



Office of Project Assessment
Earned Value Management System (EVMS)
Surveillance Review Report on the

**Fermi Research Alliance,
LLC – Fermi National
Accelerator Laboratory
(FRA-FNAL)
at Fermi National Accelerator Laboratory**

March 2016

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1. SUMMARY OVERVIEW

A Department of Energy/Office of Science (DOE/SC) Earned Value Management System (EVMS) surveillance review of the Fermi Research Alliance, LLC-Fermi National Accelerator Laboratory (FRA-FNAL) was conducted at FNAL on March 7-8, 2016. The review was conducted by the Office of Project Assessment (OPA), and chaired by Robert Wunderlich, Consultant (DOE retired) for OPA.

The focus of the review was to ensure that FRA-FNAL continues to implement its contract-wide certified EVMS in accordance with the Electronic Industries Alliance (EIA)-748 Intent Guide across all applicable capital asset projects under DOE Order 413.3B, Program and Project Management for the Acquisition of Capital Assets. The review was conducted in accordance with the OPA EVMS Surveillance Guide and the FRA Surveillance Plan (Appendix A). The Surveillance Review Committee and the guidelines (GL) for which they were responsible are identified in Appendix B, and the review agenda is shown in Appendix C.

The FRA-FNAL EVMS was certified in January 2010 by DOE/Headquarters Office of Project Management Oversight and Assessments (formerly Office of Engineering and Construction Management). There were no significant changes to the previously certified FRA-FNAL EVMS and the Surveillance Committee did not uncover any issues with the EVM Systems Description or associated procedures.

Three projects were selected for participation at this surveillance review:

1. Muon g-2—a \$46.4 million Major Item of Equipment (MIE) project; Critical Decision (CD) 2/3, Approve Performance Baseline and Start of Construction, was obtained in August 2015; CD-4, Approve Project Completion, is scheduled for third quarter 2019.
2. Muon to Electron Conversion (Mu2e)—a \$273.7 million Line Item Construction project; CD-2/3b was approved in March 2015; CD-4 is scheduled for first quarter 2023.
3. Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment (LBNF/DUNE)—although the LBNF/DUNE project has not been baselined, it was reviewed for progress in implementing the FRA-FNAL EVMS and EIA-748 guidelines (GL) for long lead procurements and overall implementation strategies. A summary level presentation was provided to the Committee on the status of its plans for implementing the FRA-FNAL EVMS on the LBNF/DUNE project. It was noted that the Project Management Team was very aggressive in implementing a sound project management system for LBNF/DUNE. Early implementation of key elements of EVMS was a positive sign. Based on the October 2015 LBNF/DUNE Director's Review and the March 2016 EVMS Surveillance Review, the FNAL plan to implement the FRA-FNAL EVMS for the LBNF/DUNE project is reasonable, on track, and should continue to be implemented. Specific corrective actions from this Surveillance review report should be examined for their potential application to the LBNF/DUNE project, and where appropriate, they should be implemented.

The documents reviewed and individuals interviewed, as part of this review, are shown in Appendices D and E, respectively.

The Committee identified four Corrective Action Requests (CARs) and 10 Continuous Improvement Opportunities (CIOs / CIOs*). A summary of the CARs/CIOs are identified below with detailed supporting documentation included in Section 2 of this report. Upon implementation and acceptance of the corrective actions, OPA will provide notification that the FRA-FNAL EVMS remains compliant with the EIA-748 Standard.

1.1 Corrective Action Requests (CAR)

CAR-01, GL 6: CAM Understanding of their Schedules and Schedule Integrity is Inconsistent and Incomplete. Issues with planning and schedule integrity including logic issues, sequencing of activities, use of schedule float, inconsistent development of “steps” for activities and inability of Control Account Managers (CAMs) to clearly articulate critical path and near critical path activities.

CAR-02, GL 7: Long Duration Activities with EV Method of % Complete without Quantitative Progress Measures. Need to establish, upfront, more rigorous basis for reporting % Complete including strengthening performance measures using objective measures.

CAR-03, GL 12: Inconsistent Description of Use of Combined Level of Effort (LOE) and Discrete Activities (Process versus Practice)

CAR-04, GL 28: Ensure that Change Control Process “Bundling” is Consistently Performed with Traceable Results. The change control process includes bundling of baseline change requests (BCRs); however, there is a need to ensure that each BCR in the bundle is documented and traceable. A standardized process is desirable and the change control logs should include initiation date, approval date, and implementation date.

1.2 Continuous Improvement Opportunities (CIOs/CIOs*)

CIO-01, GL 2: Inconsistent and Incomplete Documentation/Configuration Management. Information provided to the Surveillance Committee was sometimes different than the official schedules; organization charts need to be updated; there were outdated links between system description and procedures; and CAM organization should be identified on the RAM and key contractors in the organization description.

CIO-02, GL 9: Negative Budgeted Values. Continue to refine the process for establishing the baseline without use of negative values.

CIO-03, GL 8: Define Process for Closing Control Accounts

CIO-04, GL 22: Lack of Visibility on “Contributed” or Un-costed Project Effort

CIO-05, GL 25: Reporting Calendar Included in Project Management Plan (PMP)

CIO-06, GL 21: CAMs Unaware of Invoice Payments Impacting their Projects. CAMs should be informed of contract terms and copied on correspondence to Technical Representatives for invoice approvals.

CIO-07, GL 19: Application of Indirect Expense. Consider apportioning the appropriate indirect costs to all projects associated with the contract as opposed to burdening a single project with the costs.

CIO-08, GL 23: Variance Thresholds May Not be Set at Appropriate Level

CIO-09*, GL-22: Lack of Face-to-Face Meetings between CAMs and Project Controls Staff

CIO-10*, Section 1.4 Cross-Cutting (below): Training.

1.3 Noteworthy Practices

The Committee documented several noteworthy practices that are being employed in the execution of the FRA-FNAL EVMS, including:

- A positive cultural change (changing from an operations focus to a project focus laboratory) at all levels at FNAL management.
- Use of a standardized (institutional) systems approach to project management in general, and EVMS in particular, has been a positive influence, principally since FNAL depends on a matrix management organization to achieve project success.
- Based on responses to interview questions and knowledge of the FRA-FNAL EVMS, CAMs have improved and have clearly embraced the EVMS culture.
- Introductory presentations, provided to the Surveillance Committee, helped to put FNAL, FRA-FNAL EVMS, as well as the Muon g-2, Mu2e, and LBNF projects into perspective.
- FNAL made considerable use of lessons learned from previous projects to make improvements in EVMS.
- The increased level of schedule detail is being used effectively by CAMs; often developing lower levels of schedule data than are required by the FRA-FNAL EVMS.
- The quality and information contained in the variance analyses have improved.
- FNAL Laboratory Management continued engagement in projects, through the Performance Oversight Group (POG) and Project Management Group (PMG), is a very positive activity in support of the EVMS objective to gather and analyze data for effective decision-making. The POG, which meets monthly to review project progress and issues, involves senior management including the Laboratory Director.
- Use of corrective action logs, SMART Tool, and electronic notebooks are a valuable means for improving the ability of the CAMs—FNAL should continue to enhance these processes.

1.4 Cross Cutting Issues

The Committee identified a set of cross-cutting issues that, if corrected, should minimize the re-occurrence of the identified corrective action requests. The FRA-FNAL EVMS Corrective Action Plan should address these cross-cutting issues:

1. Root and Cross-Cutting Issue (**see CIO-10* below**)—CAM training involves CAR-01, CAR-02, and CAR-03; and CIO-09* and CIO-10*. Although progress has been made, additional CAM guidance and training would be beneficial in improving the level of rigor in the (detailed) planning the project work. Some CAM performance practices differ from the FRA-FNAL EVMS policy and procedures (e.g., CAM Project Status Meetings).

Also, additional guidance/training is needed concerning the application of LOE and the method for measuring the amount of work completed, such as % Complete. The CAM training issue also involves a more complete review of the project schedules to ensure that logic and other issues do not remain in the baselined schedule. A checklist might also be helpful for this latter issue.

CIO-10*

Subject (Issue): Training

Reference Guidelines: GL 6, GL 7, GL 12, GL 22

Description of the Issue:

CAM training is needed for improved response/better understanding of details of FRA-FNAL EVMS with targeted training on scheduling, critical path analysis, and trend charts.

Recommendation:

- Targeted training on LOE, level of details in planning the project work, methods for measuring work, project scheduling, and trending. The training may include checklists and flow diagrams to assist the CAMs in implementing the procedures.

2. Portions of CAR-01 and CAR-04 include a repeat issue from previous surveillance reviews. FNAL management needs to ensure that formal closeout of corrective actions are documented and provide for the effective implementation of the FRA-FNAL EVMS, as well as ensure that the results are sustainable. Schedule logic, traceability, and tracking management reserve (MR) and contingency usage were issues identified in the February 2015 surveillance review (which resulted in two CARs), and although the tracking of MR and contingency usage has been resolved, traceability and schedule logic issues continue to be a concern (although progress has been made). Additional effort is needed to ensure sustainable solutions.
3. CIO-02, CIO-04, CIO-06, and CIO-08 each focus on areas where different projects handle data differently, such as contributed effort or specific thresholds. It may be valuable for the FNAL Project Office to examine these differences (primarily because FNAL utilizes a matrix organization) and determine if this practice creates a lack of clarity.

2. EVMS GUIDELINES

Area 1: Organization

Guideline 1: Define the authorized work elements for the program. A work breakdown structure (WBS), tailored for effective internal management control, is commonly used in this process.

Reviewer Name(s): Kurt Fisher, DOE/OPA
Compliant with EAI-748: **Yes**

Justification for Compliance: All three projects reviewed are implementing a work breakdown structure (WBS) consistent with FRA procedure Project Management Number 12.PM-001, Project WBS, Organizational Breakdown Structure (OBS), Responsibility Assignment Matrix (RAM). Both Muon g-2 and Mu2e developed a hierarchical, product-oriented WBS that includes all project scope and deliverables. The WBS is developed down to the Control Account, work package, and activity level and the WBS structure is consistently used for project performance reporting. The projects developed a WBS Dictionary as a separate document that defines the project scope/deliverables and is updated and maintained for all scope-related changes to the projects, down to WBS Level 5 in some cases. The LBNF/DUNE project presented an EVM Implementation Plan for the CD-3a, Approve Long Lead Procurement, scope of work that is consistent with FRA procedures for developing a WBS, and was tailored appropriately for the planned work to be undertaken.

Guideline 2: Identify the program organizational structure including the major subcontractors responsible for accomplishing the authorized work, and define the organizational elements in which work will be planned and controlled.

