Closeout Report on the DOE/SC Status Review of the

Muon g–2 Project

Fermi National Accelerator Laboratory

April 6-7, 2016

Kurt Fisher

Committee Chair

Office of Science, U.S. Department of Energy

http://www.science.doe.gov/opa/

Review Committee Participants

Kurt Fisher, DOE/SC, Chairperson

SC1
Accelerator

* Rod Gerig, retired ANL
Peter Ostroumov, ANL

SC2
Storage Ring

* Ross Schlueter, LBNL
Sasha Zholents, ANL

SC3
Technical Integration

* Soren Prestemon, LBNL
Howard Gordon, BNL

SC4
Detectors

* Richard Kass, OSU

SC5
Cost and Schedule

* Jerry Kao, DOE/SC
Ron Lutha, DOE/ASO

SC6
Project Management

* Jeff Sims, SLAC
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Observers

Mike Procario, DOE/SC
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Petros Rapidis, DOE/SC
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Pepin Carolan, DOE/FSO
Paul Philp, DOE/FSO

LEGEND

SC Subcommittee
* Chairperson

Count: 12 (excluding observers)

Charge Questions

1. Are the planned Scope, Schedule and Estimate to Complete updated and credible, including any planned scope enhancements?

2. Has the risk analysis been updated to reflect the real risks for completing the project and are the contingencies acceptable?

3. Are there any significant risks that jeopardize CD-4 completion and require management attention?

2.1 Accelerator

R. Gerig, retired ANL, P. Ostromouv, ANL
Subcommittee 1

1. Are the planned Scope, Schedule and Estimate to Complete updated and credible, including any planned scope enhancements?
   Yes – ETCs are updated and supported. There are no planned scope enhancements in this area.

2. Has the risk analysis been updated to reflect the real risks for completing the project and are the contingencies acceptable?
   Yes – the risk analysis is up-to-date and comprehensive. The risks are either related to either scheduled or cost, and are appropriately accounted for.

3. Are there any significant risks that jeopardize CD-4 completion and require management attention? No.

2.1 Accelerator

R. Gerig, retired ANL, P. Ostromouv, ANL

Subcommittee 1

Findings:

- Commission with beam to the target station dump is scheduled after the summer shutdown, October 2016.
- Installation and check-out are scheduled to be completed by March, 2017. Commissioning of beam into the storage ring is scheduled to follow installation, with some data obtained before the 2017 summer shutdown.
- An internal review of the Delivery Ring AIP was conducted in Feb 2016; we were presented with the review report.

Comments:

- The committee is concerned that remaining installation may still pose a bottleneck problem. A dedicated installation team should be in place after the summer shutdown
- We commend the project for the recent Delivery Ring AIP review. This review identified a number of issues related to scheduling that could impact, not only the ability to commission the storage ring by June 2017, but also impact the delivery of g-2 scope by March. We echo these recommendations and encourage the project to address them.
- An AIP funded kicker, similar to the g-2 kicker has recently been tested in 100 Hz burst mode. We commend the pulsed power group for this accomplishment, which partially addresses our recommendation from the last review.

Comments:

- The risk analysis is up-to-date and comprehensive. The risks are either related to either scheduled or cost (not technical), and are appropriately accounted for in contingency.
- M4/M5 magnet installation is on the critical path, so receiving magnets late would jeopardize the early completion date of March 2017. Every effort should be made to ensure that the Technical Division produces these magnets on schedule.

Comments:

- While we have no concern related to this work scope being completed by the CD-4 date of Q3, FY2019, we are concerned that the early completion date of March, 2017 is at risk. We encourage the project to socialize a "start of storage ring commissioning" date, and optimize schedules of g-2 project deliverables and AIPs to meet this date.
- To this end, we encourage the laboratory to immediately develop a detailed transition to operations plan, including a schedule, to set these priorities. This plan should be developed in a way which additionally defines the prioritization between installation and commissioning activities following the FY16 summer shutdown.

