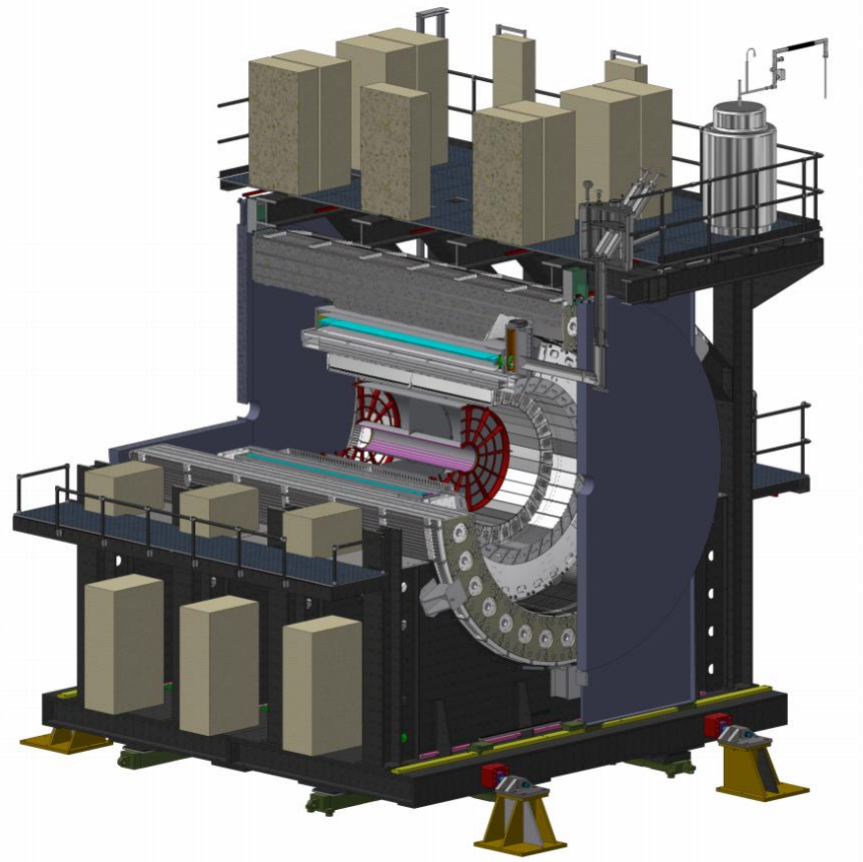
sPHENIX MIE Associate Laboratory Director's Review
July 28-29, 2020



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i. Introduction and Executive Summary

Introduction

The scientific goals of the sPHENIX MIE have been endorsed by the 2010 National Academy Study: Nuclear Physics, Exploring the Heart of Matter, in the 2015 Long Range Plan for Nuclear Science, and in a science review of the sPHENIX detector conducted by the Office of Nuclear Physics.

The sPHENIX MIE is a major upgrade to the PHENIX experiment that will enable precision characterization of jets produced in nucleus+nucleus (AA), proton+nucleus (pA) and proton+proton (pp) collisions at the Relativistic Heavy Ion Collider (RHIC) located at BNL prior to the construction of the Electron Ion Collider (EIC).

The sPHENIX MIE received PD-2 (similar to CD-2 Approve Performance Baseline) and PD-3 (similar to CD-3 Approve Start of Construction) in May 2019, for a total project cost of $27M. The MIE includes project management, an outer tracking system with associated electronics, an electromagnetic and hadronic calorimeter with electronics, a data acquisition and trigger system plus a minimum bias detector.

The Review committee was charged by the Associate Laboratory Director for Nuclear and Particle Physics of Brookhaven National Laboratory to evaluate and comment on any relevant aspects of the sPHENIX project. In particular, the purpose of this review was to assess all aspects of the project's plans – technical, cost, schedule, management, and environment, safety, and health (ES&H). The following main topics were requested to be considered at the review: Project scope, Cost and Schedule, Management, Environment Safety & Health and Quality Assurance, Recommendations, and issues related to COVID-19.

Committee members for this review were chosen based on their technical and/or project management expertise, and experience with building large scientific research facilities, as well as their independence from the project. The full review committee is listed in Appendix C. The Chairperson organized the Committee into five subcommittees, each assigned to evaluate a

particular aspect of the project corresponding to members' areas of expertise. The five subcommittees dealt with (1) Calorimeters and Tracking Detectors, (2) Data Acquisition, Triggers, and Electronics, (3) Environment, Safety and Health, (4) Cost and Schedule, and (5) Project Management.

The sPHENIX Project Office developed the agenda (Appendix E). This final report is also organized into these 5 main areas. The experience of review committee members with past similar projects was relied on heavily for assessing technical requirements, cost estimates, schedules, and adequacy of the management structure.

The review took place from July 28-29, 2020 remotely.

Executive Summary

The Committee finds that very substantial progress has been made on all project fronts in the intervening year since the Project Decision-2/3 Review in May 2019. The committee finds that most elements of the project are proceeding as planned. There are a few key recommendations coming from this review related to Cost and Schedule and Project Management, however, which should be addressed soon. We list all recommendations here as part of this executive summary before proceeding to the detailed report.

WBS 1.01 – Project Management

- Prior to the end of FY20, due to current COVID restrictions and rules in the workplace, the project should re-evaluate potential inefficiencies that might need to be included in the P6 forecast plan.
- By the end of October 2020, conduct a comprehensive EAC update taking into account future COVID impacts due to social distancing inefficiencies.
- By the end of FY20, revisit the Risk Register to review the assigned likelihoods and impacts and to check the consistency of assumptions across the project.
- Prepare a plan by the end of October 2020, with anticipated decision dates, for potential scope opportunities that could be implemented should the project continue to perform well.

WBS 1.02 - TPC

• None.

WBS 1.02.05 TPC FEE

• None.

WBS 1.03 EMCal

- None.

WBS 1.04 HCal

- None.

WBS 1.05 Calorimeter Electronics

- None.

WBS 1.06 Daq/Trigger

- None.

WBS 1.07 Min Bias Trigger Detector

- None.

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1. Calorimeters and Tracking

Sub-Committee 1
John Parsons, Columbia U., Subcommittee Chair
Tom Cormier, ORNL, Review Chair
Paul Grannis, Stony Brook U.

The detectors considered are the Time Projection Chamber (TPC), the EM Calorimeter (EMCal) and the Outer Hadron Calorimeter (HCal).

1.1 Calorimeters and Tracking – TPC – Findings

A TPC using quad-layer, Gas-Electron Multiplier (GEM) avalanche foils is under construction as the central tracker in sPHENIX for precision tracking with low Ion Back Flow (IBF) distortions.

The TPC features Front End Electronics (FEE) with updated SAMPA chips developed by ALICE operated in continuous readout mode. The TPC requires 72 GEM readout chambers connected to 624 FEE cards each reading out 256 pads. The readout pad planes are configured in a chevron pattern allowing precise charge sharing even with low transverse charge diffusion.

GEM foils are produced in the CERN shop and are framed and tested in 4 different sPHENIX collaborating institutions following techniques developed for the ALICE TPC upgrade.

A laser calibration system will use both line and diffuse illumination.

