Panel Outbrief

NSF Review of CMS High Luminosity Upgrade Construction Progress

August 25, 2021

1a - Review FDR panel recommendations and comment to NSF on whether they have been satisfactorily addressed

Although most of the recommendations have been carried out, some were delayed. The delays in large part can be attributed to the COVID situation.

High level compliance matrices have been developed and used. The project is in the process of developing the detailed verification plans and compliance expectations linked to individual requirements (as in customary verification matrices).

TFPX recommendation #5 (separate risks for planar and 3D sensor quality) was not completed, with the result that the current risk impact may be over- or under-estimated. The project plans to separate this risk (RT-402-7-15-N) at the next meeting of the Risk Management Board not long before the planned downselect decision on the inner-ring sensor this November,

1b - Have pre-construction technical activities that were separately funded by NSF through the CMS operations program been satisfactorily completed?

Most of the pre-construction activities are completed by 2020. There are two remaining (nearly complete) R&D milestones in TFPX.

2a - Implementation of the Project Execution Plan, project controls and financial reporting, including sub-awardee oversight. Examine the current version of the Project Execution Plan, representative change control actions, and recent Earned Value Management Reports and advise NSF on their use as effective management tools.

The panel found that all CMS management plans were well-prepared and incorporated best practices. In addition, the panel found a strong correlation between these plans and schedules and the effective execution and management of the project at this point in time.

Cost, schedule and risk status are well-integrated with technical progress in the EVM system, thus enhancing confidence in objective performance status and projections of future performance.

EVM data have also been analyzed for each institute, leading to improved accuracy in cost accruals by sub-awardees.

2b - Financial tracking of COVID and non-COVID costs & cumulative COVID costs-to-date

CMS properly accounts for and clearly identifies all COVID related as well as non-COVID related costs.

2c - Risk management process, including completeness of current projections of risk and potential mitigation costs and the adequacy of the contingency budget and schedule to mitigate future non-COVID risks. Advise NSF on the completeness of the risk register in identifying currently foreseen non-COVID related threats and opportunities with appropriate probabilities and estimated cost and schedule

The Risk Register appears complete and well maintained. The identified risks and their proposed mitigations are appropriate.

The panel recommends that prior to the rebaseline review, the project should develop a COVID Risk Register.

2d - Adherence to the QA/QC processes presented at FDR. Advise NSF on whether it is being implemented as intended

Yes.
QA/QC processes are in development as expected for a project in pre-production phase. Early production components have well advanced specifications / QC test plans. QA/QC tasks, tests, and specifications will be finalized by the iCMS EDR.

3a - Examine and comment to NSF on COVID impact modelling and assessment by the project of forecast COVID-related cost and schedule impacts. Advise NSF on the realism of assumptions and the credibility of the models used, and the completeness (based on current understanding) of additional schedule and budget needs. Advise NSF on the timing for when additional NSF funds to offset pandemic impacts are likely to be needed within the project

CMS utilizes best in class modelling tools for the assessment of the potential cost and schedule effects of both COVID related and non-COVID related effort. Its modelling assumptions are reasonable, credible and thorough. In addition, its model appears to be forward compatible to adapt to potential future impacts such as those related its supply base and the non-linear evolution of COVID.

The project has done a very detailed and well thought out analysis of the Covid impact and its implications for the future. The panel agrees with the project's contention that they would be ready to rebaseline as early as Spring 2022, with stated prerequisites.

3b - Examine and comment to NSF on the realism of plans for the coming project year (10/1/21 – 9/30/22) based on current understanding of COVID pandemic impacts and mitigation strategies, and lessons learned from the first year of construction

The project plans for FY2022 are as well formulated and realistic as possible at this time given the uncertainties in the evolution of COVID and awaiting a decision by CERN on the LS3 schedule.

3c - Examine the forecast risk-adjusted expenditure and obligation profile (including pandemic-related risks) for the coming fiscal year and advise NSF on the adequacy of its substantiation. Make recommendations for modification, if appropriate.

The CMS expenditure and obligation plan is well-developed and substantiated to support the execution of the project plan within cost and on-schedule through the end of GFY22. In addition, the Covid costs incurred to date and expected to be incurred through the period have been adequately estimated and provided for in the plan.

3d - Do the materials presented by the project provide adequate substantiation for re-baselining within the next 6-12 months? If not, what criteria must be satisfied as a precondition for conducting a re-baselining review that would confidently bound estimates for additional schedule and budget based on current understanding?

Yes. The proposal to be ready for re-baselining as early as in Spring 2022 is realistic and well supported. As prerequisites, the panel recommends that CMS wait until (i) CERN decides on the schedule for long shutdown 3 and (ii) the risks of COVID uncertainties are understood better before conducting a rebaseline of the project. If these prerequisites cannot be fulfilled in 2022, it is not clear to the panel that there will be a negative affect to the execution of the project plan in GFY24.

4a - Comment on the adequacy of progress and planning across all Level 3 Work Breakdown Structure (WBS) elements, considering COVID-19 uncertainties. Identify non-COVID-related impediments to technical progress and comment on the adequacy of plans and efforts exerted by CMS to mitigate their impacts.

Trigger is making good progress following the project plan even under the difficult circumstances imposed by COVID.

Before the summer '22 Technical Review, TFPX should consider more aggressive schedule optimization and descope options to allow more schedule margin.

BCAL has made excellent technical progress across all WBS elements with good cost and schedule performance. The highest technical risk for BCAL is the availability and performance of the lpGBT. The lpGBTv1 is due Oct 2021 and is expected to address the out-of-spec jitter performance. A mitigation strategy to order the production quantities of the FPGAs in early 2022 should be strongly considered.

4b - Based on progress to date and current understanding of CERN's schedule for completion of custom ASIC design/testing, advise NSF on the best time to conduct an independent technical review of TFPX. (The FDR panel recommended that this should occur approximately 6-9 months after the start of the MREFC project to examine the status of the project before the iCMS TFPX EDR. The outcome of this review would be to assess whether changes to the NSF baseline scope are warranted in view of unanticipated delays or problems encountered in completing R&D and early MREFC activities, and to examine any impacts from changes to the overall HL-LHC schedule.)

The committee agrees that next summer is the right time for this comprehensive review, while recognizing the interrelationship between the timing of this review, the CERN master schedule decision, and the NSF rebaselining.