Recommendations:

1. Immediately proceed with the formation of a team to develop a detailed transition to operations schedule and commissioning plan. The initial components of this plan are needed by the end of the 2016 summer shutdown.

Charge Questions w/.r.t. Storage Ring:

Are the planned Scope, Schedule and Estimate to Complete updated and credible, including any planned scope enhancements? YES

Has the risk analysis been updated to reflect the real risks for completing the project and are the contingencies acceptable? YES

Are there any significant risks that jeopardize CD-4 completion and require management attention? No; (comments address early finish schedule).

2.2.1 Findings:

- The main storage ring magnet reached full current 21-Sept-2015, after repair of a high resistance indium joint. The 1.45T KPP has been attained, WBS 3.2 has been closed out ($4.55M) and turned over to operations.

- The SR Controls & Instr., WBS 3.7 has also been closed out ($0.92M). Automated handling of vacuum, cryogenics, & power supplies is fully enabled.

- Remaining Storage ring work includes that in WBS3.3 inflectors, WBS3.4 vacuum, WBS3.5 kickers, WBS3.6 quads, and WBS3.8 field.

- Most significantly, the collective storage ring schedule has slipped 2 months, Slippage is primarily due to difficulty in achieving required field uniformity, which is now essentially on a critical path. The "rough shimming" must be completed prior to vacuum installation It is being "managed proactively"

2.2.1 Findings:

- Main magnet shimming (WBS3.8, $1.38M) involves trolley measurement, frequency measurement, passive shims, & active shims.
- (i) Shimming plan comprises ~15 steps over ~9 mo, per June 2015 g-2 review
- (ii) Shimming has been in progress for 6 mo., since attaining full magnet current, [10- 2015].
- (iii) WBS is presently estimated to be 43% complete as of end-Feb-2016.
- (iv) Initial 1400ppm azimuthal variation around ring was reduced to 550ppm. Error sources are known; expectation is that 25ppm is attainable.
- (v) Attaining requisite field quality only using "easy knobs" is not possible.
- (vi) Expanded shimming is underway, first, time-consuming shimming to re-shape/re-orient/re-position pole surfaces (83% complete), to be followed by fine-adjustment, "easy-knobs" to achieve the ~25ppm; anticipated completion is June 2016.

2.2.1 Findings:

- Inflector (WBS 3.3) enables efficient beam injection. The existing inflector's lead can has been refurbished and a new SOA power supply was purchased. The new power supplies will be ready for installation in 2 weeks. The inflector (and first vac chamber and peripherals) will be ready in November 2016.

- A new-design/improved inflector to enable additional physics capability, with a 60% higher transmission is an alternative future option. It incorporates modified (open) ends that also reduce field at the shield location and newly available enhanced shield material. Next step for this option is to fab & test a "stage 1" prototype inflector cold mass (in-project cost $400k +40% cont. over 1 year); this is beyond the KPP. If successful, the prototype could become an early upgrade option. Alternatively, with DOE guidance/approval, out-of-project (or contingency) dollars could be used to fabricate a "stage 2" completely new production inflector (cost $620K +30% cont. over 1.5 years) of the new design for subsequent implementation in the SR.

2.2.1 Findings:

- Three kickers (WBS3.4) move the injected beam into the main orbit. New kicker cages have been completed at Cornell, and full current pulsing at ~<150ns has been demonstrated. Expected arrival at FNAL is June 2016. The interface issue with the vacuum chamber via common element rails to be aligned with FNALs rails (trolley continuation) is recognized/planned for.

- Electrostatic quadrupoles (WBS3.6), per the CD2 design, initially incorporated an outer Quad plate moved radially outward so as to avoid injected beam. However, it was not possible to achieve the increased 70kV needed at this larger radial position. A subsequent redesign w/ symmetric (equal-radially-positioned) plates (thus reducing muon count) but with new vertical standoffs (recovering muon count) performed adequately per HV tests. HV pulsers have been ordered with ETA June 2016.

