on scope, schedule and cost, commensurate with the project proposal from 2015?
3. Are the change-management methods and their implementation since the previous C&S review (i.e. tracing and validation of these changes) appropriate for managing this project?
4. Is the level of risk appropriately addressed and does the global evolution of the cost and schedule of both projects still stay within the original intent of the project?

The review team was requested to give an oral presentation of the findings, comments and recommendations by the end of the third day. The chair of CMAC was invited to the SPC to present its preliminary findings. A final report will be prepared within the following four weeks.

Executive Summary

The review committee again is very impressed with the enormous amount of work that was presented. Both, the LIU team and HL-LHC team continue to perform at a very high level and an enormous amount of work has been accomplished since the last review. Both teams addressed the recommendations from the last review as well and dealt with new challenges which developed over the last eighteen months.

After the 2015 Cost & Schedule review, the schedule for the Long Shutdown 2 and 3 were affected. LS 2 was delayed by 6 month and extended by 6 month. LS 3 was delayed by one year while maintaining the duration.

The management team of HL-LHC has been increased and strengthened while focusing on the major issues the project had to deal with since the last review. Most prominently detailing the layout of the civil construction identified schedule and cost increases which the HL-LHC team effectively dealt with. This work package has made significant progress and the maturity of the design is at a comparable level. Cost increases were addressed by re-baselining the other work packages which maintained the Total Project Cost (TPC).

During a detailed discussion on the global schedule, it became clear that the LS2/LS3 shifts allowed accommodating some of the delays that started to appear in the other work packages of LIU and HL-LHC. Nevertheless, it became also clear that further delays will negatively impact e.g. maintenance schedules for cryo-plants, detector upgrade schedules, increase standing army costs etc, and therefore would have to be carefully assessed before implemented.

For Civil Engineering scope of work, which now has to be executed quite a bit earlier, namely almost completely during LS 2, timely preparation and execution of the tender for Infrastructure contracts demand highest priority and regular oversight of the LIU/HL-LHC Executive Committee.

Throughout the review it became clear, that manpower has to be added to both projects in order to allow them to stay on schedule. In many cases the expertise required does/will not exist (anymore) at CERN and must be recruited as soon as possible, be trained and brought into the projects. For the LIU project an assessment was performed and a request submitted that the review team agrees with. Cost management includes the recommendation to find efficiencies elsewhere in the project to support this request.

Acknowledgement

The members of the MAC are indebted to the CERN management, the LIU and HL-LHC team for following up thoroughly on our last report. We want to thank especially Frederick Bordry for his hospitality and Evelyn Delucinge, Malika Meddahi, Benoit Delille, Lucio Rossi and Frank Zimmermann for their support and excellent preparation.