Reviewer Name(s): Kurt Fisher, DOE/OPA
Compliant with EAI-748: **Yes—with CIO-01 (below)**

Justification for Compliance: All three projects reviewed are implementing an OBS consistent with FRA procedure Project Management Number 12.PM-001. All three projects presented an OBS designed to define the projects team roles and responsibility for accomplishing the work scope. The Organizational Structure defines the relationship of the project team members and their respective work responsibility for the project. Each project identified the organizations that are assigned to the respective projects. Both Muon g-2 and Mu2e have developed a Project Execution Plan (PEP) and Project Management Plan (PMP) that identify the roles and responsibilities within the projects. LBNF/DUNE has a Preliminary PEP.

CIO-01**Subject (Issue): Inconsistent and Incomplete Documentation/Configuration Management**

Referenced Guideline(s): GL 2, GL 3

FRA EVM Procedure 12 PM-001 section 4.3 states, “The OBS helps management focus on establishing the most efficient organization to perform project work scope by taking into consideration availability and capability of management and technical staff, including subcontractors, to achieve the project objectives.” Major subcontractors are to be included in the OBS in addition to internal project organizations.” Criteria have been established defining a major subcontractor. Section 4.3 also states “Major subcontractors are to be included in the OBS in addition to internal project organizations.”

FRA EVM Procedure 12 PM-001 section 4.4 states, “The RAM is an essential element of the project plan that integrates the organizational structure defined in the OBS with the scope of work outlined in the WBS. The RAM establishes ownership of the work depicted in the WBS by linking the WBS and the OBS.” “EVMS RAMs will identify the control account managers (CAMs) for these intersection points by name.” “The Project Manager will identify the staff resources and the organizations necessary to participate in the planning and execution of the project.”

Referenced Data Trace: The Muon g–2, Mu2e, and LBNF/DUNE organization charts and OBS, and RAMs.

Description of Issue:

Some information provided to Surveillance Committee was different than the official schedules; organization charts need to be updated, outdated links between system description and procedures, CAM organization to be identified on the RAM, handling of key contractors in organization description. Some of the organization charts presented were outdated and require updating. The OBS for all projects can be strengthened by identifying the major/key subcontractors and the organizational element for the designated CAM who is responsible for managing that effort and ensuring that the status of this work is being accurately portrayed.

FNAL is highly dependent on a matrix organization. The RAMs for all three projects can be strengthened by identifying the organizational element for designated CAMs who are responsible for managing that effort and ensuring that the status of this work is being accurately portrayed.

Recommendations:

- Update the organization charts and the OBS and include the CAM organizational element and major subcontractors.
- The RAM for all three projects can be strengthened by identifying the organizational element in addition to the CAMs name and Control Accounts.

Guideline 3: Provide for the integration of the company’s planning, scheduling, budgeting, work authorization and cost accumulation processes with each other, and as appropriate, the program work breakdown structure and the program organizational structure.

Reviewer Name(s): Kurt Fisher, DOE/OPA

Compliant with EAI-748: **Yes—with CIO-01 (GL 2)**

Justification for Compliance: All three projects reviewed are implementing a RAM consistent with FRA procedure Project Management Number 12.PM-001. Each project developed and maintained a RAM that illustrates the integration of the WBS and OBS to define the Control Accounts. The Control Accounts are usually established at WBS Level 3 or 4. An individual

CAM is assigned responsibility for managing and completing the work scope for each Control Account within the budget outlined in the RAM.

The Work Authorization Document (WAD) is the vehicle used to assign responsibility for budget, schedule, and scope requirements to the CAM. The WADs are updated as the scope of work is modified through the change control process and remains current through the life of the project. The WADs have been reviewed and are current and consistent with Project Management—PM-003, Work Authorization.

Guideline 4: Identify the company organization or function responsible for controlling overhead (indirect costs).

Reviewer Name(s): Betsy O’Connell, ANL
Compliant with EAI-748: **Yes**

Justification for Compliance: The FNAL Chief Financial Officer (CFO) is responsible for establishing the indirect rate structure and monitoring performance of the Laboratory’s indirect rates.

A budget request is sent to all direct and indirect organizations annually. Budgets are reviewed and approved by Laboratory Management. These budgets serve as the basis for the indirect rates. The performance of the rates is analyzed each month. If rate variances are significant, the rates may be changed during the fiscal year, retroactive to October 1. The rates are adjusted to actual at year end.

Baseline Change Requests (BCRs) are prepared at the project level for any significant rate changes. Also, a project-level BCR is prepared at the beginning of the fiscal year to reflect the impact of the new fiscal year indirect rates on the projects.

Guideline 5: Provide for integration of the program work breakdown structure and the program organizational structure in a manner that permits cost and schedule performance measurement by elements of either or both structures as needed.

Reviewer Name(s): Kurt Fisher, DOE/OPA
Compliant with EAI-748: **Yes**

Justification for Compliance: All three projects reviewed are implementing an OBS consistent with FRA procedure Project Management Number 12.PM-001. The projects have established the Control Accounts at the intersection of the WBS and OBS. The size of the Control Accounts for each project is considered reasonable and manageable. The Control Accounts for Muon g–2 are established at WBS Level 3, and for Mu2e at WBS Level 3 or 4. Performance is reported by WBS in the Contract Performance Reports (CPR)/Format 1 and the project schedules are organized by WBS—status is measured monthly.

Area 2: Planning, Scheduling, and Budgeting

Guideline 6: Schedule the authorized work in a manner which describes the sequence of work and identifies significant task interdependencies required to meet the requirements of the program.

Reviewer Name(s): Greg Capps, ORNL / Cathy Lavelle, BNL / Jenn O'Connor, BNL
Compliant with EAI-748: **No—with CAR-01 (below)**

The Muon g-2 and Mu2e schedules are in Oracle Primavera and are composed of well-decomposed, distinct activities and milestones. The project contains logic ties between the activities and milestones, is logically driven, and is capable of generating a critical path.

In most cases, the level of activity decomposition seems very appropriate and reasonable. However, both projects show some instances of schedule task durations that appear to be excessive or have grown significantly in length once the task begins. In many cases, these excessive durations were explained as schedule delays due to the unavailability of labor resources.

While the overall project schedules appear well tied, there are many cases of questionable logic that has resulted in high float numbers. Due to the numerous logic issues observed, the project critical path and near critical paths are questionable. The schedules are organized by the project WBS and appear to reflect the scope of work described within the WBS Dictionary and discussed during CAM interviews.

The schedules are also resource loaded with detailed estimates of elements of cost, and the total costs and resources selected seem appropriate for the scope of work. However, the slips that have been identified in the schedule were often attributed to a lack of resources to perform the work, which does call into question either the estimated quantities of hours or the resource availability.

Both projects have established and are maintaining baseline schedules, and are conducting monthly status updates of their working schedules; and performance is monitored against the latest approved baseline.

CAR-01

Subject (Issue): CAM Understanding of their Schedules and Schedule Integrity is Inconsistent and Incomplete.

Referenced Guideline(s): GL 6

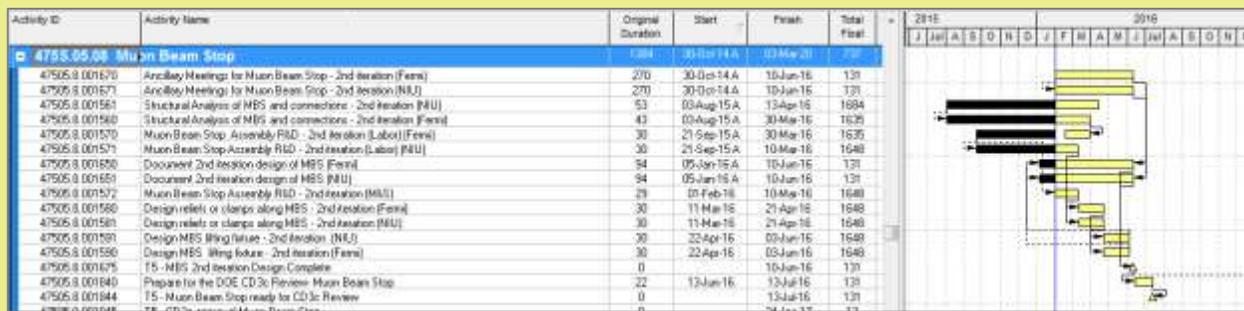
Referenced Data Trace: Detailed Schedule Review, Acumen FUSE Analysis, and CAM interviews

CAM Understanding of their Schedules. The most troubling aspect of the CAM interviews involved the general inability of the CAMs to identify their most critical path through the Control Account, or to assess their relationship to the project critical path or major project milestones. While the CAMs were very knowledgeable about their scope of work and demonstrated familiarity with their schedules, they did not appear to be comfortable, and could not easily utilize the schedules to answer questions regarding float or critical paths.

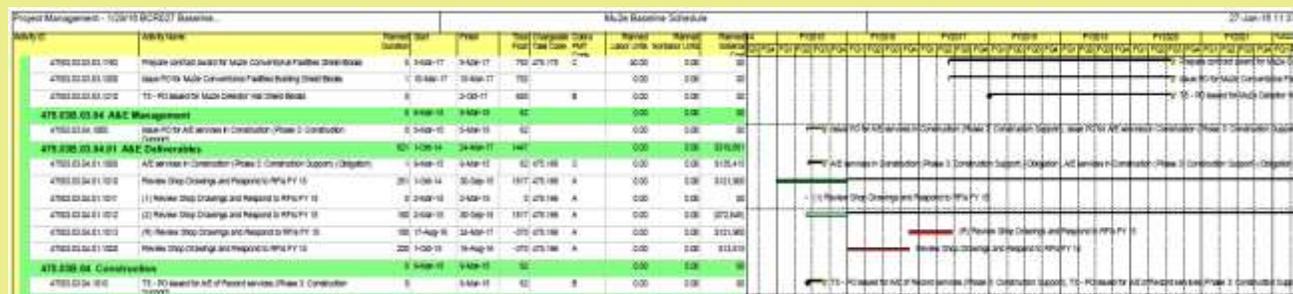
Schedule Integrity. Several findings surrounding schedule logic and status negatively impact the schedule integrity for both projects. To quantify the float issues, an analysis of the Mu2e schedule was conducted using DELTEK Acumen FUSE and the standard FUSE Schedule Analysis algorithm. While scoring well on many of the attributes, high float numbers in the schedule are hard to miss (see Primary Formula Analysis below).