2.2.1 Findings:

- Vacuum chamber (WBS3.4) is also on a critical path. Chamber cleaning (w/ ethanol) and trolley rail simplifications have been incorporated. Additional manpower has been deployed. A 10-7 torr w/o the need for vacuum ovens has been demonstrated.

- Vacuum Chamber (WBS3.4) and Quadrupole (WBS3.6) have the largest SR ETC's. This is recognized by management. Additional manpower and resources have been dedicated to maintain schedule. The bulk of the manpower has no conflicts or outside project shutdown obligations.

2.2.2 Comments:

- Schedule push for a 2017 start of muon measurements should not be allowed to compromise field quality, and thereby an ultimate deterioration of data quality & usefulness.

- The superconducting magnet system for the experiment has demonstrated KPP 1.45T field strength and KPP 25ppm field quality over a single pole

- Reducing azimuthal nonuniformity from1400ppm down to 550ppm has been achieved, as has requisite 15um pole-to-pole alignment. Getting to the 25ppm KPP requires first, completion of shimming with "time-consuming-knobs", followed by vacuum chamber insertion, then fine-tuning with "easy knobs". Indeed, 25pmm is anticipated, as it has been demonstrated over a single pole. It remains to demonstrate KPP 25ppm field quality around the full SR. If any unanticipated full-scale field correction implementation issues arise, impact to schedule would likely be large. Anticipated validation is June 2016; this will give timely indication of any potential schedule risk.

2.2.2 Comments:

- It is desirable to get quads/vacuum chamber deployed timely, so as to subsequently integrate and test performance with all components in place.

- Agreed, indeed it is prudent, per plan, to not delay early muon measurement; any new design inflector installation can occur after initial 2017 measurement, when ready in a deployment of Stage 1 or Stage 2 new inflector design. Additionally, in any case, having a spare inflector for this single-point-of-failure inflector is attractive, as it reduces operational risk.

- A clear preferred implementation plan for the inflector Stage 1 and/or Stage 2 options is not completely defined.

- Several WBS components are at or near critical path. Resource competition with other FNAL projects is recognized by management.

2.2.2 Comments:

- Overall, key remaining risks in the SR arena include:
  - finalization of the original inflector (cold test planned)
  - timely attaining global SR requisite field quality in the presence of all ring components, incl. quads and vacuum chamber
  - timely access to labor
  - managing Helium leak
    - Repair is planned after magnet shim & quad, kicker, & inflector tests are complete
    - Problem is in lead can, likely in isolator; repair cost Is not high, but
    - is a schedule risk due to necessary warm-up, repair, &cool-down time
- With lessons learned applied, and continuously updated planning and scheduling, the SR scope, schedule, and ETC are still credible.

2.2.3 Recommendations:

- Committee supports proceeding forthwith with "Stage 1" of the new-design inflector prototype and getting DOE guidance re implementation paths for any potential "Stage 2" inflector implementation, as appropriate.

2.3 Technical Integration

S. Prestemon, LBNL /
H. Gordon, BNL Subcommittee

- **Findings**
  - The plan for the next year has many activities involving the accelerator beam lines, the storage magnet and detectors.
  - Many activities in the plan for the previous year have slipped so that several paths are all close to the critical path.
  - A detailed day by day Integration and Installation (I & I) plan has been made for the next 3-4 months.
  - The project will be integrating the Cornell kicker section in June, which will require interfacing with the vacuum chamber via common rails that need to be aligned
  - The cryoplant refrigerator is shared with mu2e, but built into the spec to have excess capability, with either functioning even if the other facility has an issue
  - The Threshold KPPs for Accelerator require beamlines M2, M3, M4 and M5 ready for installation, with the caveat “dependent on external factors”. Those external factors have been addressed and will not impact beamline installation relative to CD-4.

