

**Director's Critical Decision 1 Review  
of the  
Muon g-2 Project  
July 23-25, 2013  
Charge**

The Committee is to conduct a Director's Review of the Muon g-2 Project to assess if the project meets the Critical Decision 1 (CD-1) "Approve Alternative Selection & Cost Range" CD-1 requirements as specified in DOE O 413.3B. The Muon g-2 Project received CD-0 on September 18, 2012. Muon g-2 is scheduled for a DOE Critical Decision 1 (CD-1) Review on September 17-18, 2013.

The Muon g-2 Project will construct a next generation experiment to measure the anomalous magnetic moment of the muon to an unprecedented level of precision, reducing the experimental error by a factor of 4 or 5 relative to the Brookhaven Muon g-2 experiment, E821. If the anomaly measured at BNL persists, this reduction in the experimental error will push the difference with theory to  $> 5$  sigma, a clear signal of new physics. The Muon g-2 Project will reuse the storage ring and much associated equipment along with beam elements from the Brookhaven experiment. The reassembly of the g-2 equipment in the new Muon Campus area being developed at Fermilab will begin in January 2014. Reassembly of the device requires careful attention to detail in order to produce the sub-ppm magnetic field uniformity required for the experiment. Beyond reassembly of the experiment, a number of upgrades are planned to enhance the injection efficiency into the storage ring, operate at higher repetition rates, and better control systematics. Upgraded subsystems include electromagnetic kickers, electrostatic quadrupoles, field-monitoring NMR subsystems, and possibly a new superconducting inflector. New particle detectors based on PbF<sub>2</sub> calorimetry and in vacuo straw trackers will be constructed for the experiment. Beyond the storage ring and associated subsystems, the project will include modifications to portions of the anti-proton source to deliver a customized muon beam. The project also depends on elements provided by the Muon Campus AIP and GPP initiatives that are common to Muon g-2 and Mu2e needs.

The Committee's main focus is the review of the Project's CD-1 readiness and will focus on the project's cost, schedule, management, risks, and ESH&Q. The project will present a Cost Range that the committee is to assess and determine if it is appropriate based on the following factors: the scope of work; the maturity of the design; the Basis of Estimate (BOE); and the risks associated with the scope of work. The team will also look at the WBS – Work Breakdown Structure, WBS Dictionary, BOE – Basis of Estimate documentation, risk and contingency analyses, RLS – Resource Loaded Schedule, and time phased funding and cost profiles. The committee is asked to review each of these items, for quality, completeness, and accuracy. Furthermore, the committee is asked to review and assess the quality of and comment on the additional formal project management documentation required for CD-1 approval.

A Director's Independent Conceptual Design was conducted on June 5-7, 2013, which concluded that the Project's integration of past experience on g-2, coupled with its considerable efforts related to design improvements and optimization, have resulted in a well-developed design. The Committee is to assess the Project's progress on addressing the recommendations from this Review.

The committee is to assess the progress of the Muon g-2 in their preparations to meet the CD-1 requirements of DOE O 413.3B to determine the state of readiness to move to a DOE CD-1 Independent Project Review (IPR). To meet CD-1 readiness Muon g-2's conceptual design needs to be sound and achievable, and that the project documentation (schedule and basis of estimate) is develop to a level to support the cost and schedule range presented. The review committee is asked to address the questions in Attachment 1 to assess the Project's progress.

Finally, the committee should present findings, comments, recommendations, and answers to the above questions at a closeout meeting with Muon g-2 and Fermilab's management. A written report will be provided within two weeks after the review.

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Mike Lindgren, Head, PPD; Line Manager, Muon g-2

**Attachment 1**

CD-1 Readiness Review Charge Questions

1. Has the Project developed a quality resource loaded schedule that includes the entire project's scope of work and is it achievable?
2. Are the estimated cost and proposed schedule ranges realistic, consistent with the technical and budgetary objectives, and justified by the supporting documentation? Has all the work been appropriately identified, estimated and scheduled, including the work associated with performing the preliminary design, final design and value engineering activities?
3. Has the Project implemented a Risk Management Process by identifying risks, performing a risk assessment and started developing mitigation plans at an appropriate level for the CD-1 stage?
4. Is the Project Team adequately staffed and does it possess adequate experience to successfully carry out the Project?
5. Is the current staffing level adequate to complete the work to achieve CD-2? If not, has the appropriate staffing level been identified in the schedule and has a staffing plan been developed to acquire the future staffing needs?
6. Are ESH&Q aspects being properly addressed given the project's current stage of development?
7. Are the draft Key Performance Parameters (KPPs) achievable base on the design, cost range and schedule range presented?
8. Is the documentation required by DOE O 413.3B and Fermilab's Project Management System in order?
9. 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?
10. Is the relationship between the Muon g-2 Project and the muon campus GPPs/AIPS understood and reflected in the Project's configuration management process, risks, and in the schedule?
11. Is the Project ready for a DOE CD-1 Independent Project Review (IPR) review scheduled for September 17-18, 2013?