FEE electronics cooling has been simulated to produce no temperature rise at the location of the pad plane. The significant risk associated with the SAMPA chip development has been retired. TPC FEE is on the verge of production release.

The TPC is approximately 1 month off the Critical Path.

The May 2020 Schedule Project Index is 0.8 for the TPC.

1.2 Calorimeters and Tracking – EMCal – Findings

The EMCal consists of 64 sectors of W powder blocks, each read out by 4 fibers to SiPMs.

All of the W powder has been received, but investigations are still ongoing about the uniformity and usability of all the W deliveries. Recent deliveries of W powder have led to blocks that are very difficult to machine and this will need to be fixed in the long run.

About 8 sectors worth of blocks have been fabricated.

Apart from COVID-related delays, the block fabrication at UIUC has not yet ramped up to the specified rate. Problems associated with machining and humidity control have been identified. $300K of contingency has been assigned to cover increased Standing Work Force and M&S costs.

Prototype Sector 0 completed for final design. Sector 1 is completed and in test; Sector 2 assembly is in progress.

Most of the blocks in the region $0.85 < |\eta| < 1.1$ are not on MIE project, but are being built by collaborators in International collaborators.

Risks due to lack of students available for assembly and testing have been identified. One or two techs at UIUC might be hired to help improve the production rate.

The EMCal is on the overall sPHENIX critical path with completion delayed by 1 month due to pandemic to Nov. 4, 2021. There remains a 13 month float to project PD-4.

1.3 Calorimeters and Tracking – HCal – Findings

All 32 outer HCal steel sectors have been delivered to BNL and 75% of 6360 scintillating tiles have been delivered with the last shipment expected soon.

About half of the tiles have been tested at Georgia State; 1 – 2% fail quality tests. The team expects to finish these tests by the end of December 2020.

Sector assembly and testing at BNL were shut down due to the pandemic. Social distancing requirements make testing more difficult.

Inner HCal Al structure supports all inner detectors. The design is now complete. The Inner HCal detector tile (non-MIE) R&D is complete and the contract is in place.

The HCal May 2020 Schedule Performance Index = 0.71.

1.4 Calorimeters and Tracking – TPC – Comments

The committee appreciates the progress that has been made since the previous review.

Within the TPC activity, SBU is the largest consumer of undergraduate labor. Particularly in the face of COVID, this is a possible problem going forward. Plans are underway to hire a technician to take up the slack. This is a potentially important risk mitigation step.

GEM production at CERN is the critical first step for TPC production. GEM production was already delayed due to COVID. This continues to be a significant possible future risk.

The diffuse laser illumination calibration method has received significant thought but would benefit from a quantitative proof of principle demonstration.

The TPC is showing some schedule variance. TPC FEE installation and testing would benefit from increased parallelization to help preserve schedule float.

1.5 Calorimeters and Tracking – EMCal – Comments

The committee appreciates the progress that has been made since the previous review.

The project has dealt very well so far with the impacts of the COVID-19 pandemic, incurring delays of only 1-2 months.

Given the issues found with the uniformity/quality of the W powder, continued attention should be paid to the powder procurement.

The EM blocks and sector assembly rely heavily on the availability of undergraduate student manpower (e.g. plans at UIUC include up to 25 undergraduates), which might be difficult to realize in practice given the COVID-19 restrictions.

Project management is considering adding 1 - 2 technicians to the block fabrication. Since the EMCal is on the critical path, and the target production rate has not yet been achieved, this sounds like a wise use of contingency.

The risk probabilities for EM blocks at UIUC related to COVID-19 are set to 2% for fiber assemblies and 10% for block fabrication. These seem low and are below those for student testing of sectors at BNL (25%) and for the corresponding HCal scintillator tile testing at Georgia State (50%).

The addition of a third EMCal assembly station, mainly for testing, is being considered. Adding capacity to the sector assembly and test would be a useful hedge against further schedule slip, and also help with COVID-related distancing requirements.

Consideration of how and when decisions should be made for using schedule contingency for the calorimetry would be useful. There is a high probability that delays of MIE or non-MIE aspects of sPHENIX will occur and it would be good to have some prior analyses available.

1.6 Calorimeters and Tracking – HCal – Comments

The committee appreciates the progress that has been made since the previous review.

Despite some delays due to the pandemic, progress on the HCal has been good.

The HCal is showing some significant schedule variance in May (SPI = 0.71), though it was stated that the situation is improved as of June. Attention should be paid to this issue to verify if the schedule is back on track.

Two risks related to availability of GSU student manpower at GSU and BNL are each ranked with 50% likelihood, demonstrating that careful attention will need to be paid to this (COVID-related) issue.

1.7 Calorimeters and Tracking – Recommendations

None.

1.8 WBS 1.07 Min Bias Trigger Detector – Recommendations

None

2. Data Acquisition, Triggers, and Electronics

Sub-Committee 2
Myron Campbell, U. of Michigan
Rainer Bartoldus, SLAC
Ken Read, ORNL
Vivian O'Dell, FNAL

This committee reviewed: Electronics, WBS 1.05, which includes the optical sensors, EMCal electronics and HCal electronics; and DAQ & Trigger, WBS 1.06, which includes the DAQ, Trigger, GL1 and Timing systems. The electronics for the TPC FEE, WBS 1.02.05, and TPC DAM, WBS 1.02.06 are included in this subcommittee review.

2.1 Data Acquisition, Triggers, Electronics (WBS 1.05 – 1.07) – Findings

The team has successfully capitalized on technologies and equipment developed elsewhere, for example by ATLAS, ALICE, and NSLS II.

The SAMPA V5 ASIC passed successful Final Design and Production Readiness Reviews. The associated risks were retired. Approximately 40% of the SAMPA V5 chips have been delivered, with hundreds already robotically tested passing specifications.

Ten pre-production FELIX cards have been received and are being tested.

Six Reviews associated with DAQ, LL1, GL1, Timing are scheduled for summer and early fall 2020.

The DAQ has lost one month of schedule float, but remains months away from the overall critical path.

Online monitoring will collect separate data files to create full events on subsets of triggers.

The prototype Global Level 1 Trigger and timing system is slightly delayed, but still not near the critical path.

It is advantageous that the Slow Control monitoring is push rather than pull based.

The annual test beam studies for 2019 were cancelled.

The DAQ team lost 1 FTE, the LVL-3 manager for 1.06.01 DAQ, due to retirement and is searching for a replacement.

There are a satisfactory number of DCM2 spares available, even allowing for some increase in bandwidth. Since many parts are obsolete now, it is difficult to order more.

Unspent financial contingency could be used to purchase more DAQ hardware to increase the available DAQ bandwidth.

The Risk Registry includes two risks specifically associated with DAQ/Trigger: TPC producing a higher data rate, and DAQ prototype not meeting specifications (now retired). The Risk Registry does not include a COVID-19 related risk for DAQ/Trigger.

The radiation performance studies reported in August 2019 used the SAMPA V4 ASIC on TPC FEE v1 boards.

