

**Charge**  
**Director's Independent Design and CD-2/3 Review**  
**of the**  
**LHC Compact Muon Solenoid (CMS) Detector Upgrade Project**  
**May 28 - 30, 2014**

The Committee is to conduct a Director's Independent Design and CD-2/3 Review of the LHC Compact Muon Solenoid (CMS) Detector Upgrade Project to assess if the Project meets the Critical Decision (CD) 2/3 (CD-2, Approval of Performance Baseline and CD-3, Approval to Start Construction) requirements as specified in DOE O 413.3B. The LHC CMS Detector Upgrade Project received CD-1 approval on October 17, 2013. The Project is scheduled for a DOE CD-2/3 Review on August 5-7, 2014.

The LHC CMS Detector Upgrade Project includes the design and construction of upgrades to the Hadron Calorimeter, the Silicon Pixel detector, and the Level 1 Trigger subsystems of the CMS detector at CERN. The LHC, running at 8 TeV center of mass energy, has nearly reached its design luminosity. It is expected that with planned upgrades, it will exceed the original design by a factor of at least two. CMS was not designed to run efficiently at the luminosity now projected for the next several years. With these upgrades, the detailed study of the properties of the new boson and the search for new physics that should be associated with it can take full advantage of the excellent performance of the LHC and resolve many of the open questions in electroweak physics.

The review committee will assess the level of maturity of the Project's design. To meet the requirements for CD-2 the design has to be at the preliminary level or greater, and for CD-3 the design has to be at the level of final or near final design. The committee will make their assessment based on the LHC CMS Detector Upgrade Project's Technical Design Report (TDR), drawings, specifications, and discussions with the Project team.

In addition, the review committee will focus on the Project's CD-2/3 readiness including assessing the technical scope as well as the cost, schedule and management areas. The technical scope of this review will include an assessment of the status of the CMS Detector Upgrade final design work. The committee will evaluate the current schedule, taking risks into consideration, and determine if the Project's scope of work can be accomplished within the approved Total Project Cost (TPC) by the CD-4 date. The committee is to assess if the Project team is in place to implement full construction while providing monthly statusing progress reports to DOE and Lab Management on cost/schedule against the Project Plan. The committee will also assess and confirm that ESH&Q has been adequately addressed.

A DOE CD-1 Review of the LHC CMS Detector Upgrade Project was conducted on August 26-29, 2013, which resulted in CD-1 Approval. In addition, an Independent Conceptual Design Review was conducted on May 14-16, 2013, which found the designs were well advanced and provided a good basis for establishing the cost and schedule range. A Director's Cost and Schedule Assessment was performed on May 15-16, 2013, which focused on the state of the Project's cost estimate, schedule, and risk development as they prepared for a CD-1 review. The Independent Conceptual Design Review and the Cost and Schedule Assessment resulted in several recommendations. The Committee will assess the Project's progress on addressing the recommendations from these prior reviews and assessments.

The review committee is asked to address the following questions to assess the Project's progress:

1. Is the Project's design appropriately developed and well documented in their Technical Design Report (TDR)? Does the design satisfy the Project's performance requirements to

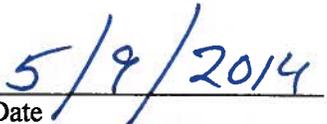
carry out the scientific mission? Is the final design sufficiently mature so that the Project can start construction? For those elements of the design that are not finalized, has the Project shown there are no major issues that need to be addressed and that they are on a clear path to a final design?

2. Has the Project developed a resource loaded schedule that includes the Project's scope of work and is achievable?
3. Does the Project have credible cost and schedule estimates? Do they include adequate scope, cost and schedule contingency?
4. Has the Project documented the Basis of Estimate (BOE) that supports the baseline cost and schedule presented?
5. Is the scope of work clearly defined between what is funded by DOE or NSF, and is this reflected in the cost, schedule and risk assessment presented to the committee?
6. Has the Project implemented risk management by identifying risks, performing a risk assessment (qualitative and quantitative) and developing mitigation plans?
7. Is CD-4 achievable with the Project's risks and within the DOE approved Total Project Cost?
8. Has the Project updated required project management documents per DOE Order 413.3B for CD-2/CD-3 and per the Fermilab Project Management System?
9. Are the Project organization and staffing levels adequate to manage the work to get to CD-4?
10. Are the ESH&Q aspects being properly addressed?
11. Does the Project's process for monthly statusing and reporting satisfy DOE and Laboratory requirements?
12. Has the Project addressed the recommendations from the DOE CD-1 Review, the Director's CD-1 Review, the Independent Conceptual Design Review and the Director's Cost and the Schedule Assessment?
13. Is the CMS Detector Upgrade Project ready for a DOE CD-2/3 review in August?

Finally, the committee should present answers to the above questions and present findings, comments, and recommendations at a closeout meeting with the CMS Detector Upgrade Project and Fermilab management. A written report will be provided within two weeks after the review.

Approval:

  
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Nigel Lockyer, Director of Fermilab

  
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Date