- **Comments**
  - The plan developed for commissioning and transition to operations and should be implemented and completely agreed to by all parts of the Laboratory . In particular, the project should work with operations lab management to initiate planning for an Accelerator Readiness Review, so that the project can make sure all of the requisite documentation and safety systems are in place.
  - The project requires significant technical resources to maintain the installation schedule over the next year; coordination with, and commitment of the resources by Accelerator, Particle Physics and the Technical Division is critical moving forward, in particular after the summer 2016 accelerator shutdown is complete.
  - With so many activities and interfaces, the Project needs to continue to coordinate evaluate and develop the detailed schedule.

- **Recommendations:**

  None

1. **Are the planned Scope, Schedule and Estimate to Complete updated and credible, including any planned scope enhancements?**

YES

2. **Has the risk analysis been updated to reflect the real risks for completing the project and are the contingencies acceptable?**

YES

3. **Are there any significant risks that jeopardize CD-4 completion and require management attention?**

No, however there is concern about the schedule for obtaining the straws necessary to construct the tracker. The management is well aware of the situation and is taking proper steps to eliminate the risk.

Findings

The spokespersons and lab managers appear to have an excellent working relationship. The collaboration includes many talented individuals and seems enthusiastic about pursing the experiment's physics goals.

The prototyping of the calorimeter and tracker indicate that the detector performance will exceed that required to measure g-2 to the desired precision.

A subset of the data acquisition system is being exercised regularly and meets the requirements for the experiment.

All of the PbF2 crystals have been received by the experiment. Each crystal was subjected to a set of QC measurements and as a result a small subset of crystals will be replaced by the manufacturer. The dimensions of each crystal were measured and will be used to optimize the assembly of the calorimeter. All of the SiPMs necessary to readout the calorimeter are in hand. A laser calibration system for tracking gain stability had been incorporated into the calorimeter design.
Touch labor for installation procedures has been estimated based on calorimeter module stacking experience in the lab and at test beam sites. Final detector assembly will occur at Fermilab before installation.

The manifolds necessary for the tracker are being machined using the facilities at Liverpool.

With the exception of the tracker straws all the other necessary parts (e.g. wire, feedthroughs, etc) are in hand. QC procedures for the steps involved in assembling the tracker modules have been developed.

The vacuum chamber that holds the tracker modules has been modified and successfully passed the necessary QC checks. Based on this success the additional necessary vacuum chambers are being modified.

The uncosted labor (i.e. faculty, postdocs, graduate students) available to assemble, install, and operate the experiment is quite impressive and likely to be sufficient to the task.

Comments

As previously mentioned there is concern that the straw tubes necessary for the tracker are not already in hand. However, management is well aware of this and are actively working with the straw tube provider to help them successfully manufacture the straws. Management is aware that they may shortly have to seek an alternative source for the straws. Fermilab Procurement should be actively engaged in this effort. The committee emphasizes that it is important that management continue to aggressively pursue the procurement of the straws including exploring options that involve resources that might be available to members of the collaboration.

The schedule calls for the tracker manifolds to be machined over eight months. Given that the experiment is scheduled to be operational within about a year management may want to exercise options sooner rather than later that would speed up the manifold production.

While the prototyping indicates a very well designed experiment there is still an enormous amount of work to be done in actually assembling the calorimeter, tracker, DAQ system, etc. and then turning these individual elements into an experiment capable of making an extremely precise measurement of g-2.