2.2 Data Acquisition, Triggers, Electronics (WBS 1.05 – 1.07) – Comments

The overall design is well matched to the sPHENIX data taking challenges and Scientific Objectives. The committee recognizes the considerable experience and competence of the team working on the DAQ, Trigger and Electronics. The committee commends the skillful

mitigation of risks during the pandemic, especially at particular institutes including U. Sao Paulo and Lund U.

The committee commends the solid progress demonstrated by multiple successful Design and Production Readiness Reviews over the past year. The committee is pleased to see the down-select on Local Level 1 Trigger (including a Review).

We applaud the teams for the successful test beam results and chain tests using the available hardware and RCDAQ software.

We strongly stress the importance of full system functionality tests with the SAMPA V5 on the TPC FEE v2 board. It will be important to subsequently perform integrated tests on the TPC detector prototype for full system tests in a test beam.

Testing the simultaneous readout of the full readout chain for multiple subsystems (i.e. calorimeter and tracking) should be performed at the earliest opportunity.

Several DAQ hardware tests were delayed by about 10 weeks. The upcoming DAQ PRR in August is critical for reviewing the Global Level 1/GTM platform.

It is essential to test the impact of the full-length cables on performance, signal quality, and cross talk at the earliest opportunity.

It is recognized as highly advisable to continue to work closely with the integration team.

It continues to be important to have mitigation strategies prepared to respond to the potential impacts of COVID-19 on small teams, such as DAQ/Trigger.

The planned personnel addition to the DAQ/Trigger team is needed. The committee is concerned that the organization of the DAQ system is understaffed, and short by at least 1 FTE. We encourage filling the remaining unfilled Level 3 roles in the org chart.

2.3 Data Acquisition, Triggers, Electronics (WBS 1.05 – 1.07) – Recommendations

None.

3. Environment, Safety and Health

Subcommittee 3
James Niehoff, FNAL

3.1 Environment, Safety and Health – Findings

The sPHENIX upgrade detector consists of distinct activities, the major items of equipment which include infrastructure and facility upgrades. There is a specific Hazard Analysis Report along with an Environment, Safety, and Health Plan for sPHENIX detector. These plans are based on DOE's Integrated Safety Management System (ISMS). The Hazard Analysis Report (HAR) which describes an updated list of the hazards, a risk matrix for each hazard, and mitigating factors and controls.

Assembly and testing of the BNL built components will be done in BNL Buildings 510, 912, and 1008. There are parts of the detector that are being built by universities and other DOE national laboratories. The sPHENIX detector will be located and operated in BNL Building 1008.

The BNL's Standards-Based Management System (SBMS) Management System: *Project Management, Program Description: Program Management for DOE Office of Science Projects with TPC $50M or Less* is a tailored approach based on DOE Order 413.3B.

The quality assurance program is documented and delivered through BNL's SBMS. The sPHENIX Quality Assurance Program uses an integrated management systems approach. It describes the various BNL management system processes and functions to provide a sound approach that conforms to the basic ten criteria defined in DOE Order 414.1D titled "Quality Assurance".

The purpose of the specific sPHENIX Project's Quality Assurance (QA) Plan is to outline how the project aligns with the BNL's institutional QA requirements and any supplemental project-specific requirements. The Project's QA Plan unifies the projects quality assurance activities, which are spread across multiple universities and laboratories, and is implemented through documented processes that address specific quality requirements.

3.2 Environment, Safety and Health – Comments

The HAR dated July 14, 2020 Revision 1, has been updated to address the ionizing radiation risk due to working in building 1008 and the COVID-19 Pandemic. BNL's Work Planning Controls (WPC) are well documented and are in place to assure worker safety and health to their employees, collaborators (users) and contractors when on-site.

BNL SBMS which is flowed down in part to universities through Supplier Quality Assurance Technical Specification. The BNL SBMS contains the BNL Quality Assurance Program. There is a specific Quality Assurance Plan (QAP) for the sPHENIX which delineates the QA requirements and the associated implemented procedures to be used by the project.

The BNL SBMS Management System: Project Management, Program Description: Program Management for DOE Office of Science Projects with TPC $50M or Less requires an updated Environment, Safety, and Health Plan. The ES&H Plan, though not part of the original documentation, has been provided and was updated in May 2019, Revision 2. In addition, the transition to operations plan will be covered in an Unreviewed Safety Issue (USI) process and then incorporated into the Safety Assessment Document (SAD).

BNL Office of Quality Management and ES&H have conducted surveillance visits of detector components being manufactured by universities and other DOE National Laboratories.

There is a controlled procedure guidelines document as well as documents related to document controls (drawings) etc. delineated in the QA Plan.

3.3 Environment, Safety and Health – Recommendations

None.

4. Cost and Schedule

Subcommittee 4
Craig Brackett, SLAC, Chair
Garrett Meek, ORNL

4.1 Cost and Schedule – Findings

The status date is May 2020.

The Project TPC is $27.0M and is 46.4% complete.

The Project CPI is 1.04 and SPI is 0.91.

There are 29 active risks, of which 12 are high risk. 8 out of the 12 are related to COVID. 8 of 9 milestones have been met ahead of schedule.

The project has allocated through baseline changes $162K of contingency since PD-2/3.

The Work to go is $11.880M.

The Project has 22.8 student FTE's and 15.66 tech FTE's planned in FY21.

A 90% Monte Carlo contingency analysis projects a contingency need of $3.3M.

The Project BAC contingency is $4.8M, which is 40.6% on remaining work.

The Project EAC contingency is $5.1M, which is 42.8% on remaining work.

The project critical path runs through EMCAL fabrication of final blocks.

The project PD-4 completion is Dec. 2022.

The project early completion is Nov. 2021 and has 13 months of float to get to PD-4 (as of May 2020).

4.2 Cost and Schedule – Comments

Review team was impressed with how the project team is exercising the earned value system and associated tools at a very detailed level.

Project has addressed prior cost and schedule recommendations.

The project has the support of multiple various collaborators, which includes a large amount of student/university contributed support.

Project cost and schedule contingency appear to be healthy and adequate. However, due to recent delays in schedule (1 month loss between Feb-May and 1 month loss between May-Jun), the schedule contingency appears to be at risk for additional future decreases. In this new COVID environment, some additional risks and/or EAC liens might need to be identified and analyzed.

The project P6 plan and durations seem to be similar to the original baseline plan. It could be prudent for the project team to consider possible inefficiencies that might need to be included in the project forecast plan. e.g. Universities seem to be very conservative bringing students back.

4.3 Cost and Schedule – Recommendations

Prior to the end of FY20, due to current COVID restrictions and rules in the workplace, the project should re-evaluate potential inefficiencies that might need to be included in the P6 forecast plan.

5. Project Management

Subcommittee 5
Ron Ray, FNAL, Chair
Vincent Riot, LLNL

5.1 Project Management – Findings

sPHENIX is a major upgrade to the PHENIX detector. It is a large-acceptance, high-rate detector for Heavy Ion physics that repurposes >$20M in existing PHENIX equipment, infrastructure and support facilities. The Project is supported by a large international collaboration of 80 institutions.

sPHENIX was identified as both a National and International nuclear physics priority.

The sPHENIX detector is optimized to measure jet and heavy quark physics by incorporating a Time Projection Chamber, Electromagnetic and Hadronic Calorimeter with a high rate DAQ/Trigger and a 1.4 T solenoidal magnetic field.

