

HL-LHC/LIU Cost and Schedule Review – November 2019

1 INTRODUCTION

At the request of the Management of CERN, three extensive Cost and Schedule Reviews of both the LIU and HL-LHC projects were carried out in [March 2015](#), [October 2016](#) and [March 2018](#).

The latest International Review was conducted by the CERN Machine Advisory Committee members (CMAC)¹, helped by reviewers² called to cover some specific items of the review.

The baseline of both projects, which includes the scope description, the schedule and the cost, was assessed. The assessment was considering the technical developments that were still ongoing, including how risks and uncertainties are managed. The final report and recommendations provided by the review committee in March 2018 are annexed to this document.

With the LIU project having entered its deployment stage during the ongoing Long Shutdown 2 and the HL-LHC project approaching the series production of many critical deliverables, the management of CERN is now calling a fourth Cost & Schedule review of the LIU and HL-LHC projects. This review will be organized at CERN between the 11 and 13 of November 2019.

2 CHARGE OF THE REVIEW

The scope, schedule and cost of both projects and their evolution since the Cost & Schedule review of March 2018 will be assessed by the review committee. In particular, the charge to the review team will focus on the following topics:

1. Project technical status and progress
 - a. Has the project identified the critical pieces of hardware and their schedule and/or cost challenges?
 - b. Is the progress in each WP consistent with readiness for LS3 starting in January 2024?
 - c. Are the remaining beam performance risks for protons and HL-LHC ion operation in Run3 identified and is the currently envisaged hardware and beam commissioning strategy sound?
2. Project Steering and organization
 - a. Are the changes since the previous C&S clearly identified and the reasons are documented?
 - b. Has the impact on scope, schedule and cost been understood and integrated in the project plan?
3. Cost Optimization:
 - a. Is the overall project cost managed effectively and the impact consistent with the overall project goals?
 - b. Is the risk/cost/scope managed effectively and potential further descoping along with the related impact identified?
4. Is the presented strategy managing schedule and resources for critical items effectively?

¹ CMAC members: M. Bai (GSI, Helmholtzzentrum für Schwerionenforschung); S. Gourlay (LBNL, Lawrence Berkeley National Laboratory); N. Holtkamp (Chair of the review, SLAC National Accelerator Laboratory); T. Koseki (KEK, High Energy Accelerator Research Organization in Japan); M. Seidel (PSI, Paul Scherrer Institute); P. Vedrine (CEA-Saclay, Commissariat à l'énergie atomique et aux énergies alternatives); Q. Qing (IHEP, Institute of High Energy Physics)

² Additional review committee members were: W. Fischer (BNL, Brookhaven National Laboratory); C. Neumeyer (PPPL, Princeton Plasma Physics Lab); M. Pedrozzi (PSI, Paul Scherrer Institute); T. Watson (ITER, International Thermonuclear Experimental Reactor); A. Yamamoto (KEK, High Energy Accelerator Research Organization in Japan).

Complementary to the charge defined in this section, the fourth C&S review will aim at assessing the readiness and implied risks of starting the industrialization process for critical deliverables of the HL-LHC project.

3 SESSIONS

The C&S review of November 2019 is organized over three days through plenary and parallel sessions. The following preliminary agenda is proposed ([Indico agenda](#)):

Day 1 Morning	Plenary Session addressing the status of both projects and providing an overview of the HL-LHC and LIU projects and their current challenges.
Day 1 Afternoon	Plenary Session: HL-LHC and LIU cost, schedule and EVM
Day 2 Morning	Parallel Sessions addressing baseline changes and their impact on cost and schedule of both projects sub-systems: Session 1: LIU project Session 2: HL-LHC – Magnets, powering and cryogenic systems Session 3: HL-LHC – Superconducting RF and other accelerator systems Session 4: HL-LHC – Technical Infrastructure, integration and (de)installation
Day 2 Afternoon	Parallel Sessions – continued Session 1: LIU project Session 2: HL-LHC – Magnets, powering and cryogenic systems Session 3: HL-LHC – Superconducting RF and other accelerator systems Session 4: HL-LHC technical infrastructure, integration and (de)installation
Day 3 Morning	Parallel Sessions – continued Additional presentations/clarifications requested by reviewers Close-out preparation
Day 3 Afternoon	Close-out preparation / Close-out

4 REVIEW COMMITTEE

The review will be conducted by the CERN Machine Advisory Committee members and additional experts. The composition of the committee and the distribution across the parallel sessions is proposed to be the following:

Session 1: LIU Project CERN lead: M. Meddahi	W. Fischer (BNL, Brookhaven National Laboratory) M. Bai (GSI, Helmholtzzentrum für Schwerionenforschung) M. Pedrozzi (PSI, Paul Scherrer Institute)
Session 2: HL-LHC – Insertion Region Magnets and Powering System CERN lead: J. M. Jimenez	S. Gourlay (LBNL, Lawrence Berkeley National Laboratory) T. Koseki (KEK, High Energy Accelerator Research Organization, Japan) P. Vedrine (CEA-Saclay, Commissariat à l'énergie atomique et aux énergies alternatives)
Session 3: HL-LHC – Accelerator systems 1 & 2 CERN lead: P. Collier	A. Yamamoto (KEK, High Energy Accelerator Research Organization in Japan) S. Nagaitsev (FNAL, Fermi National Accelerator Laboratory, USA) S. Bousson (CNRS/IN2P3, Institut national de physique nucléaire et de physique des particules, France)
Session 4: HL-LHC technical infrastructure and Integration, (De)Installation CERN lead: R. Losito	N. Holtkamp (SLAC National Accelerator Laboratory) T. Watson (ITER, International Thermonuclear Experimental Reactor) M. Seidel (PSI, Paul Scherrer Institute) Q. Qin (IHEP, Institute of High Energy Physics)