Recommendations

None

1. Are the planned Scope, Schedule and Estimate to Complete updated and credible, including any planned scope enhancements? Yes

2. Has the risk analysis been updated to reflect the real risks for completing the project and are the contingencies acceptable? Yes

3. Are there any significant risks that jeopardize CD-4 completion and require management attention? No

Findings

- The Total Project Cost (TPC) remains at $46.4M and the CD-4 date remains at the 3QFY19.
- As of the end of February 2016 the project is:
  - 70% complete
  - $5.65M of cost contingency (46% to go).
  - 22 months of schedule contingency (139% to go).
  - $3.55M in estimate uncertainty (65% labor, 35% M&S)
  - $1.6M in 90% confidence level risk
  - $28.4M work completed
- Since the last CD-2/3 IPR review in June 2015 (May data) the project was:
  - 51% complete
  - $7.23M of cost contingency (37% to go)
  - 24 months of schedule contingency (100% to go)
  - $5.5M in estimate uncertainty
  - $2.1M in 90% confidence level risk
  - $19.5M work completed

Findings

- The $5.65M in contingency remaining represents the contingency after subtracting the management's estimate at completion. The project updates ETC monthly in areas of known cost increases, and a bottom's up ETC was completed 8 months ago. A full bottom's up ETC is planned in 2 months.
- The Project is proposing a scope enhancement to build and test a full-scale technical inflector model using recycled parts (Stage 1). The cost for this is $400K with 40% contingency included. An engineering estimate was completed and the majority of the cost is labor. The labor needed for the new inflector would involve an entirely different team separate from the baseline inflector scope.
- The project is also proposing to build a new inflector from all new parts with a cost estimate of $620K including 30% contingency (Stage 2)
- The Project has utilized EVMS for approximately 24 months.
    - The SC March 7-8, 2016 EVMS Surveillance Review stated that the "FRA EVMS still meets the requirements and intent of the ANSI/EIA-748 standard.

Findings

- Since August 2015, the risk registry has had 23 updates (6 modified, 3 added, 11 retired, and 3 realized).
- The critical path goes through accelerator construction and the installation of the M4/M5 beamline.
- Given the remaining risks, the project has stated that the overall potential for schedule delay is projected to be as much as 6 months from the March 2017 early completion date.
- Major risks remaining include repairing the He leak in the lead can, cooling and powering the inflector, and uncosted scientific labor.
- The necessary GPP projects are substantially complete and the remaining AIP projects needed for the project are scheduled to be completed this summer, well before the March 2017 need by date.
    - Beam Transport, Recycler RF, Delivery Ring

Findings

- The Level 2 milestone, Prototype test of Q1 Quadrupole complete, was completed two months late.
- Several major procurements not on the critical path are delayed (Straw procurement and pulsed power supply procurement).
- There were no prior Cost and Schedule recommendations from the June 2015 review.

Comments

- The project has performed well since the last DOE review. Since May 2015, $9M of work has been completed and $12M of work remains. During this period, $1.3M in contingency was used. The CPI and SPI are 1.0 and 0.99 respectively.
- Since May 2015, the combined estimate uncertainty and 90% CL of risk remaining was reduced by $2.45M from $7.6M to $5.15M. The $1.3M in contingency used during this period is a positive trend. At the current rate, the $5.65M in contingency available is adequate to complete the project (~$3M used at the current rate).
- When determining to add new scope, the project set the following guidelines: contingency of at least 40% of cost-to-go (~$5M), and contingency adequate to cover 100% of estimate uncertainty and 90% CL risk ($5.15M). These guidelines appear appropriate, thus leaving $500K available to use for scope enhancements at this time.
- A full bottom's up ETC that the project plans to perform in 2 months is prudent in order to fully examine the remaining cost to complete the project.

Comments

- The project appears to have sufficient contingency to add the proposed Stage 1 inflector scope enhancement. The initial cost estimate appears credible, and the committee agrees with the project's plan to have an internal review to validate scope and cost once approved. This scope enhancement does not create additional schedule or cost risk to the current baselined scope. The project will need approval of the Stage 1 scope enhancement this month in order to complete the work within the early completion date. If the project runs into a situation where it needs additional cost contingency, the Stage 1 inflector work can be stopped anytime without jeopardizing the project KPPs.
- The committee commends the projects use of EVMS as a project management tool. The CAMs are providing useful information and analysis to help successfully manage and complete the project.
- The committee also commends the project on actively managing risks. The remaining risks on the project appear comprehensive, complete, and well understood. The cost and schedule contingency available appears adequate to successfully complete the project.