PD-2/3 was received in September 2019. The scope is unchanged since PD2/3.

A majority of the Project Office and L2 Managers have been working together on sPHENIX for over 5 years.

The Project falls below the DOE 413.3b $50M threshold but follows 413.3b principles. The BNL Lab Director is responsible for completing the project on budget and on schedule.

EVMS is not required but BNL has required the project to follow the principles of EVMS and use it to manage the project.

FY20 is the peak funding year. All FY20 funds have been received. The Project has an approved funding profile that runs through FY22.

There is $11,880k of cost remaining as of May 2020. 86.1 FTEs are needed to complete the project scope. This includes labor from all sources.

The Project KPPs are for components that will be assembled into the detector, not on the assembled detector itself. The KPPs do not require beam operation but a year of data will be required to confirm that the Ultimate Performance Parameters have been achieved.

The MIE budget is 90% M&S and 10% Labor. The percentage of labor is low because of a significant amount of contributed labor. Scope that is not included in the MIE Project includes:

- $23M of contributed labor from RHIC Operations
- BNL-funded Infrastructure and Facility Upgrade ($33.4M)
- Former BaBar Superconducting magnet, tested to full current at BNL.
- Collaborator contributed labor
- Si strip detector (INTT) funded by RIKEN Lab –Japan with other international contributions.
- Extended EMCal eta coverage (to -1.1< eta < 1.1) from international sources.
- BNL-funded capital project for instrumentation of an Inner HCal
- BNL-funded capital project for an Si pixel detector (MVTX)

Contributed labor is tracked to understand progress.

Installation and commissioning are not part of the Project scope.

BNL has granted the sPHENIX MIE an Extraordinary Project Rate (Reduced Overhead)

Four Long Lead Procurements were approved at CD-1/3a

- Silicon Photomultipliers for EMCal & OHCAL – COMPLETE
- Tungsten Powder for EMCal – COMPLETE
- Scintillating Fibers for EMCal. 15 of 23 batches arrived. Monthly batch deliveries proceeding on schedule
- Scintillating Tiles for Outer HCal. 9 of 12 batches delivered.

The Project has set up a program of Design and Procurement Reviews for major systems and is working its way through them.

The sPHENIX MIE project has embedded ES&H and QA experts.

The Project's Risk Registry is updated monthly. A Monte Carlo simulation of Project risks using the Primavera Risk Management Tool has been performed and reported at the 90% confidence level. There are a total of 29 active risks with a breakdown of 12 high risks, 5 moderate and 12 low. 29 risks have been retired.

The Project performed a Monte Carlo of the schedule risks. The current early completion date is November of 2021 and the PD-4 milestone date is December 2022. The Monte Carlo indicates that the project will be completed on or before April 2022 at the 80% C.L.

Over the past year the Project has retired 19 risks, identified 4 new risks and realized 3 risks.

The Project's critical path runs through electronics and the EMCal and is technically limited.

The project has experienced a number of COVID Impacts:

- All labs and universities were closed for several months, starting in March 2020 and are now reopened but working under new social distancing guidelines. Immediate impact on schedule was a month delay reflected in the May schedule release with another month delay expected in the June schedule release.
- Specific impacts included:
    - Suspension of EMCal, Outer HCal and TPC construction
    - Cal FEE, DAQ testing suspended
    - Commercial vendors by and large continued working
- Potential cost impact if the Project wants to recover schedule
- 60% of the sPHENIX staff is currently onsite at BNL. The remaining staff continues to work remotely for the time being.
- To date, overall schedule slip can be absorbed by 14-month schedule float.
- The COVID impact was reported as zero cost and zero schedule to date through formal DOE reporting.

The current baseline does not include potential future impacts due to social distancing inefficiencies. The Project is currently evaluating these inefficiencies and plans to submit baseline change requests so that these impacts are reflected in the cost and schedule.

5.2 Project Management – Comments

The Project benefits from a strong team with significant experience that has largely been intact for many years and is functioning well.

There appears to be good communication between the Project and the Collaboration.

The project performance presented through the end of May 2020 is excellent despite the pandemic. There appears to be ample contingency remaining for both cost and schedule. Contingency on work remaining has improved from about 26% last year to 40% this year.

The Project's integration effort is mature and functioning well but sufficient attention must be paid to off-project components as well as those included in the MIE. Backup plans, if contributed components are delivered late, should be developed.

The availability of significant contributed effort is a benefit to the Project and reduces the standard marching army risk in the case of delays, but there are also risks if all the effort cannot be provided or if the contributed effort is not adequate. The Lab is clearly committed to the Project and MOUs are in place with the various organizations that supply resources, so the

probability of this risk is low, but the impact would be very high,if realized. It is important that the Project continues to track this effort and appropriately captures these risks.

The MIE scope relies heavily on contributed labor from the PHENIX group that is funded by RHIC Operations. The Project could be impacted if there are unanticipated draws on RHIC Operations funding to mitigate COVID.

Progress on long-lead items has been good.

The team plans to recover COVID-19 delays by increasing the staff at specific locations. This may not be compatible with new distancing requirements. The project has asked for more space at BNL, which will help. Similar plans will be required at all contributing institutions to make this plan successful.

The project is highly vulnerable to student availability due to COVID. Possible mitigations include replacing students with technicians, at some cost to the project. The project should monitor the situation closely as a better understanding of longer term COVID impacts become apparent.

Additional COVID delays will appear in the June schedule release. The current EAC includes the impact of past variances. In several areas the free-float buffer is now gone so further impact will be day-for-day. The impact over the next several months may not be fully forecasted in the EAC.

Many areas of the project are trying to accelerate work to recover schedule. Safety will need to be managed closely to ensure incidents do not occur due to schedule pressure.

Several risks have both a low and most likely cost impact of zero and a significant high impact cost (e.g. sPH_HCal_004). While this was explained as trying to capture schedule risk with limited cost impact from contributed labor, this may not reflect the true cost exposure.

The Schedule Monte Carlo indicates that the Project should be completed well before the PD-4 deadline. This assumes that all schedule risks are appropriately captured. Future COVID impacts continue to be a significant unknown. Probabilities and impacts should be reviewed to ensure visibility to potential future issues.

5.3 Project Management – Recommendations

Conduct a comprehensive EAC update, taking into account future COVID impacts due to social distancing inefficiencies by the end of October 2020.

Revisit the Risk Register to review the assigned likelihoods and impacts and to check the consistency of assumptions across the project by the end of FY20.

Prepare a plan by the end of October 2020, with anticipated decision dates, for potential scope opportunities that could be implemented should the project continue to perform well.

APPENDICES

A. Charge Letter to the Review Committee
B. BNL Guidance for Project Management for Office of Science Projects with a Total Project Cost Equal to or Less than $50 Million and Greater than $10 Million Review Agenda
C. Review Committee members
D. Answers to questions included in the Charge
E. Review Agenda

Appendix A – Charge Letter to the Review Committee

Associate Laboratory Director for Nuclear and Particle Physics

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Associate Laboratory Director's Cost & Schedule Review of the sPHENIX MIE July 28-29, 2020 Charge to the Review Committee

Thank you for agreeing to participate as a panel member in the Annual Progress Review of the sPHENIX Major Item of Equipment (MIE) that will take place remotely.