Primary Formula Analysis													
		Ribbon Analyzer											
		Critical	Non-Critical	Negative Float	Zero Days Float	0 to 20 Days Float	20 to 30 days float	More than 30 days float	High Float	Avg Float	Max Float	Float Ratio™	Score
Ribbons	4755.01	11	26	0	11	5	0	21	21	465	1,602	1.97	76
	4755.02	4	561	0	4	6	0	555	555	632	1,737	17.01	39
	4755.03	4	98	0	4	2	0	96	96	500	1,657	8.61	57
	4755.04	16	535	0	16	42	10	483	478	295	1,737	6.16	58
	4755.05	7	269	0	7	62	2	205	181	253	1,736	4.9	68
	4755.06	4	263	0	4	0	0	263	263	374	1,736	17.25	57
	4755.07	10	110	1	9	4	29	77	73	257	1,639	2.44	47
	4755.08	4	140	0	4	12	0	128	128	255	1,717	6.47	63
	4755.09	0	84	0	0	0	0	84	84	352	1,691	9.59	51

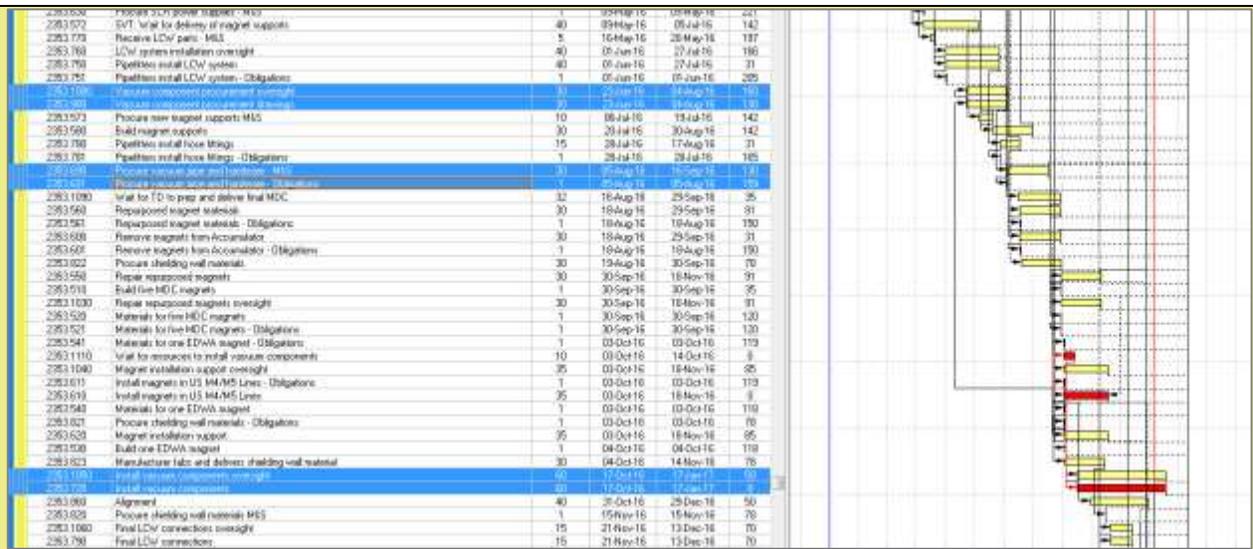
Below is an example of Mu2e activities with extremely high float numbers, mostly likely due to missing logic.



A data trace of the Mu2e baseline schedule showed a negative float of -370 days on activity 3.03.04.01.1013, A&E Deliverables Review Shop Drawings.



Additionally, a data trace confirmed during the CAM interview, identified a logic error in the 1.02.03.05.02 Implementation of the Storage Ring section of the Muon g-2 schedule; highlighted in “blue” below:



information to the CAMs and project management. If these issues exist, it will be difficult for the CAMS to use the schedule to understand the tool and use it properly to manage their scope of work.

Recommendations:

- The issues within the schedule should be addressed immediately to ensure the projects are monitoring the correct critical paths. Until the logic is corrected the projects critical paths are questionable.
- Working with the CAMs to correct the logic issues will also correct the CAM inability to discuss their schedules. It is suspected that the logic and status issues are exacerbating the CAM interview problem.

Guideline 7: Identify physical products, milestones, technical performance goals, or other indicators that will be used to measure progress.

Reviewer Name(s): Greg Capps, ORNL / Cathy Lavelle, BNL / Jenn O'Connor, BNL
Compliant with EAI-748: **No—with CAR-02 (below)**

The Muon g-2 and Mu2e projects use activities and milestones to identify tasks and deliverables, and these are tracking monthly against the baseline schedule. The CAMs identified Performance Measurement Techniques (PMT) for use within their Control Accounts, with most of the methods being LOE or % Complete.

To facilitate good performance measurement, the baseline schedules are generally decomposed to a level that progress is determined by task completion. For longer % Complete tasks, the projects are using "Steps" within Primavera or alternate performance tracking spreadsheets to quantify the % Complete.

While the use of Steps and performance tracking spreadsheets were observed in the CAM interviews, neither practices were used in all cases as prescribed by the FRA-FNAL EVM System Description (EVM-SD). There were a significant number of instances where activities using the % Complete PMT, spanned more than two accounting periods, but did not possess some objective measurement of work completed or remaining.

It was observed during CAM interviews and data traces that most CAMs are not using objective basis for assessing EV. Some CAMs indicated they use "actual cost" to determine EV when % Complete was identified as the PMT. Other CAMs indicated they use their judgement. The Committee saw some evidence of Steps in the schedule for EV % Complete. Additionally, the CAMs were developing a basis for objective EV for work packages where the duration of the activity was short initially but was subsequently delayed resulting in longer duration activities. The CAMs must develop a method for longer duration activities/work packages when the activity is delayed.

CAR-02

Subject (Issue): Long Duration Activities with EV method of % Complete without Quantitative Progress Measures

Referenced Guideline(s): GL 7

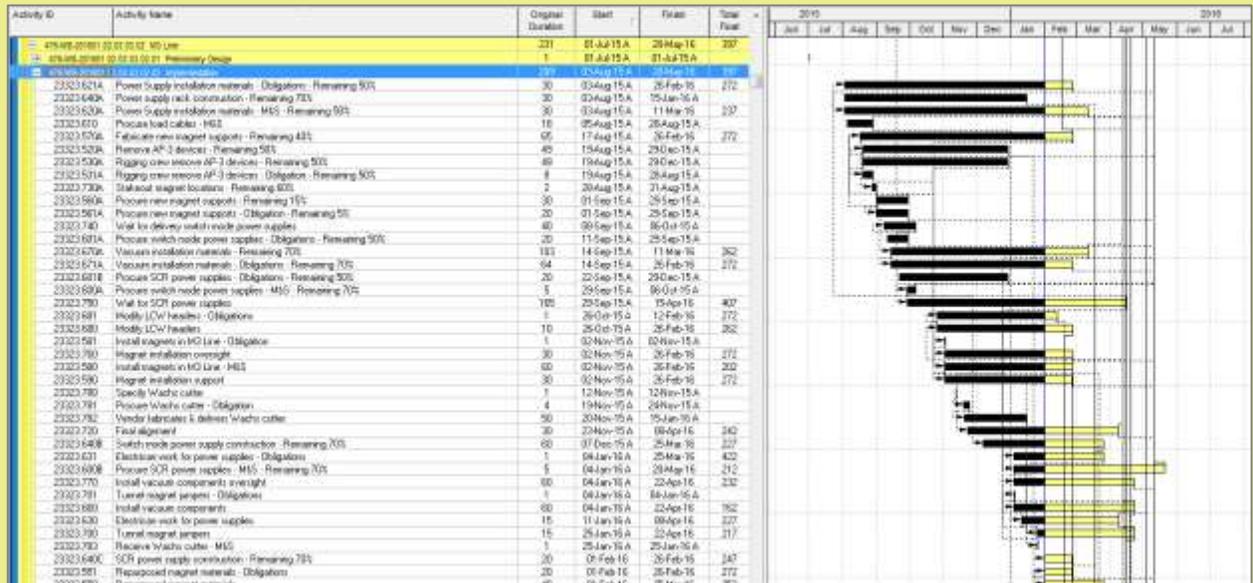
FNAL EVM-SD, 5.1.1, pages 34-35; Control Accounts, Work Packages, and Planning Packages 12.PM-002, 4.2, pg. 3.

Referenced Data Trace: Detailed Project Schedule Analysis, CAM interviews, Supplemental % Complete Data

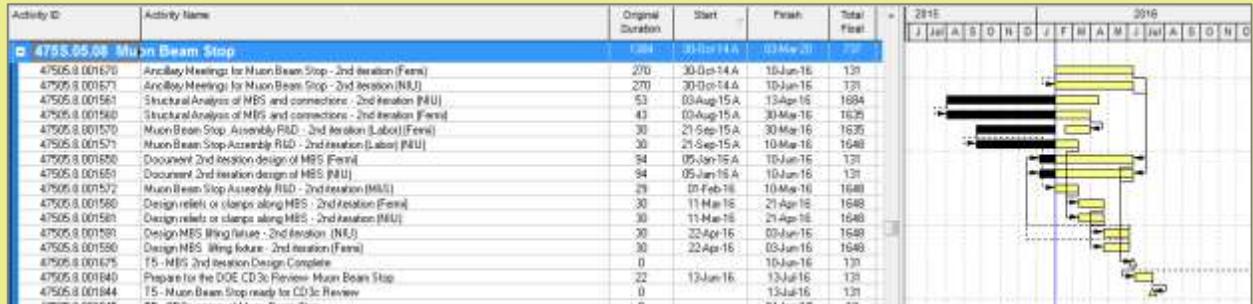
During the CAM interviews for Muon g-2 and Mu2e, there were schedule activities with the PMT of % Complete with planned durations greater than two accounting periods that did not have objective measures for establishing status. This violates the FRA-FNAL EVM-SD.

Additionally, there were many instances of activities with planned durations that were less than 2 accounting periods but had actual durations that had slipped to much greater length, which would then need some objective measure of % Complete. In many cases, these excessive durations were explained as schedule delays due to resource limits that “stretched out the activity”.

While the activities in the following Muon g-2 example start early and include some “budgeting and accounting tasks”, the durations on all the tasks are significantly longer than planned.



This example of Mu2e activities not only has high float numbers, but also a significant growth duration (from the planned duration).



These examples largely exemplify situations where activities were decomposed sufficiently at the baseline, but changed over time. While these may be from one perspective compliant with the FRA-FNAL EVMS, their significant duration slips bring into question how % Complete is determined.

Description of Issue:

The FRA-FNAL EVM-SD states in two documents that PMT used should have objective measures. For the PMT of % Complete there should be objective measures, and the User Defined method should be used on activities of less than 2 financial accounting periods. There were significant instances of non-compliance with the FRA-FNAL EVMS to warrant a CAR in this area.

Recommendations:

- For both projects, develop objective % Complete measures on applicable activities to be compliant with the FRA-FNAL EVMS.
- Develop guidance on handling performance measurement on applicable activities that slip greater than two accounting periods.