Comments

- The project is potentially a year away (March 2017) from achieving the KPPs for CD-4, but the project is entering its peak workload period which continues through project completion. Significant effort and diligence to complete the work on schedule is needed in order to complete the project on the early completion timeframe.
- The project is now entering a crucial period where procurement and activity delays can potentially push back early project completion. Labor represents the majority of remaining cost so delaying project completion results in significant standing army costs (up to $200K a month in project management).
- The project has also lost float in many areas and activities, and all the major divisions (accelerator, storage ring, detectors) are either on critical path or near critical path. Once activities are near the critical path, those activities appear to receive more attention and resources. This may lead to parallel critical paths that are harder to manage, but the committee feels there is ample schedule/cost contingency to handle the remaining issues/risks.

Comments

- The unsuccessful Q1 Quadrupole prototype test will result in the project using the original Q1 plate which causes a 20% loss in injection efficiency. This has no affect on cost/schedule and meeting the KPPs, but it does lengthen the operational time period.
- Procurements are moving forward and many of the delays are due to extra time needed to prepare the requirements/specifications. None of the procurements appear to be delaying the early finish project schedule at this time.
- Continued management attention on the remaining procurements and proactively managing vendors will be essential to completing the project on the early finish schedule.
- The accelerator work is on the critical path and represents approximately 60% of the remaining work. Continued management attention should be paid to this area so that laboratory resources and labor are made available for the successful initiation of the experiment.

Recommendations

- Based on current project performance and available contingency, the committee supports moving forward with adding scope enhancements up to $500k.

PROJECT STATUS as of February 29, 2016		
Project Type	Major Item of Equipment (MIE)	
CD-1	Planned:	Actual: 12/19/2013
CD-2	Planned:	Actual: 8/20/2015
CD-3	Planned:	Actual: 8/20/2015
CD-4	Planned: 3QFY19	Actual:
TPC Percent Complete	Planned: 69.7%	Actual: 70.4%
TPC Cost to Date	$28.4M	
TPC Committed to Date	$29.9M	
TPC	$46.4M	
TEC	$27.45M	
Contingency Cost (w/Mgmt Reserve)	$5.65M	__45.8% on to go
Contingency Schedule on CD-4b	_22_months	__139%
CPI Cumulative	1.0	
SPI Cumulative	0.99	

1. Are the planned Scope, Schedule and Estimate to Complete updated and credible, including any planned scope enhancements? **Yes**

2. Has the risk analysis been updated to reflect the real risks for completing the project and are the contingencies acceptable? **Yes**

3. Are there any significant risks that jeopardize CD-4 completion and require management attention? **No**

Findings

- The Muon g-2 Risk Management Plan was issued on June 1, 2014, and it delineates the process wherein a Risk Change Log is maintained to identify and track potential risks to the project. The project team effectively uses this tool to identify, track, and control risks to the project.

- At this time, most activities conducted as part of the Muon g–2 project are performed by laboratory personnel and are addressed by the FNAL ES&H programs. Integrated Safety Management (ISM) principles are employed in planning and execution of work throughout all levels of the project.

Findings

- Furthermore, the review also examined the project's safety performance trends. From October 1, 2014, through March 31, 2016 (inclusive), the project recorded 82,275.16 hours worked. For that period, the Total Recordable Cases (TRC) rate was 0.00, and the days away from work, job transfers, or restrictions (commonly known as DART) rate was 0.00. In contrast, the Fermilab TRC and DART rates for FY15 were 0.96 and 0.64, respectively. For FY16 (through March 31, 2016), the rates were 1.36 and 0.52, respectively.