The sPHENIX MIE is a major upgrade to the PHENIX experiment that will enable precision characterization of jets produced in nucleus+nucleus (AA), proton+nucleus (pA) and proton+proton (pp) collisions at the Relativistic Heavy Ion Collider (RHIC) located at BNL prior to the construction of the Electron Ion Collider (EIC).

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The committee is charged to evaluate and comment on any relevant aspects of the sPHENIX project. In particular, the purpose of this review is to assess all aspects of the project's plans – technical, cost, schedule, management, and environment, safety, and health (ES&H). The following main topics will be considered at the review:

1. Project scope: Is the project executing its technical baseline in a manner to deliver the science? Is the current design maturity and fabrication progress appropriate for this stage of the project? Are all interfaces properly understood?

2. Cost and Schedule: Are the cost and schedule estimates, including contingency, complete, adequate, and reasonable based on project performance to date? Is contingency usage appropriate for this stage of the project? Is the project critical path clearly identified and understood?

3. Management: Is the project being properly managed at this stage? Are the risks properly identified and managed and are appropriate mitigation strategies in place? Is the technical progress on the long lead procurements adequate? Are the procurements being properly managed?

4. Environment, Safety & Health and Quality Assurance (ES&H/QA): Are the ES&H/QA requirements being properly addressed given the project's current stage of development?

5. Recommendations: Has the project responded appropriately to previous review recommendations?

6. COVID-19: Are the cost/schedule impacts from COVID-19 on the sPHENIX MIE cost and schedule understood and being properly assessed?

The review will take place from July 28-29, 2020 remotely. A closeout will be presented to the sPHENIX project team, and the Laboratory prior to adjourning. A report should be submitted to my office by close of business on August 20, 2020.

I very much appreciate your willingness to lend your time and expertise to this important step in the sPHENIX review process and look forward to receiving your assessment.

Sincerely,

Berndt Mueller
Associate Laboratory Director for Nuclear and Particle Physics
Brookhaven National Laboratory

Appendix B – BNL Guidance for Project Management for Office of Science Projects with a Total Project Cost Range Total Project Cost Equal to or Less than $50 Million and Greater than $10 Million

BNL Guidance for Project Management for Office of Science Projects with a Total Project Cost Equal to or Less than $50 Million and Greater than $10 Million

1.0/PMSC_PD.docx 1 (05/2019)

Background

Department of Energy (DOE) Memo from Steve Binkley, Deputy Director of Science Programs, Office of Science (SC), dated August 2, 2018, exempted projects with a Total Project Cost (TPC) Equal to or Less than $50 Million from DOE Order (O) 413.3B Project Management requirements. This Memo delegates the responsibility for managing these projects to the Laboratory Director.

Purpose and Applicability

1. The purpose of this procedure is to describe the project management process Brookhaven National Laboratory (BNL) will implement to manage SC projects with a TPC equal to or less than $50 million (50M) and greater than $10 million (10M). All SC projects with TPC equal to or less than $50M or greater than $10M will follow this procedure unless specifically exempted by DOE. The BNL procedure will follow the principles of good project management and the intent of DOE O 413.3B, which include: Line management accountability.
2. Sound, disciplined, up-front planning.
3. Well-defined and documented project requirements.
4. Corporate effective risk handling mechanisms.
5. Well-defined and managed project scope and risk-based performance baselines and

   stable funding profile that support original baseline execution.

6. Development of reliable and accurate cost estimates using appropriate cost

   methodologies and databases.

7. Properly resourced and appropriately skilled project staffs.
8. Effective implementation of management systems supporting the project (e.g., quality

assurance, integrated safety management, risk management, change control,

performance management and contract management systems).

9. Early integration of safety into the design process.
10. Effective communication among all project stakeholders.
11. Utilization of peer reviews throughout the life of a project to appropriately assess and

make course corrections.

Tailoring Strategy

BNL's Project Management process allows for the development of a tailoring strategy for each project, based on the risk, complexity, visibility, cost, safety, security, and schedule. The requirements of BNL are to be applied on a tailored basis as appropriate to the project. Tailoring is subject to the Laboratory Director's approval and DOE concurrence and is identified prior to the impacted significant project decisions/approvals (e.g., Approve Project Performance Baseline, Approve Project Production, and Approve Project Completion). These reviews will be conducted as independent reviews with invitations to the respective DOE Program Offices and the DOE BHSO Manager to observe. The projects will follow all federal regulations and Executive Orders.

Roles and Responsibilities **BNL Laboratory Director**

The BNL Laboratory Director has full responsibility for project planning and execution, and for establishing broad policies and requirements for achieving project goals. The Laboratory Director is accountable to DOE for BNL Project Performance and has the following responsibilities:

Approves the Project Management Plan.

Approves the appointment of the Project Director

Approves Level 1 baseline changes.

Approves Project Decisions (PD) through BNL Independent Project Reviews (IPRs)

including:

- PD-1 Approve Conceptual Design and Cost Range
- PD-2 Approve Project Performance Baseline
- PD-3 Approve Project Execution
- PD-4 Approve Project Completion
- The responsibility for CD-0 Mission Need is the responsibility of DOE

Concurs with funding requests to DOE. **BNL Associate Laboratory Director (ALD)**

The BNL Associate Laboratory Director, as delegated by the BNL Laboratory Director, has the following responsibilities:

Ensures BNL Lead Laboratory commitments are met in executing the project within scope, cost, and schedule in a safe and responsible manner.

With the Laboratory Director's concurrence, appoints the Project Director and ensures the Project Director is qualified and has appropriate communication and leadership skills prior to designation.

Initiates objectives of the project.

Initiates and successfully executes BNL Independent Project Reviews (IPRs) for Project

Decisions (PDs) and status reviews:

- PD-1 Approve Conceptual Design and Cost Range
- PD-2 Approve Project Performance Baseline
- PD-3 Approve Project Construction/Execution/Production
- PD-4 Approve Project Completion
- Annual Project Status Reviews after approval of the Project Performance Baseline

(PD-2)

- PDs can be tailored to request LLP, site prep, or other tailoring requests

Ensures access to Laboratory/contractor resources, systems, and capabilities required to execute the project.

Accepts changes to the funding profile as directed by DOE.

Approves KPPs (Key Performance Parameters) with DOE concurrence.

Approves major subcontracts in accordance with federal regulations and BNL policy.

Project Management Executive

The Project Management Executive has the following responsibilities:

Supports the request for the federal appropriation necessary to support this project.

May concur on the PMP .

May concur on KPPs.

May attend and concur on BNL's Independent Project Reviews and Project Decisions.

Will assign a Performance Evaluation Measurement Plan (PEMP) goal to the Laboratory.

Federal Program Manager (FPM)

Serves as the primary DOE Program Office point of contact for the project and is charged to fulfill program responsibilities for project funding, coordination, oversight, and communication with other DOE Headquarters (HQ) offices. The DOE FPM has the following responsibilities:

Functions as DOE HQ point of contact for project matters.

Serves as the representative in communicating the interests of the SC program.