Guideline 8: Establish and maintain a time-phased budget baseline, at the Control Account Level, against which program performance can be measured. Initial budgets established for performance measurement will be based on either internal management goals or the external customer negotiated target cost including estimates for authorized but undefinitized work. Budget for far-term efforts may be held in higher level accounts until an appropriate time for allocation at the Control Account Level. On government contracts, if an over-target baseline is used for performance measurement reporting purposes, prior notification must be provided to the customer.

Reviewer Name(s): Greg Capps, ORNL / Cathy Lavelle, BNL / Jenn O'Connor, BNL
Compliant with EAI-748: **Yes—with CIO-03 (below)**

Justification for Compliance: Both Muon g-2 and Mu2e presented a time-phased budget baseline at the Control Account Level, along with Control Account Plan (CAP) reports and basis of estimate (BOE) documents. Both projects utilize both work packages and planning packages. The budget values and overall baseline totals were validated against the dollarized RAM for each project, as well as the CPRs and WADs posted for this review.

CIO-03

Subject (Issue): Define Process for Closing Control Accounts

Referenced Guideline(s): GL 8

Referenced Data Trace: CAM interviews

Description of Issue:

During interviews it was revealed that the CAMs were unsure of how to close a Control Account once all work was completed in that account. FNAL Project Management confirmed that there is no Control Account closure process defined and acknowledged there should be a process.

Recommendation:

- FNAL Project Management should define a process for closing out Control Accounts, and ensure that the CAMs are aware of their responsibilities in implementing this process.

Guideline 9: Establish budgets for authorized work with identification of significant cost elements (labor, material, etc.) as needed for internal management and for control of subcontractors.

Reviewer Name(s): Greg Capps, ORNL / Cathy Lavelle, BNL / Jenn O’Connor, BNL
 Compliant with EAI-748: **Yes—with CIO-02 (below)**

Justification for Compliance: The budgets for both Muon g–2 and Mu2e were established using a BOE process that entailed the identification of resources needed to complete the scope of work. Each project utilizes detailed WADs at the Control Account Level, which include budget for authorized work with identification of significant cost elements such as labor and materials. These WADs are updated after each baseline change. Budget values presented were consistent with the budget values shown on the posted RAM, CAP reports, CPR, and WADs.

CIO-02
Subject (Issue): Negative Budgeted Values

Referenced Guideline(s): GL 9

GL 9 states that each Control Account should contain the resources necessary to complete the assigned effort and the budgets reflecting these resources. The negative values diminish the objective evidence that should be found in a resource loaded schedule.

Referenced Data Trace:

Data traces of Mu2e revealed negative budget values that the CAMs interviewed were unable to explain (See Exhibit 1 example below from P6 baseline schedule).

Exhibit 1

Activity ID	Activity Name	BL Project Start	BL Project Finish	BL Project Total Cost	Budgeted Total Cost
+ Project: Mu2e475S.01	Project Management - 1/29/16 Baseline after BCR027 with 20160129 status	02-Mar-15	02-Mar-15	(\$19,780.58)	(\$19,780.58)
+ Project: Mu2e475S.02	Accelerator - 1/29/16 Baseline after BCR027 with 20160129 status	28-Apr-14	13-May-15	(\$733,188.97)	(\$733,188.97)
+ Project: Mu2e475S.03	Conventional Construction - 1/29/16 Baseline after BCR027 with 20160129 status	28-Apr-14	25-May-16	(\$20,893,209.37)	(\$20,893,209.37)
+ Project: Mu2e475S.04	Solenoids - 1/29/16 Baseline after BCR027 with 20160129 status	30-Apr-14	20-Feb-17	(\$5,733,042.36)	(\$5,733,042.36)
+ Project: Mu2e475S.05	Muon Beamline - 1/29/16 Baseline after BCR027 with 20160129 status	30-Apr-14	08-Jun-16	(\$199,552.89)	(\$199,552.89)
+ Project: 4Mu2e75S.06	Tracker - 1/29/16 Baseline after BCR027 with 20160129 status	30-Apr-14	15-Jul-15	(\$1,055,297.01)	(\$1,055,297.01)
+ Project: 4Mu2e75S.07	Calorimeter - 1/29/16 Baseline after BCR027 with 20160129 status	30-Apr-14	05-Oct-15	(\$829,298.41)	(\$829,298.41)
+ Project: Mu2e475S.08	Cosmic Ray Veto - 1/29/16 Baseline after BCR027 with 20160129 status	30-Apr-14	28-Apr-15	(\$616,744.71)	(\$616,744.71)
+ Project: Mu2e475S.09	Trigger & DAQ - 1/29/16 Baseline after BCR027 with 20160129 status	30-Apr-14	31-Mar-15	(\$179,030.00)	(\$179,030.00)

Description of Issue:

Project Management explained that these negative values resulted during the baseline process when setting Budgeted Cost of Work Scheduled (BCWS) and Budgeted Cost of Work Performed (BCWP) equal to actuals. These negative values are designated as “CD-2 Baseline Single Point Adjustment” shown in Exhibit 2 below.

Exhibit 2

Activity ID	Activity Name	BL Project Start	BL Project Finish	BL Project Total Cost	Budgeted Total Cost
- Mu2e475S.02.01.03		02-Mar-15	02-Mar-15	(\$4,867.80)	(\$4,867.80)
475.008 CD2	475.008 CD-2 Baseline Single Point Adjustment	02-Mar-15	02-Mar-15	(\$4,867.80)	(\$4,867.80)
- Mu2e475S.02.03		28-Apr-14	02-Mar-15	(\$3,118.40)	(\$3,118.40)
- Mu2e475S.02.03.01		28-Apr-14	28-Apr-14	(\$3,092.00)	(\$3,092.00)
- Mu2e475S.02.03.01.1		28-Apr-14	28-Apr-14	(\$3,092.00)	(\$3,092.00)
475.152 ADJ	Internal Baseline Single Point Adjustment (S=P=A)	28-Apr-14	28-Apr-14	(\$3,092.00)	(\$3,092.00)
- Mu2e475S.02.03.02		02-Mar-15	02-Mar-15	(\$23.50)	(\$23.50)
- Mu2e475S.02.03.02.1		02-Mar-15	02-Mar-15	(\$4.80)	(\$4.80)
475.016 CD2	475.016 CD-2 Baseline Single Point Adjustment	02-Mar-15	02-Mar-15	(\$4.80)	(\$4.80)
- Mu2e475S.02.03.02.2		02-Mar-15	02-Mar-15	(\$18.70)	(\$18.70)
475.019 CD2	475.019 CD-2 Baseline Single Point Adjustment	02-Mar-15	02-Mar-15	(\$18.70)	(\$18.70)
- Mu2e475S.02.03.03		02-Mar-15	02-Mar-15	(\$2.90)	(\$2.90)
475.099 CD2	475.099 CD-2 Baseline Single Point Adjustment	02-Mar-15	02-Mar-15	(\$2.90)	(\$2.90)
- Mu2e475S.02.04		02-Mar-15	02-Mar-15	(\$700.59)	(\$700.59)
- Mu2e475S.02.04.02		02-Mar-15	02-Mar-15	(\$700.59)	(\$700.59)
- Mu2e475S.02.04.02.1		02-Mar-15	02-Mar-15	(\$700.19)	(\$700.19)
47502.04.02.1.001016	Per (1) Extraction location change to inside of ring; Make MARS calc. c	02-Mar-15	02-Mar-15	(\$700.19)	(\$700.19)
- Mu2e475S.02.04.02.2		02-Mar-15	02-Mar-15	(\$0.40)	(\$0.40)
475.695 CD2	475.695 CD-2 Baseline Single Point Adjustment	02-Mar-15	02-Mar-15	(\$0.40)	(\$0.40)
- Mu2e475S.02.05		28-Apr-14	13-May-15	(\$91,650.91)	(\$91,650.91)
- Mu2e475S.02.05.02		28-Apr-14	13-May-15	(\$44,440.16)	(\$44,440.16)
475.045 CD2	475.045 CD-2 Baseline Single Point Adjustment	02-Mar-15	02-Mar-15	(\$31,146.60)	(\$31,146.60)
47502.05.02.001132	design (2), build, & test prototype vac chamber w/ small prototype C-f	02-Mar-15	13-May-15	(\$6,115.38)	(\$6,115.38)
47502.05.02.001131	design (1), build, & test prototype vac chamber w/ small prototype C-	02-Mar-15	02-Mar-15	(\$5,549.47)	(\$5,549.47)
47502.05.02.001086	Continue (1) working w/ small prototype, R & D, etc, also develop FEA	02-Mar-15	02-Mar-15	(\$1,342.30)	(\$1,342.30)
475.045 ADJ	Internal Baseline Single Point Adjustment (S=P=A)	28-Apr-14	28-Apr-14	(\$286.41)	(\$286.41)
- Mu2e475S.02.05.04		28-Apr-14	28-Apr-14	(\$2,593.71)	(\$2,593.71)
475.057 ADJ	Internal Baseline Single Point Adjustment (S=P=A)	28-Apr-14	28-Apr-14	(\$2,593.71)	(\$2,593.71)
- Mu2e475S.02.05.05		28-Apr-14	02-Mar-15	(\$40,611.75)	(\$40,611.75)
475.061 CD2	475.061 CD-2 Baseline Single Point Adjustment	02-Mar-15	02-Mar-15	(\$31,736.10)	(\$31,736.10)
47502.05.05.001091	Test AM digitizer and DAC (1)	02-Mar-15	02-Mar-15	(\$6,593.05)	(\$6,593.05)
47502.05.05.001101	Develop of timing system (1)	02-Mar-15	02-Mar-15	(\$1,427.25)	(\$1,427.25)
47502.05.05.001061	Simulate Feedback Regulation Logic (1)	02-Mar-15	02-Mar-15	(\$437.93)	(\$437.93)
475.059 ADJ	Internal Baseline Single Point Adjustment (S=P=A)	28-Apr-14	28-Apr-14	(\$417.42)	(\$417.42)
- Mu2e475S.02.05.06		28-Apr-14	28-Apr-14	(\$123.68)	(\$123.68)
475.063 ADJ	Internal Baseline Single Point Adjustment (S=P=A)	28-Apr-14	28-Apr-14	(\$123.68)	(\$123.68)
- Mu2e475S.02.05.07		28-Apr-14	02-Mar-15	(\$3,881.61)	(\$3,881.61)
- Mu2e475S.02.05.07.2		28-Apr-14	28-Apr-14	(\$1,334.08)	(\$1,334.08)
475.072 ADJ	Internal Baseline Single Point Adjustment (S=P=A)	28-Apr-14	28-Apr-14	(\$1,334.08)	(\$1,334.08)
- Mu2e475S.02.05.07.3		02-Mar-15	02-Mar-15	(\$2,547.53)	(\$2,547.53)
47502.05.07.3.001061	Fabricate (1) the prototype of the supply with higher voltage FETs (1)	02-Mar-15	02-Mar-15	(\$2,547.53)	(\$2,547.53)

Project Management stated this practice is currently in the process of being refined. These same data traces also identified negative values that may or may not be a result of establishing the CD-2 Baseline (no reference to CD-2 Single Point Adjustment). With the exception of certain BCRs, negative budget values are not typical. However, negative budget values were evident throughout the Mu2e schedule shown in Exhibit 3 below.