- The appropriate ESHQ programmatic documentation is in place and appears to be implemented throughout the project (e.g., Integrated Safety Management (ISM) Program of the Muon g-2 Project, Hazard Analysis Report, Quality Assurance Program, NEPA).

- Project Controls has essentially completed installation of personnel protection system (radiation safety system and electrical safety system) in the M5 Line Tunnel.

Comments

- The ES&H aspects of the project are being properly addressed. The project has responded appropriately to recommendations from previous DOE/SC reviews. ES&H programs are mature and implemented throughout all levels of the project, and are well-positioned to support project completion.

- The project has an excellent health and safety record, and diligence to integrated safety management principles is noteworthy.

- Based on discussions in several break-out sessions, the project does not currently have a developed programmatic plan or methodology in place that adequately supports transition from the current project phase to operations.

- Although the Accelerator Safety (AS) Program is independent of the Muon g–2 project, consideration should be given to reporting on progress and implementation of the AS program with respect to the project in forthcoming DOE/SC reviews.

- At this time, the project team has yet to fully implement an Accelerator Readiness Review (ARR) Program. The ARR committee has yet to be chartered, and the project needs to move forward with creation of the ARR committee and subsequent implementation of reviews.

Recommendations

1. Provide a plan to the Program Office which describes the process for addressing requirements of the Accelerator Safety Order, specifically requirements for development of an Accelerator Safety Envelope (ASE), Accelerator Readiness Reviews (ARRs), and installation of Personnel Protective Systems (PPSs). The plan should be provided within three months.

1. Are the planned Scope, Schedule and Estimate to Complete updated and credible, including any planned scope enhancements? **Yes**

2. Has the risk analysis been updated to reflect the real risks for completing the project and are the contingencies acceptable? **Yes**

3. Are there any significant risks that jeopardize CD-4 completion and require management attention? **No**

Findings

- g-2 project is currently 70% complete with the bulk of the remaining work primarily involving the Accelerator WBS.
- The g-2 science collaboration currently includes 150 members at 35 institutions.
- There are 55 active risks, 3 have been realized and 11 have been retired.
- The storage ring has been installed, turned over to operations and brought to full power in September of 2015.
- g-2 received CD-2/3 ESAAB in August of 2015
- A helium leak was discovered in a lead can of the storage ring. The operations team is working on repair solutions that may effect the on project shimming efforts.

Findings

- The project team is fully staffed
- 15 baseline changes have been processed to date costing approximately $1.3M
- Related AIP projects are on schedule and do not appear to add risk to the CD- 4 for g-2.
- The recommendations from the previous reviews have been addressed.
- Transition to operations planning and scheduling related to individual systems and components is beginning.

Comments

- The review team found the g-2 project team to be a very capable, proactive, and committed.

- The project anticipates carrying over between $1M and $2M of budget into FY17. The program office confirmed that early funding of g-2's FY17 $6.2M budget is expected.

- Vigilance related to completing the remaining procurements on schedule and managing vendor delivery/performance is critical to the early delivery of g-2.

- The review committee feels shared technician and magnet fabrication resources could be a challenge to complete the g-2 project to support early science. Vigilance related to early planning, communicating and assigning Fermilab labor resources will be key to the experiments ability to collect early data.

Comments

- The risk register appears to be appropriately developed and adequately managed.
- Transition to operations and commissioning planning efforts are in the early stages and should be a high priority moving forward.
- The review team supported the concept of the new Inflector. The g-2 project should finalize their planning related to the inflector design and construction to ensure it is prepared in time to support early science.

Recommendations

1. The g-2 project in consultation with the program office should further evaluate the new inflector strategy.
2. Develop a detailed, integrated transition to operations plan and schedule that includes all activities from commissioning through experiment start up (including accelerator readiness). Present the plan and schedule to the program office no later than June, 30 2016.