Coordinates with Laboratory Director, DOE BHSO Manager, SC Staff offices, and DOE HQ program offices, as needed, to execute the project.

Assists with budget formulation.

Reviews and concurs with Level 1 baseline changes.

Attends monthly meetings.

Reviews and concurs with the PMP .

Reviews project progress reports and deliverables.

The DOE FPM is consulted in the charge, agenda and schedule of formal periodic reviews of the project, including BNL Independent Project Reviews (IPRs) and is invited to attend the reviews.

Brookhaven Site Office Manager

The Brookhaven Site Office (BHSO) supports the Program Office in their oversight of their respective BNL Projects. The DOE BHSO Manager has the following responsibilities:

Assigns a Contracting Officer to oversee performance in accordance with contract requirements.

Appoints a BHSO Project point of contact.

Reviews and concurs on Project Decisions PD-1 PD-2, PD-3, and PD-4.

Reviews development and implementation of key project documentation.

Reviews project cost, schedule, performance, and scope progress to baseline plans.

Ensures design, construction, environmental, safety, security, health, and quality efforts performed comply with the M&O Contract, public law, regulations, and Executive Orders.

Concurs with the PMP .

CD-0 (Mission Need) is still the responsibility of DOE and the remaining critical decision equivalent, called Project Decisions, will be the responsibility of the Laboratory to initiate and execute. The respective Program Office and BHSO will be invited to participate in the Project Decisions.

Project Director/Project Manager

The Project Director leads the Project Management team. The Project Director/Project Manager is appointed by and reports directly to the BNL ALD. The Project Director/Project Manager is responsible for ensuring that adequate direct, indirect, and support resources are available for the successful execution of the project. The Project Director's/Project Manager's responsibilities include the following:

Approves the project organization in consultation with the ALD.

Represents the project in interactions with the DOE.

Collaborates with the responsible Project Scientist to provide overall direction to the project.

Establishes clear and achievable project objectives (KPPs) in consultation with the FPM.

Successfully executes the project scope.

Assembles the staff and resources necessary to complete the project.

Appoints Level 2 Managers, Level 3 Managers and Control Account Managers (CAMs)

for the project whom will be responsible for managing bid package(s), overseeing daily technical and managerial oversight of specific assigned WBS tasks from design through construction, and for preparing change requests in conformance with Baseline Change control.

Manages the completion of Project deliverables as defined in the PMP.

Ensures that the project deliverables meet functional requirements.

Ensures timely resolution of critical issues within Project Director's control.

Identifies risks to scientific and technical performance; works with the CAMs to control

project risks.

Defines areas of collaboration and relationship between the project and other BNL

departments and divisions, and other institutions participating in the project. Develops appropriate Memoranda of Agreements (MoAs), Memorandum of Understandings (MOUs) and other collaborative agreements as applicable.

Works with the Project team to define the WBS structure and to establish intermediate milestones.

Allocates contingency funds according to the procedure defined in the Baseline Change Controls.

Provides monthly financial reports to BNL and DOE.

Approves major subcontracts.

Implements a tailored Earned Value Management System (EVMS) in accordance with the DOE-approved EVMS system at BNL.

Maintains change control log and documentation.

Assures that work is performed in compliance with the BNL Environmental, Safety and

Health requirements and Worker Safety Regulations.

Project Management Plan (PMP)

Projects will develop a Project Management Plan (PMP) which will describe the elements and process for planning and executing a successful project. The PMP will be approved by the Laboratory Director and BNL will obtain concurrence from BHSO and the responsible Program Office.

The PMP will include the following elements:

1. Introduction, Background, Mission Need
2. Project Baseline (Including scope, cost, schedule baseline)
    1. Scope Baseline
        1. Key Performance Parameters (KPP)
        2. WBS Dictionary
    2. Schedule Baseline
        1. Summary Schedule
        2. Project Milestones (L1-L4)
        3. Detailed Resource Loaded Schedule
        4. Critical Path
        5. Schedule Contingency/Float
    3. Cost Baseline
        1. Cost Estimate by WBS, Labor and Material
        2. Obligations Profile
        3. Estimate Uncertainty and Cost Contingency
        4. Time phased Plan by month
    4. Funding Profile
        1. TEC (Total Estimated Cost), OPC Other Project Costs
        2. TPC -Total Project Cost (TEC+OPC)
        3. Time-phased by Fiscal Year
3. Risk Management
    1. Risk Management Plan
    2. Risk Register
4. ES&H
5. Procurement
6. Tailoring Strategy
7. Management Organization

8. Roles and Responsibilities
9. PM Oversight
10. Change Control
11. Project Controls Systems/EVMS
12. Project Reviews

13. Project Reporting
14. Transition to Operations 15. Project Closeout

Projects will maintain all project documentation in a shared site accessible by DOE and the project team.

Key Performance Parameters (KPPs)

The project will define Key Performance Parameters (KPPs) with which DOE concurs. KPPs will be developed similar to larger projects, with threshold, objective, and if required, Ultimate PPs. The Laboratory Director and ALD must approve all KPPs. The responsible Program Office must concur on all KPPs.

Project Phases/Reviews

Reviews will be conducted for each phase in the project lifecycle (Conceptual Design – TDR, PDR-Preliminary Design, FDR-Final Design, procurement phase, start of construction, execution or production and project closeout) Project Decisions (PD) will be defined in a procedure which will follow a similar but tailored review process. Experienced external reviewers will chair the PD reviews to ensure independence. Projects will conduct external Independent Project Reviews at these critical points, based on guidance from the Program Office in the project lifecycle at least annually and during the Project Decision phases. DOE will be asked to concur with the review team members and will be invited to attend the reviews.

1. The Conceptual Design will be finalized and approved as part of PD-1 (Project Decision 1) (similar to CD-1). The Cost Range and Conceptual Design is approved.

   Project Decision 1 - The Conceptual Design and Cost Range will be developed and approved as part of PD-1 (Project Decision 1). A successful PD-1 Review will be attained when an approach to meet the gap in mission capability has been identified, selected, and a nominal cost range established. This is an indication that the project team and the sponsor have agreed on path forward for meeting the mission need defined by DOE CD-0. To achieve PD-1 the project team should meet the following requirements and produce the following documentation:

   - Conduct Conceptual Design Review

- Complete Conceptual Design Report
- Approve Preliminary Project Management Plan (PPMP)
- Develop a Risk Management Plan (RMP)
- Develop a project cost range, initial cost estimate and schedule.
- Develop NEPA Determination
- Prepare a Preliminary Hazard Analysis Report
- Develop a preliminary Integrated Safety Management Plan, and
- Develop a preliminary Quality Assurance Plan
- Conduct a Safeguards and Security Vulnerability Assessment, if required
- Begin reporting monthly progress to BNL Project Oversight Board

2. The Preliminary Design will be finalized and approved as part of PD-2 (Project Decision 2) (similar to CD-2). The project Performance Measurement Baseline is

approved.