Exhibit 3

Activity ID	Activity Name	BL Project Start	BL Project Finish	BL Project Total Cost	Budgeted Total Cost
- Mu2e475S.02.07		28-Apr-14	02-Mar-15	(\$16,838.62)	(\$16,838.62)
- Mu2e475S.02.07.01		02-Mar-15	02-Mar-15	(\$2,462.03)	(\$2,462.03)
47502.07.01.004011	Final Design - Fixed magnet Supports (1)	02-Mar-15	02-Mar-15	(\$1,374.47)	(\$1,374.47)
47502.07.01.004023	Final Design - Beam Stop (1)	02-Mar-15	02-Mar-15	(\$712.31)	(\$712.31)
47502.07.01.001016	Final (1) magnet layout and identification New Design (1)	02-Mar-15	02-Mar-15	(\$375.25)	(\$375.25)
- Mu2e475S.02.07.03		02-Mar-15	02-Mar-15	(\$4,104.65)	(\$4,104.65)
47502.07.03.001116	Final Vacuum Design (1)	02-Mar-15	02-Mar-15	(\$3,293.37)	(\$3,293.37)
47502.07.03.002001	Final LCW system design (remaining) (1)	02-Mar-15	02-Mar-15	(\$419.25)	(\$419.25)
47502.07.03.002011	Final compressed air system design (1)	02-Mar-15	02-Mar-15	(\$392.03)	(\$392.03)
- Mu2e475S.02.07.02		02-Mar-15	02-Mar-15	(\$12.68)	(\$12.68)
47502.07.02.001031	Final Design - power supply specifications (1)	02-Mar-15	02-Mar-15	(\$12.68)	(\$12.68)

Recommendation:

- FNAL Project Management should continue to refine the process for establishing the baseline so that it eliminates the use of negative budget values. It is also recommended that all negative budget values contained throughout the Mu2e project be reviewed and applicable processes refined as necessary in order to reduce the use of negative budget values whenever possible.

Guideline 10: To the extent it is practicable to identify the authorized work in discrete work packages, establish budgets for this work in terms of dollars, hours, or other measurable units. Where the entire Control Account is not subdivided into work packages, identify the far term effort in larger planning packages for budget and scheduling purposes.

Reviewer Name(s): Greg Capps, ORNL / Cathy Lavelle, BNL / Jenn O'Connor, BNL
Compliant with EAI-748: **Yes**

Justification for Compliance: Both projects breakdown their budget into discrete work packages and planning packages that summarize to Control Accounts in the RAM. The budgets are loaded into P6 at the activity level by hours and direct material dollars as measureable units. These units are priced in Cobra to establish the time-phased budget using rates established by the Budget Office. The work packages have an Earned Value Technique (EVT) assigned. Most CAMs interviewed indicated they had no planning packages in their Control Accounts. During CAM interviews, some CAMs indicated that they did have planning packages. There also seemed to be confusion on the part of the CAMs about when/how to detail plan the planning packages and what documentation is required to detail a planning package. There should be more emphasis in the CAM training concerning the process of detail planning a work package. Cost and schedule variances are collected at the Control Account Level for both projects. Some inconsistencies were noted during the CAM interviews:

- CAM (Mu2e) stated he had only one planning package left but WAD documents identify several planning packages in his Control Accounts (WAD packages were last time updated in November/December 2015—these should have been updated).
- CAM (Mu2e) was unclear of when to convert planning package to work package, and thought it to be six months, when procedures state one month.
- CAM was unclear if converting a planning package to a work package required a BCR.

Guideline 11: Provide that the sum of all work package budgets plus planning package budgets within a Control Account equals the Control Account budget.

Reviewer Name(s): Greg Capps, ORNL / Cathy Lavelle, BNL / Jenn O'Connor, BNL
Compliant with EAI-748: **Yes**

Justification for Compliance: The sum of all the work package and planning package budgets equals the Control Account budget for Muon g-2 and Mu2e. The RAM was used to verify the budget in the project baseline and budgets reported in the CPR and RAM as of December 2015 were reconciled through a data trace conducted for both projects.

Guideline 12: Identify and control level of effort activity by time-phased budgets established for this purpose. Only that effort which is unmeasurable or for which measurement is impracticable may be classified as level of effort.

Reviewer Name(s): Greg Capps, ORNL / Cathy Lavelle, BNL / Jenn O'Connor, BNL
Compliant with EAI-748: **No—with CAR-03 (below)**

The Muon g-2 and Mu2e projects each have work packages that contain LOE work scope. The LOE activities were typically project management or oversight support activities and distinctly separate from discrete work. During the CAM interviews and discussions, there was an understanding of LOE and its proper use. However, the coding of activities in the WAD and schedule indicated that some of the activities' PMT were LOE, but the RAM indicated there were no LOE activities in the Control Account. In addition, there were many instances of a mixing of LOE and discrete work within a Control Account. Time-phased budgets are established on both projects and the use of LOE activities within the schedule appeared identifiable and coded as LOE. Total LOE by project was 20% for Muon g-2 and 21% for Mu2e—the percentages were high relative to the accepted guidance of 15% to 19%.

An issue is the apparent discrepancy between the policy/procedure that indicates there will not be a mixing of LOE and discrete work by Control Account and the practice. In reviewing and comparing the schedule coding of EV type work and the RAM and CAM interviews, there was a discrepancy/inconsistency between the documentation and practice. Some clarity is needed. If the guidance is 15-19%, then the EVMS documentation should reflect this and the CAMs trained accordingly. There is a need to review the data to make sure that the data is consistent with the FNAL process.

CAR-03

Subject (Issue): Inconsistent Description of Use of Combined LOE and Discrete Activities (Process versus Practice)

The EVMS overview presentation stated no mixing of LOE and discrete tasks within same Control Account. FNAL procedures state there is no mixing of LOE and discrete EV methods in the Control Accounts. The RAM clearly shows a mix of LOE and discrete as indicated by the percentages. Data traces of schedule show mixing of LOE and discrete within same Control Account. Performance Measurement PMT Procedure 12.PM-004 Section 2 General Guidance.

During several CAM interviews, the CAMs indicated they did not mix LOE and discrete. Several CAMs stated they did not have any LOE in any of their Control Accounts, that the management of their accounts were in a separate account, and all their work was discrete. Data Traces indicated this is not the case in practice.

Referenced Guideline(s): GL 12

GL 12 states "Level of effort work packages should be separately identified from discrete effort work packages." "Level of effort must be limited to those activities that are unable to be measured discretely to avoid distorting project performance data."

Referenced Data Trace: Muon g-2 Project 476.05 BNL Equipment Disassembly and Transport per the RAM LOE is 14% of the work which is valued at 546,581, 475.05.11; Mu2e - Muon Beamline Systems Integration, per the RAM 15% of the work within this Control Account is LOE, several work packages are coded as LOE.

There are multiple examples where the RAM indicates there are no work packages coded as LOE, but the schedule indicated there were (e.g., exhibited below WBS 475.06.02- Straws). The RAM indicates there are no LOE activities but the schedule example below clearly indicates there are.

Muon g-2—two Control Accounts have a mixture of LOE and discrete tasks:

- 476.01 Project Management (Committee thought this would be all LOE) 99% LOE
- 476.05 BNL Equipment Disassembly & Transport 14% LOE

Mu2e—several Control Accounts (more than half) have a mixture of LOE and discrete tasks:

- 475.02.01 Project Management 98% LOE
- 475.02.03 Instruments and Controls 12% LOE
- 475.02.04 Radiation Safety Improvements 18% LOE
- 475.02.05 Resonant Extraction System 7% LOE
- 475.02.07 External Beamline 4% LOE
- 465.05.01 Muon Beamline Project Management 88% LOE
- 475.08.01 Cosmic Ray Veto Project Management 87% LOE

For Control Account 475.04.08 Magnetic Field Mapping System, the RAM posted shows no LOE. However, a data trace of the WAD package for this account (exhibited below) identified two activities, one containing 30 labor hours coded as LOE and one containing 126 labor hours coded as LOE. The percentage of LOE usage is not properly reflected on the RAM for this Control Account. The data trace example is shown on page 21—this is an example of where the mix of LOE and discrete work within a control account can “mask” the EV value for the discrete work.

There are multiple examples where the RAM indicates there are no LOE work packages but the schedule indicated there are LOE work packages (e.g. WBS 475.06.02 – Straws). The RAM indicates there are no LOE activities but the schedule example (exhibited below) clearly indicates there are.

Description of Issue:

The corrective action from the February 2014 FRA-FNAL EVMS Surveillance Review indicated that rather than looking at a percentage of LOE for the project, the project would be better served in determining if “all discrete are properly identified”. The project views all oversight as not discrete. However, in reviewing the EV methods indicated by work package in the schedule and comparing this to the RAM there were discrepancies. The RAM indicated there were not LOE-coded activities in the schedule but the schedule indicated there were LOE EVT assigned. This illustrates a discrepancy between the stated process and the implementation of the use of LOE vs. discrete in practice in each project.

Recommendation:

- FNAL should review the use of LOE on their projects and ensure: 1) consistency between the documentation and implementation of their process within the projects, 2) consistency between the schedule and the RAM; and 3) minimize the use of LOE activities within Control Account where discrete work is planned. As indicated in previous reviews, the project should maintain a separation of LOE and discrete work at the “cost coding, control account and project levels to ensure LOE data does not skew earned value of discrete work”.



Mu2e Project
Mu2e WAD Activities

Cobra PMT Code Legend

A = Level of Effort C = Physical Percent Complete D = Unit
E = 50-50 F = 0-100 K = Planning Package

Activity ID	Activity Name	Start	Finish	Cobra PMT Code	Funding Type
Lamm, Mike		7/2/12 A	8/9/19		
Control Account: 475.04.08 Magnetic Field Mapping System		7/2/12 A	8/9/19		
475.252 ADJ	Internal Baseline Single Point Adjustment (3P/A)	4/30/14A	4/30/14A	C	DOE HEP LN PED
475.252 CD2	475.252 CD-2 Baseline Single Point Adjustment	3/2/15	3/2/15	C	DOE HEP LN PED
475048.001070	Produce preliminary engineering design for Magnetic Field Map Sys - FY13	7/2/12 A	9/30/13 A	C	DOE HEP LN PED
475048.001071	Produce preliminary engineering design for Magnetic Field Map Sys - FY14 from 5/1/14	5/1/14	9/30/14	C	DOE HEP LN PED
475048.0010711	Produce preliminary engineering design for Magnetic Field Map Sys - FY14 from 5/1/14 Adj1	3/2/15	3/2/15	C	DOE HEP LN PED
475048.0010712	Produce preliminary engineering design for Magnetic Field Map Sys - FY14 from 5/1/14 Adj2 Replan	3/2/15	7/2/15	C	DOE HEP LN PED
475048.001090	Produce preliminary design drawings- Magnetic Field Map Sys	10/1/14	10/28/14	C	DOE HEP LN PED
475048.0010901	Produce preliminary design drawings- Magnetic Field Map Sys Adj1	3/2/15	3/2/15	C	DOE HEP LN PED
475048.0010902	Produce preliminary design drawings- Magnetic Field Map Sys Adj3 Replan (Argonne)	7/23/15	9/28/15	C	DOE HEP LN PED
475048.001100	Prepare draft specifications for Magnetic Field Map Sys	2/14/14A	4/25/14A	C	DOE HEP LN PED
475048.001130	Produce final engineering design for Magnetic Field Map Sys	1/30/15*	1/30/15	C	DOE HEP LN PED
475048.001131	Produce final engineering design for Magnetic Field Map Sys - Reduction	1/30/15*	1/30/15	C	DOE HEP LN PED
475048.001132	Produce final engineering design for Magnetic Field Map Sys - Replan	8/5/15	1/29/16	C	DOE HEP LN PED
475048.001134	Produce final engineering design for Magnetic Field Map Sys - Replan Adj2 Future Reduction	9/1/15	1/29/16	C	DOE HEP LN PED
475048.001135	Produce final engineering design for Magnetic Field Map Sys - Replan Adj3 Replan	10/28/15	4/2/16	C	DOE HEP LN PED
475048.001140	Produce final design for Magnetic Field Map Sys (Argonne work)	12/1/15	3/18/16	C	DOE HEP LN PED
475048.001150	Provide software for Mu2e Field Mapping System	12/1/15	2/26/16	C	DOE HEP LN PED
475048.001180	Provide Survey & Alignment support for utilizing a laser tracker for FMS design	12/1/15	3/3/16	C	DOE HEP LN PED
475048.001180	Prepare bid packages for purchased parts	1/2/18	1/1/18	C	DOE HEP LN CNSTR
475048.001190	Prepare bid packages for fabricated Magnetic Field Mapping System components	1/2/18	1/1/18	C	DOE HEP LN CNSTR
475048.001210	Prepare magnetic field mapping system purchased parts bid package	1/24/18	2/2/18	C	DOE HEP LN CNSTR
475048.001280	Evaluate vendor proposals for fabricated Magnetic Field Mapping System components	1/12/18	1/12/18	C	DOE HEP LN CNSTR
475048.001270	Award Contract for fabricated Magnetic Field Mapping System components	1/16/18	1/16/18	C	DOE HEP LN CNSTR
475048.001282	Vendor delivers Magnetic Field Mapping System components	5/23/18	5/23/18	C	DOE HEP LN CNSTR
475048.001300	Evaluate vendor proposals for magnetic field mapping system purchased parts	2/23/18	3/8/18	C	DOE HEP LN CNSTR
475048.001320	Evaluate vendor proposals for purchased parts	1/12/18	1/26/18	C	DOE HEP LN CNSTR
475048.001330	Prepare contract award for magnetic field mapping system purchased parts	3/9/18	3/19/18	C	DOE HEP LN CNSTR
475048.001340	Evaluate vendor progress & performance of fabrication of Field Mapping System components	1/18/18	5/22/18	A	DOE HEP LN CNSTR
475048.001350	Award Contract: purchased parts -Magnetic Field Mapping	1/29/18	1/29/18	C	DOE HEP LN CNSTR
475048.001362	Vendor delivers Magnetic Field Mapping System purchased parts	3/2/18	7/26/18	K	DOE HEP LN CNSTR
475048.001380	Administer Contract for Magnetic Field Mapping System purchased parts	3/2/18	8/16/18	A	DOE HEP LN CNSTR
475048.001400	Conduct acceptance testing for all Magnetic Field Mapping System parts- Labor	7/27/18	9/7/18	C	DOE HEP LN CNSTR
475048.001420	Prepare system components for assembly	9/10/18	9/2/18	C	DOE HEP LN CNSTR
475048.001430	Write assembly drawings	9/24/18	11/16/18	C	DOE HEP LN CNSTR
475048.001440	Review and revise drawings	11/19/18	12/18/18	C	DOE HEP LN CNSTR
475048.001450	Approve drawings	12/19/18	12/27/18	C	DOE HEP LN CNSTR
475048.001460	Assemble system - Labor (Planning Package)	12/28/18	5/8/19	K	DOE HEP LN CNSTR
475048.001490	Test system - Labor	5/23/19	7/25/19	K	DOE HEP LN CNSTR
475048.001520	Prepare system for installation	8/9/19	8/9/19	C	DOE HEP LN CNSTR

submit their annual budget requests. The budgets are reviewed and modified as necessary and become the basis for the proposed indirect expense rates. The budgets and rates are reviewed and approved if acceptable to the scientific programs and Laboratory management. The final indirect rates are approved and communicated by the CFO at the beginning of the fiscal year.

The overhead pools are structured in a way that any overhead or support organization is included in only one of the general and administrative (G&A) rate pools as described in the Laboratory's Disclosure Statement. The performance of the provisional rates is monitored monthly by the CFO. Any significant rate variances may be adjusted retroactively to the beginning of the year. The provisional rates are adjusted to actual at year end and variances are spread back to the programs previously assessed.

Guideline 14: Identify management reserves and undistributed budget.

Reviewer Name(s): Greg Capps, ORNL / Cathy Lavelle, BNL / Jenn O'Connor, BNL
Compliant with EAI-748: **Yes**

Justification for Compliance: Both Muon g-2 and Mu2e maintain a MR that is reported in the CPR each month. Contingency and MR are tracked in the change control log. MR is authorized through the Baseline Change process and is "replenished" from contingency. The Project Manager has authority over use of the MR. For both projects, MR is an allocation of funding through the change control process. Undistributed budget (UB) is not used on either project but there are circumstances (Field Changes) where the use of UB should be considered for Mu2e.

Guideline 15: Provide that the program target cost goal is reconciled with the sum of all internal program budgets and management reserves.

Reviewer Name(s): Greg Capps, ORNL / Cathy Lavelle, BNL / Jenn O'Connor, BNL
Compliant with EAI-748: **Yes**

Justification for Compliance: The Control Account budgets plus MR and contingency for Muon g-2 and Mu2e reconcile to the total program budgets, as evidenced by reviewing and reconciling the RAM, CPR, and monthly reports and change control logs against the total project cost (TPC) for both projects.

Area 3: Accounting Considerations

Guideline 16: Record direct costs in a manner consistent with the budgets in a formal system controlled by the general books of account.

Reviewer Name(s): Betsy O'Connor, ANL
Compliant with EAI-748: **Yes**

Justification for Compliance: Transactions are reported in FNAL's Oracle Financials general ledger or in subsystems to the general ledger that are imported into the financial system for

processing and reporting. For example, employees report their effort weekly in the Kronos time reporting system. The effort is reported in hours to each project and each employee is assigned an hourly rate or pay category. The product of hours times the rate is posted in the general ledger as labor or effort cost.

The Variance Analysis Report (VAR) for 475.03.04.01, “Mu2e Detector Service Building & Hall” indicated that the variance of \$25K was due to the misapplication of an invoice. The error was traced in the financial system. The correction of the misapplication was also verified and entered into the system on March 3. When errors occur, they are identified and corrected quickly.

Guideline 17: When a work breakdown structure is used, summarize direct costs from Control Accounts into the work breakdown structure without allocation of a single Control Account to two or more work breakdown structure elements.

Reviewer Name(s): Betsy O’Connor, ANL
Compliant with EAI-748: **Yes**

Justification for Compliance: A crosswalk from the WBS codes used by the projects to the chargeable task codes used in FNAL’s official financial system was provided. The chargeable task codes may be at a lower level than the WBS Level 4 but not higher, which assures that direct costs from the task codes are allocated to a single WBS element.

In the past, the official financial system used the WBS as the chargeable task code; however, the chargeable task code structure for Muon g–2 and Mu2e is different with each WBS level established as a single chargeable task code. This new structure can make it more challenging to roll-up financial data in the financial system but simplifies the reporting in the EVMS.

Guideline 18: Summarize direct costs from the Control Accounts into the contractor’s organizational elements without allocation of a single Control Account to two or more organizational elements.

Reviewer Name(s): Betsy O’Connor, ANL
Compliant with EAI-748: **Yes**

Justification for Compliance: The January spotlight reports for both Muon g–2 and Mu2e were traced to the financial reports without issue. Materials purchases were traced from the financial system to the procurement system successfully.

Labor was traced from the Kronos time reporting system to the financial reports, including verification of the pay category and standard rate. Standard labor rates were implemented in FY 2016 and appear to be functioning in accordance with the Disclosure Statement. The standard rates eliminate the sensitivity of using actual labor rates and therefore provide more transparency to managers. The Budget Office is responsible for establishing and monitoring the standard rates. The rates are hourly rates that are normalized to a 40-hour work week.

CAMs were knowledgeable about the labor reporting process and most stated that they review labor reports weekly to verify the accuracy of the charges. CAMs are quick to contact employees who have charged the project in error and corrections are processed in a timely manner.

Guideline 19: Record all indirect costs that will be allocated to the project.

Reviewer Name(s): Betsy O’Connor, ANL
Compliant with EAI-748: **Yes—with CIO-07 (below)**

Justification for Compliance: The indirect expense for WBS 475.01.04 “Project Management Construction” was verified. The indirect expense was computed using the current provisional indirect rates and was applied in accordance with the Laboratory’s Disclosure Statement.

CIO-07

Subject (Issue): Application of Indirect Expense

Referenced Guideline(s): GL 19

Referenced Data Trace: WBS 475.03.04.01 Mu2e Detector Service Building and Hall Fixed Price

Description of Issue:

When comparing financial information reported in the financial system to the EVMS for WBS 475.03.04.01 “Mu2e Detector Service Building & Hall Fixed Price”, it was observed that there was no indirect expense applied to the project cost.