Project Decision 2 - The Preliminary Design and Project Baseline will be finalized and approved as part of PD-2 (Project Decision 2). A successful PD-2 Review will

be attained when the project team has estimated and time-phased the resources required to execute the project against an integrated project schedule, and a risk analysis is conducted to help determine the potential variability in scope, schedule and/or cost which might be encountered in the course of executing the project. To achieve PD-2 the project team should meet the following requirements and produce the following documentation:

- Conduct Preliminary/Technical Design Review
- Complete Preliminary/Technical Design Report
- Update and approve Project Management Plan (PMP)
- Develop a Performance Baseline including Resource-loaded schedule
- Finalize Hazards Analysis Plan
- Finalize Quality Assurance Program
- Update and approve funding changes
- Continue Monthly Reporting include Cost Performance Report
- Implement tailored Earned Value Management System (EVMS) and change

  control

- Review Project Risk Registry and assess Contingency
- Initiate Annual Status Review and EVMS Reporting after PD-2 approval.

3. The Final Design will be finalized and approved as part of PD-3 (Project Decision 3) (similar to CD-3). Procurement Execution authorization is approved.

   Project Decision 3 (PD-3) includes Approval of the Project Final Design requirements and specifications and Authorization to start Execution of the Project.

A successful PD-3 Review will be attained when it is determined that the state of the development of the project planning is adequately defined to execute the project plan for successful delivery of the project scope with effective management, resource planning, scheduling, risk assessment, and progress tracking at a level that ensures project delivery that addresses the expectations of the stakeholders. To achieve PD-3 the project team should meet the following requirements and produce the following documentation:

- Conduct Design Review of the final design requirements and specifications.
- Update Project Management Plan (PMP)
- Generate a preliminary Transition to Operations Plan
- Update Hazard Analysis Plan
- Continue Quality Assurance Program
- Update Project Integrated Safety Management Plan
- Continue Monthly Reporting include Cost Performance Report
- Implement tailored EVMS and change control
- Monitor Project Risks and Contingency
- Continue Annual Status Reviews

4. The Project Closeout will ensure all scope has been completed and approved as part of PD-4 (Project Decision 4) (similar to CD-4) and will be submitted to BHSO and the responsible DOE Program Office for concurrence after the PD-4 review has been held

and all open items have been addressed. The Laboratory Director will inform BHSO and the responsible DOE Program Office in writing that BNL has successfully completed all deliverables and KPPs and will request DOE concurrence on PD-4.

Project Decision 4 (PD-4) includes approval for Completion of the project or Start of Operations. A successful PD-4 Review will be attained when it is determined that the project has met the technical, cost, and schedule deliverables consistent with the approved project plan/objectives. To achieve PD-4 the project team should meet the following requirements and produce the following documentation:

- V erify KPPs are met
- V erify Scope completed, close accounts
- Finalize Hazard Analysis Plan
- Finalize Transition to Operations Plan
- Complete Project Closeout Report
- Document Lessons Learned

Qualifications for Project Director or Project Manager

The Project Director or Project Manager must be approved by the Laboratory Director or his designee. The Project Director or Project Manager must meet the following minimum requirements:

5. Either the Project Director or Project Manager on the project must have successfully completed BNL's Project Management Comprehensive Training Course, a similar course elsewhere, or have demonstrated experience managing projects.
6. The Project Director or Project Manager must have experience in delivering successful projects on time within budget.
7. The Laboratory Director must approve the Project Director or Project Manager

Independent High-Quality Cost Estimates:

BNL will follow the characteristics of a good estimate, the BNL Cost Estimating checklist and the BNL Standards-Based Management System (SBMS); best practice guidelines will be followed and documented in the Project Management Subject Area.

Project Controls Systems/Earned Value Management System

Projects over $20M will develop a tailored Earned Value Management System (EVMS) implementation which will meet the following EVMS principles:

Objectively assess accomplishments at the work performance level

Plan all work scope for the program from inception to completion

Break down the program work scope into finite pieces that can be assigned to a responsible person or organization for control of technical, schedule, and cost objectives

Integrate program work scope, schedule, and cost objectives into a performance measurement baseline plan against which accomplishments may be measured

Use actual costs incurred and recorded in accomplishing the work performed

Analyze significant variances from the plan, forecast impacts, and prepare an estimate at completion based on performance to date and work to be performed

Control changes to the baseline and maintain the baseline throughout contract execution

Use EVMS information in the organization's management processes with tailoring defined in the PMP.

These projects will use the standard project controls tools that are used on most BNL projects including: Primavera for scheduling, Cobra for Earned Value Reporting, PeopleSoft for Actual Costs and Procurement, and Integrated Project Database for reporting.

After PD-2 approval, the project will generate a monthly Cost Performance Report (CPR) each month by WBS that provides BCWS (planned value), BCWP (earned value) and ACWP (actual costs) for current month and cumulative to date. The cost and schedule variances and SPI and CPI indices will be calculated and reported each month along with the running SPI and CPI trends for the past six months. The calculated remaining contingency on the ETC will be calculated and reported each month. Variance analysis will be written for each Control Account when the cumulative cost and schedule variances exceed the thresholds to be determined by the Laboratory Director.

Some examples of EVMS tailoring include:

Perform monthly cumulative variance analysis only

Simplify change control thresholds and reduce change control documentation requirements

Simplify or eliminate the Work Authorization process to minimize excessive documentation.

Eliminate PARSII reporting for EVMS, prepare monthly reports CPR and scheduling status reports for Laboratory management and customer reporting.

Simplify or eliminate earned value assessment on contributed effort.

For projects less than $20M, EVMS is not required, however there is an expectation that the projects will develop a budget and schedule to measure performance against. Monthly reporting will be required to assess and report performance against the cost/schedule plan. Milestones will be established (one to two per quarter) for reporting schedule performance.

Project Oversight

The Project Oversight Board (POB) has been established by the Laboratory Director and chaired by the Deputy Director for Science and Technology to review monthly project performance, risk assessment, share lessons learned, ensure acceptable trends of performance on Laboratory large/critical projects and to provide assistance if needed, to line and project managers to resolve issues that may threaten budgets, schedules or key performance requirements. POB meetings will also serve as an opportunity to share

common experiences between Project and Laboratory managers and chartered by the Deputy Director for Science and Technology. DOE is invited and may be in attendance at the POB reviews.

The Project Oversight Board Subpanels (POB-S) are established by the Deputy Director for Science and Technology to serve as dedicated review teams tasked with assisting the Project Oversight Board (POB) in providing oversight to the Project Decision process to ensure project performance and improve overall project success at BNL. If the Laboratory Director identifies issues that require additional management attention, he can call on the POB to provide oversight and, if necessary, will convene a POB sub-panel review to assess the project performance in more detail. A charge will be developed for the review team by the Deputy Director for Science and Technology who will oversee the review process.

The project will report regularly to the ALD through the department Project Management Group (PMG) or equivalent, chaired by the ALD or their delegate, where project issues will be raised in a timely manner.