	Current Month Costs	Current YTD Costs	Current YTD Obligations	Inception To Date Costs
475 - Mu2e				
475.169 - Conv Const -- Service Type: PL-LI-CONST-MU2E				
<u>Materials & Services</u>				
COMP-SFTW LIK	0.00	0.00	0.00	0.00
EX-CIVIL CONS	702,263.79	2,439,624.67	1,635,301.00	6,838,756.36
Exp. Category Budget				
Materials & Services	702,263.79	2,439,624.67	1,635,301.00	6,838,756.36
<u>Indirect Cost</u>				
G&A ALLOC-M&	0.00	0.00	0.00	0.00
MSA ALLOC	0.00	0.00	0.00	0.00
Exp. Category Budget				
Indirect Cost	0.00	0.00	0.00	0.00
TASKSUBTOTAL				
W/O INDIRECT:	702,263.79	2,439,624.67	1,635,301.00	6,838,756.36
TASKSUBTOTAL	702,263.79	2,439,624.67	1,635,301.00	6,838,756.36
W/INDIRECT:				

The cost in this WBS was associated with one contract, which was awarded first to another project and modified to include the work for this Detector Service Building & Hall. In accordance with the Laboratory’s Disclosure Statement, indirect expense was assessed on the first \$500K of contract cost only. The first \$500K was charged to the first project and all of the indirect expense was assessed to the first project too. Therefore, no indirect expense associated with this contract will be charged to the Mu2e project even though the project benefitted from the work of the FNAL’s indirect organizations (e.g., Procurement and Accounting) in awarding and administering this contract modification.

Recommendation:

- FNAL should consider apportioning the appropriate indirect costs to all projects associated with a contract as opposed to burdening the first project with \$500K in costs. Another option would be to restart the cap on costs annually to reflect that administrative work is required to support a contract every year, such as additional contract modifications and paying monthly invoices.

Guideline 20: Identify unit costs, equivalent unit costs, or lot costs when needed.

Reviewer Name(s): Betsy O'Connor, ANL

Compliant with EAI-748: **Not Applicable**

This guideline applies to manufacturing. As a research and development organization, this guideline does not apply to FNAL.

Guideline 21: For EVMS, the material accounting system will provide for:

- **Accurate cost accumulation and assignment of costs to Control Accounts in a manner consistent with the budgets using recognized, acceptable, costing techniques.**
- **Cost performance measurement at the point in time most suitable for the category of material involved, but no earlier than the time of progress payments or actual receipt of material.**
- **Full accountability of all material purchased for the project including residual inventory.**

Reviewer Name(s): Betsy O'Connor, ANL

Compliant with EAI-748: **Yes—with CIO-06 (below)**

Justification for Compliance: In accordance with generally accepted accounting principles for an accrual based accounting system, FNAL records the cost of materials when they are received. The CAMs indicated that they were knowledgeable of the process for material accruals. In addition, FNAL's Cost Accounting Standards Disclosure Statement stated that materials are costed when received.

The CAMs may accrue the cost of services or other items that do not pass through the receiving department. Two CAMs explained that they contact outside organizations (Argonne National Laboratory (ANL), Northern Illinois University) that are working on the project to get cost estimates for the work completed during the month. The estimates are reviewed and submitted to accounting for accrual. The focus for accruals is on inception-to-date cost.

Accruals are submitted electronically and can be uploaded into FNAL's financial system. Before the month-end close, a final review of the accruals is performed by comparing the inception-to-date cost submitted to the inception-to-date cost in the financial system. Variances are investigated and typically caused by invoices entered into the system after accruals were prepared, which requires an adjustment to the accrual. All accruals reverse automatically at the beginning of the following month.

CIO-06

Subject (Issue): CAMs Unaware of Invoice Payments Impacting Their Projects

Referenced Guideline(s): GL 21

Referenced Data Trace: 476.02.03.03 M2 M3 Line – Power Supplies

Description of Issue:

One CAM explained that though he knew about the work to be performed on his WBS, he was unaware of progress payments that were being made to the vendor and did not expect any cost until the work was complete. He stated that he never saw the contract or the invoice and never approved the payments.

The CAM requested the services of a Power Supply Engineer to assist with the power requirements for the project. The engineer developed the statement of work (SOW), requested the services through the Laboratory's procurement system and was named as the Technical Representative on the contract. The contract was awarded with progress payments. As invoices for progress payments were received, they were routed to the Technical Representative (the Power Supply Engineer) for review and approval, who approved the invoices. This is the standard process at the Laboratory and a typical process found at most organizations.

Recommendation:

- The appropriate CAMs should be informed of contract terms and should be copied on all emails to Technical Representatives for invoice approvals. Accounts Payable could add the CAM to the invoice routing and/or the Technical Representative could be instructed to inform the CAMs of contract terms and invoice payments.

Area 4: Analysis and Management Reports

Guideline 22: At least on a monthly basis, generate the following information at the Control Account and other levels as necessary for management control using actual cost data from, or reconcilable with, the accounting system:

- **Comparison of the amount of planned budget and the amount of budget earned for work accomplished. This comparison provides the schedule variance.**
- **Comparison of the amount of the budget earned and the actual (applied where appropriate) direct costs for the same work. This comparison provides the cost variance.**

Reviewer Name(s): Lynda Gauthier, MSU / Rick Larson, LBNL

Compliant with EAI-748: **Yes—with CIO-04 and CIO-10* (below)**

Justification for Compliance: Each month, Project Controls provides performance reports to CAMs including a CPR/Format 1 at the Control Account Level (WBS Level 3), and a Stoplight Report at both the Control Account Level and the work package level. Both reports include current month and cumulative-to-date values for planned budget, earned and actual costs, and accurately calculate Schedule Variance and Cost Variance. The Schedule and Cost Performance Indices (SPI/CPI) are calculated on the CPR for both current and cumulative-to-date values while the Stoplight Report only includes SPI and CPI on the cumulative-to-date values. CAMs frequently use the CPR and Stoplight Reports to perform analysis and find them very useful.

CIO-04

Subject (Issue): Better Visibility for Contributed Effort

Referenced Guideline(s): GL 22

Referenced Data Trace:

CAMs interviewed for Mu2e Beamline (WBS 475.05) and for Muon g-2 Precision Field (WBS 476.03.08) managed Control Accounts with significant un-costed effort contributed by other institutions. The Mu2e

Beamline has 19K hours of contributed effort and planned effort in the Muon g-2 Precision Field Control Account is 80% contributed.

One CAM indicated he was not looking at the contributed effort and another CAM stated he monitors the effort by watching the schedule. This same CAM understood that he needed to watch the contributed effort but did not think he needed an additional report.

Description of Issue:

Un-costed effort is not reported on separately, which may prevent management from accurately assessing performance on contributed work scope. CAMs may be unable to determine status, analyze variances, and effectively make managerial decisions regarding contributed effort. While monitoring the schedule provides some visibility, a report calculated in hours showing EV and variances for only contributed effort would be beneficial.

Recommendation:

- Consider a process for ensuring better visibility for ‘contributed effort’.

CIO-09*

Subject (Issue): Lack of Face-to-Face meetings between CAMs and Project Controls Staff

Referenced Guideline(s): GL 22

Referenced Data Trace:

The “EVMS Implementation in Mu2e” presentation indicated that “Local CAMs have face-to-face meetings with Project Controls” to status schedule and milestones, review Estimate to Complete (ETC), and look ahead at new activities scheduled to begin soon to make sure resources are available.

All three CAMs interviewed from the Mu2e project indicated that they report status via a spreadsheet received from Project Controls rather than attend face-to-face meetings.

Description of Issue:

It is important for project management to understand that Mu2e project CAMs are not having face-to-face meetings with Project Controls to actively status milestones, review the ETC, and assess resource needs. It may be beneficial for CAMs to have face-to-face meetings as intended and/or actively discuss the topics surrounding schedule status during the monthly Project Management Group meeting.

Recommendation:

- CAMs should physically meet with the Project Controls representative each month to report status and look ahead at new activities scheduled to begin soon.

Guideline 23: Identify, at least monthly, the significant differences between both planned and actual schedule performance and planned and actual cost performance, and provide the reasons for the variances in the detail needed by program management.

Reviewer Name(s): Lynda Gauthier, MSU / Rick Larson, LBNL

Compliant with EAI-748: **Yes—with CIO-08 (below)**

Justification for Compliance: Each month Project Controls provides performance reports to CAMs on both Muon g-2 and Mu2e. The reports include a CPR/Format 1 at the Control Account Level

(WBS Level 3), as well as a Stoplight Report at the work package level that includes summary values at the Control Account Level. Both reports include current month and cumulative-to-date values for planned budget, earned and actual costs and accurately calculate Schedule Variance and Cost Variance. The SPI/CPI are calculated on the CPR for both current and cumulative-to-date values while the Stoplight Report only includes SPI and CPI on the cumulative-to-date values.

Both reports are color coded to coincide with the variance thresholds as defined for each project. For Muon g-2, thresholds are defined in the Project Management Plan. For Mu2e, thresholds are defined in the Monthly Status Reporting procedure (Revision 6), section 4.3, Management Variance Analysis Report and Thresholds.

Muon g-2 Variance Analysis Thresholds:

Variance Analysis Thresholds for Control Accounts - Management		
Green Thresholds -- Cost and Schedule Performance Outside of Yellow or Red Thresholds		
Yellow Thresholds		
Cost Variance Schedule Variance	Data Collection Period	Threshold Limit
Dollars	Current Period Negative	≥-10% to <-5% and ≥\$50K
	Current Period Positive	≥+10% to <+20% and ≥\$100K
	Cumulative Negative	≥-10% to <-5% and ≥\$100K
	Cumulative Positive	≥+10% to <+20% and ≥\$200K
Red Thresholds		
Cost Variance Schedule Variance	Data Collection Period	Threshold Limit
Dollars	Current Period Negative	<-10% and ≥\$100K
	Current Period Positive	≥+20% and ≥\$200K
	Cumulative Negative	<-10% and ≥\$200K
	Cumulative Positive	≥+20% and ≥\$400K

Mu2e Variance Analysis Thresholds:

Variance Analysis Thresholds for Control Accounts		
Green Thresholds – Cost and Schedule Performance falling outside of yellow or red thresholds		
Yellow Thresholds		
Cost Variance Schedule Variance	Type	Threshold limit
Dollars	Current Period	≥ ± 5% to < ± 10% and ≥ \$50K
	Cumulative	≥ ± 5% to < ± 10% and ≥ \$100K
Red Thresholds		
Cost Variance Schedule Variance	Type	Threshold limit
Dollars	Current Period	≥ ± 10% and ≥ \$100K
	Cumulative	≥ ± 10% and ≥ \$200K

According to the Monthly Status Reporting procedure (Revision 6), section 4.2, CAM Variance Review and Analysis, variances exceeding red thresholds, require the responsible CAM to prepare a VAR and have the report reviewed and accepted by the Project Manager.

A selection of VARs written for Muon g-2 and Mu2e (December 2015-February 2016) were reviewed for completeness, quality, and proper management approval. Each VAR was found to include appropriate root cause explanations, impact, and corrective action (if needed). Each report had the proper management approval as well.