Baseline Change Control Thresholds

The project will establish a formal change control process that requires all baseline changes to be managed in a controlled manner. Changes are addressed with PCRs (Project Change Requests) that clearly describe the type of change (scope, cost, schedule or administrative) and the cause, impact and corrective action for the change. A baseline log will be maintained and approvals will follow the change control thresholds below:

Change Control Level	**Laboratory Director **:** Change Control Level 1	**Associate Laboratory Director** Change Control Level 2	**Project Director/ Project Manager** Change Control Level 3
Scope	Any changes in scope and/or performance that affect the ability to satisfy the mission need or that are not in conformance with the current approved Threshold KPPs	Any changes to scope/technical performance as described in the PMP	Changes in scope affecting the technical performance WBS Level 2 elements that do not affect the KPP's
Cost	Any increase in the Total Project Cost of the Project as stated in the PMP	Cumulative allocation of $50% of Contingency or Management Reserve*	Any Contingency or Management Reserve usage
Schedule	Any delay in PD-4, Approve Project Completion.	Any delay to a Project Decision Level 1 Milestone except PD-4 or Project Level 2 Milestones or use of schedule contingency	Any delay greater than or equal to three months to all Project Milestones to Level 3.

: Baseline Change Control Thresholds and Authorities

*After the cumulative threshold has been reached and the associated change approved, the cumulative cost thresholds will be reset. ** Level 1 changes will require review and concurrence by the Federal Program Manager and the BHSO Manager or his point of contact.

Project Reporting

The project will generate a monthly project performance/status report submitted to and reviewed by the Laboratory Director, DOE BHSO Manager, and the Program Office. Upon approval of the project baseline (PD-2), with DOE concurrence, a monthly cost/schedule performance report will be provided. Milestone status will be assessed on a monthly basis.

The project will conduct weekly meetings with the project team.

The project will define and manage the project progress with project milestones assigned at increasing authority levels which will be defined in the PMP:

- L1 Milestones – Laboratory Director and BNL Deputy Director for Science and Technology

- L2 Milestones –Associate Laboratory Director
- L3 Milestones – Project Director/Project Manager
- L4 Milestones – L2 WBS Manager/CAM

The responsible DOE Program Office will assign an annual PEMP goal to the Laboratory and hold the Laboratory accountable for successful execution of these projects under $50M.

Cost Savings Reporting

The BNL Project Management Center (PMC) will track, maintain and report all documented cost savings from implementation of this procedure. Types of cost savings include:

Cost savings from DOE and Lab personnel travel for CD Reviews will be part of the cost savings reporting.

Reducing the number of documents required for the CD Review process.

Tailoring of EVMS implementation and reduced requirements for oversight and surveillance of EVMS guidelines.

Labor saved from elimination of PARSII monthly EVMS reporting.

A more streamlined review process will reduce time required for review

preparation.

Additional costs to BNL for the organization of the independent reviews.

Cost Savings reporting will be provided to Laboratory management upon request and will be reported annually to the DOE BHSO Manager and the responsible DOE Program Office.

Appendix C – Review Committee members

sPHENIX MIE Associate Laboratory Director's Review
July 28-29, 2020

Review Committee Chair

Tom Cormier, ORNL
e-mail: cormiertm@ornl.gov

Subcommittee 1—Calorimeters and Tracking

- John Parsons Columbia
  Tom Cormier, ORNL
  Paul Grannis, SBU
  e-mail: parsons@nevis.columbia.edu, cormiertm@ornl.gov,
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Subcommittee 2—Data Acquisition, Triggers, and Electronics

- Myron Campbell, U of Michigan
  Rainer Bartoldus, SLAC
  Ken Read, ORNL
  Vivian O'Dell
  e-mail: myron@umich.edu, bartoldu@slac.stanford.edu, readkf@ornl.gov,
  odell@fnal.gov

Subcommittee 3—Environment, Safety and Health

- James Niehoff, Fermilab niehoff@fnal.gov

Subcommittee 4— Cost and Schedule

- Craig Brackett, SLAC
  Garrett Meek, ORNL
  e-mail: Brackett@slac.stanford.edu, meekgs@ornl.gov

Subcommittee 5— Project Management

- Ron Ray, FNAL
  Vincent Riot, LLNL
  e-mail: rray@fnal.gov, riot1@llnl

Appendix D – Answers to questions included in the Charge

Answers to the 2020 Charge Questions

1. *Project scope: Is the project executing its technical baseline in a manner to deliver the science? Is the current design maturity and fabrication progress appropriate for this stage of the project? Are all interfaces properly understood?*

Yes, though there remain risks to the schedule that will require careful management oversight.

2. *Cost and Schedule: Are the cost and schedule estimates, including contingency, complete, adequate, and reasonable based on project performance to date? Is contingency usage appropriate for this stage of the project? Is the project critical path clearly identified and understood?*

Yes, but see recommendation concerning project forecast schedule.

3. *Management: Is the project being properly managed at this stage? Are the risks properly identified and managed and are appropriate mitigation strategies in place? Is the technical progress on the long lead procurements adequate? Are the procurements being properly managed?*

Yes, the project is well managed. The risk register could benefit from a review of probabilities and impacts. Long-lead procurements are progressing well, and procurements overall appear to be adequately managed.

4. *Environment, Safety & Health and Quality Assurance (ES&H/QA): Are the ES&H/QA requirements being properly addressed given the project's current stage of development?*

Yes, the project ES&H and QA plans are well established. The Work Planning Controls and QA processes are well-documented and implemented.

5. *Recommendations: Has the project responded appropriately to previous review recommendations?*

Yes. However, the 2019 recommendation number 4 (*Review and update the risk register*) returns as a new recommendation this year: Revisit the risk register to check for consistency across the project as a whole and include any new information pertinent to COVID-related risks.

6. *COVID-19: Are the cost/schedule impacts from COVID-19 on the sPHENIX MIE cost and schedule understood and being properly assessed?*

Yes. The project has done a very good job of managing the COVID-19 impacts so far and is evaluating ongoing and possible future risks. The COVID-19 situation, and its very significant uncertainties, will demand continued close attention from project management.

Appendix E – Review Agenda

sPHENIX MIE Annual Project Review – July 28-29, 2020

Tuesday July 28, 2020

10:00 am	Review Committee Executive Session (25)	T. Cormier
10:25 am	Welcome (5)	M. Chamizo
10:30 am	Project Overview (25+15)	E. O'Brien
11:10 am	Science Mission (15+5)	D. Morrison or G. Roland
11:30 am	Project Management and Status (20+10)	G. Young
12:00 pm	Cost and Schedule (20+10)	C. Lavelle
12:30 pm	ES&H (15+5)	L. Stiegler
12:50 pm	Lunch and Executive Session (70)	
2:00 pm	Technical Overview (20+10)	J. Haggerty
2:30 pm	System Integration (20+10)	R. Feder
3:00 pm	Time Projection Chamber (20+10)	T. Hemmick
3:30 pm	Electromagnetic Calorimeter (20+10)	C. Woody
4:00 pm	Break (20)	
4:20 pm	Hadronic Calorimeter (20+10)	J. Lajoie
4:50 pm	Calorimeter Electronics (20+10)	E. Mannel
5:20 pm	DAQ/Trigger (20+10)	M. Purschke
5:50 pm	Minimum Bias Detector (15+5)	M. Chiu
6:10 pm	Committee Executive Session (60)	

Wednesday July 29, 2020

10:00 am	Homework QA (120)
12:00 pm	Lunch and Executive Session (60)
1:00 pm	Executive session and Report Writing (180)
4:00 pm	Dry Run (60)
5:00 pm	Close Out (30)