CIO-08**Subject (Issue): Variance Thresholds May Not be Set at Appropriate Level**

Referenced Guideline(s): GL 23

Referenced Data Trace:

Muon g-2, Control Account 476.02.03, Beamlines (BAC=\$11.9M, 54% complete), January 2016 Stoplight report shows cumulative positive SV of \$513K or 9%, which does not require a VAR because the threshold is set at \$400K and 20%. This Control Account had the largest cumulative schedule variance for the project for the December 2015-February 2016 reporting periods but did not require a VAR.

Muon g-2, Control Account 476.03.08, Precision Field (BAC=\$1.3M, 57% complete as of January 2016). The CAM for this Control Account stated he had not written a VAR within the last year.

Description of Issue:

Variance thresholds may not be set at the appropriate level to provide management with early warnings and enough time to implement corrective actions.

Recommendation:

- Review the scale and appropriateness of variance analysis thresholds between projects.

Guideline 24: Identify budgeted and applied (or actual) indirect costs at the level and frequency needed by management for effective control, along with the reasons for any significant variances.

Reviewer Name(s): Lynda Gauthier, MSU / Rick Larson, LBNL
Compliant with EAI-748: **Yes**

Justification for Compliance: The FNAL indirect rate structure has become more complex over the years with attention to line item construction projects and a shift to standard labor rates. However, the assessment of the indirect expense in the financial statements was traced and verified. The application of indirect expense was found to be in compliance with the Laboratory's Cost Accounting Standards Disclosure Statement and used the Laboratory's current fiscal year rates.

As stated in the Monthly Status Reporting procedure (Revision 6), section 4.2, CAM Variance Review and Analysis, Project Controls provide CPRs to the CAMs showing status and variances for their assigned Control Accounts, including both direct and indirect costs.

While FNAL projects do not control indirect costs, CAMs interviewed understood that changes to indirect rates can affect their Control Accounts but are reviewed by the laboratory on an annual basis. CAMs acknowledged that changes affecting their Control Accounts, as a result of the annual review, are communicated via BCRs. The impact of indirect rate changes is calculated retroactively to the start of the fiscal year but is implemented as current period adjustments.

Guideline 25: Summarize the data elements and associated variances through the program organization and/or work breakdown structure to support management needs and any customer reporting specified in the project.

Reviewer Name(s): Lynda Gauthier, MSU / Rick Larson, LBNL
Compliant with EAI-748: **Yes—with CIO-05 (below)**

Justification for Compliance: Each month Project Controls provides performance reports to CAMs including a CPR/Format 1 at the Control Account Level (WBS Level 3), as well as a Stoplight Report at both the Control Account Level and the work package level. Both reports include current month and cumulative-to-date values for planned budget, earned and actual costs and accurately calculate Schedule Variance and Cost Variance. SPI/CPI are calculated on the CPR for both current and cumulative-to-date values, while the Stoplight Report only includes SPI and CPI on the cumulative-to-date values.

Both reports are color coded to coincide with the variance thresholds as defined for each project. For the Muon g-2 project, thresholds are defined in the PMP. For the Mu2e project, thresholds are defined in the Monthly Status Reporting procedure (Revision 6), section 4.3, Management Variance Analysis Report and Thresholds.

CAMs stated they frequently use the CPR and Stoplight Reports to perform analysis and find them very useful. While CAMs also receive Control Account Level EV performance charts and CPI/SPI trend charts, no one interviewed stated they used them. CAMs should be reminded to review the performance charts each month so they can monitor trends as they relate to management actions (see also CIO-10*, Section 1.4).

CIO-05

Subject (Issue): Reporting Calendar Included in Project Management Plans (PMP)

Referenced Guideline(s): GL 25

Referenced Data Trace:

The FRA-FNAL EVM-SD (version 8.0), section 5.3.2, Monthly Reporting Cycle states, “In its Project Management Plan document each project must include a calendar for producing internal and external reports that allows for both quality checks and adjustments to the project plan.”

The Monthly Status Reporting procedure (revision 6), section 4.9, Schedule for Monthly Reporting Cycle, states, “Project Management Plan documents for each project must include a calendar for producing internal and external reports that allows for both quality checks and adjustments to the project plan.”

The Muon g-2 PMP (August 12, 2015), section 7.3, Reporting and Review, does not include a reporting calendar. The Mu2e PMP (December 19, 2014), section 7.3, Reporting and Review, does not include a reporting calendar.

Description of Issue:

While neither PMP includes a specific reporting calendar, section 7.3, Reporting and Review, of each PMP states, “The Project provides reports on a regular basis to FNAL and DOE management. The objective of the reporting is to provide for the collection and integration of essential technical, cost, schedule and performance data into reports to aid in the monitoring and management of the Project.”

Both projects have reporting calendars available electronically to the project team. These calendars include due dates for PARSII/OHEP, Variance Analysis Report approval, and PMG/POG meeting dates. CAMs interviewed were familiar with the calendar and understood the timing of the reporting cycle.

Recommendation:

- Consider removing requirement for PMP documentation to include a monthly reporting calendar.

Guideline 26: Implement managerial action taken as the result of earned value information.

Reviewer Name(s): Lynda Gauthier, MSU / Rick Larson, LBNL

Compliant with EAI-748: **Yes**

Justification for Compliance: The Monthly Status Reporting procedure (Revision 6) section 4.2, CAM Variance Review and Analysis, states, “After accepting the analysis, the Project Manager (or designee) will not any required corrective action in the Corrective Action Log. The corrective action log status shall be monitored and updated when necessary, at least on a monthly basis until the action is closed.”

Both projects maintain Corrective Action Logs and review the logs during the monthly PMG and POG meetings. It is evident that managerial action is being taken as a result of the monthly EV variance analysis:

- For example, the December 2015 VAR for Muon g–2 Beamlines, WBS 476.02.03, indicated a vendor progress payment was made but not accounted in the schedule. To prevent this from happening again, the CAM took action by regularly reviewing a list from procurement for his payments.
- In another example, a January 2016 VAR for Mu2e Cryo Distribution System, WBS 475.04.05, helped the CAM address a resource issue by working with other leaders in the organization and securing additional resources with the skillset needed to advance the schedule.

Guideline 27: Develop revised estimates of cost at completion based on performance to date, commitment values for material, and estimates of future conditions. Compare this information with the performance measurement baseline to identify variances at completion important to company management and any applicable customer reporting requirements including statements of funding requirements.

Reviewer Name(s): Lynda Gauthier, MSU / Rick Larson, LBNL

Compliant with EAI-748: **Yes**

Justification for Compliance: The FRA-FNAL EVM-SD (version 8.0), section 5.2.6, Project Performance Analysis, states, “Control Account Managers periodically develop a comprehensive Estimate at Completion (EAC) at the Control Account Level using all available information to arrive at the best possible estimate.” Also in section 5.2.6, “On a monthly basis, CAMs review the status of expended effort and the achievability of the remaining forecasted work using all available information to arrive at the best possible EAC.”

At the time of this review, Muon g-2 had not yet developed a comprehensive EAC (as it was baselined within the last year, CD-2/3a, August 2015); Mu2e was in the process of developing a comprehensive EAC.

CAMs for both projects indicated they owned and reviewed their EAC values monthly. Each month, CAMs are provided with calculated EAC values down to the work package level on the Stoplight Report. The calculated EAC is based on Baseline at Completion (BAC) and cost variances to date. The Stoplight Report also includes a Variance at Completion (VAC) column. CAMs have the opportunity to manually adjust the calculated EAC and are very familiar with this process. Each month, CAMs review their remaining work in the schedule (either in P6 or schedule pdf views). Some CAMs review the remaining work at the lower, chargeable task code level.

Area 5: Revisions and Data Maintenance

Guideline 28: Incorporate authorized changes in a timely manner, recording the effects of such changes in the budgets and schedules. In the directed effort prior to negotiation of a change, base such revisions on the amount estimated and budgeted to the program organizations.

Reviewer Name(s): Julia Chaffin, SLAC / Lenny Mucciaro, Consultant
Compliant with EAI-748: **No—with CAR-04 (below)**

Data traces were conducted on Muon g-2 BCRs 019, 022, 029, 032, and 035, and on Mu2e BCRs 16, 18, 22, 24, 25, 26, 27, and 28, which represented changes to the projects from April 2015 to January 2016. The documentation varied between projects and each project established their own logs and tables; however, the Committee's review included the project change request forms, meeting notes, P6 schedules, various before and after baseline pivot tables, WADs, change request logs, project budget logs, CPR/Format1, and the monthly progress status reports. The practice of bundling BCRs makes it very difficult to trace and understand impacts, especially when there are as many as eight WBS elements affected by the change and the data is inconsistent. FNAL should consider limiting the number of change actions to be included in a BCR to 3, 4, 5, or whatever is considered reasonable depending on the scope of work that is impacted, the budget values, changes to the schedule and critical path, and changes in MR and/or contingency.

When attempting to do data traces on BCRs, it was difficult to determine if the changes were incorporated into the performance baseline in a timely manner because the Mu2e change control log does not include the initiation, approval or implementation dates, or only the submitted date; however, the approval date is on the BCR form with the appropriate signatures and the implementation date may be included on the budget log although it is not labeled. The Muon g-2 change control log does include both the submittal and approval dates, but not the initiation or implementation date. The information on the BCRs varied, the quality of the BCR packages varied, and in some cases information was omitted making it difficult for the Committee to ensure changes were being incorporated into the baseline in a timely manner and lead to the issuance of CAR-04.

It is recommended that the change logs be update to include initiation dates, approval and implementation dates, the BCR packages be consistent, and quality checks be performed to ensure completeness and accuracy of the data included in the package. The Muon g–2 BCR 19 had a complete before and after monthly spread of the BCWS from October 2012 through March 2017. The monthly spread with before and after changes should be part of every BCR package to ensure incorporating the entire change in a timely manner and to demonstrate that retroactive changes to the baseline are not occurring. Traceability and tracking MR and contingency usage was an issue identified in the February 2015 surveillance review resulting in two CARs, and although the tracking of MR and contingency usage has been resolved, traceability continues to be a concern of the Committee. The Committee does acknowledge that significant progress has been made.

The CAMs interviewed did understand the change control process although additional training in the process, approval thresholds, and documentation requirements would improve the overall quality of the BCRs.

CAR-04

Subject (Issue): Ensure that Change Control Process “bundling” is Consistently Performed with Traceable Results

Referenced Guideline(s): GL 28, GL 30

Referenced Data Trace: Data traces were conducted on Muon g–2 BCRs 019, 022, 029, 032, and 035, and Mu2e BCRs-16, 18, 22, 24, 25, 26, 27, and 28, which represented changes to the projects from April 2015-January 2016

Description of Issue:

When attempting to do data traces on BCRs, it was difficult to determine if the changes were incorporated into the performance baseline in a timely manner because the Mu2e change control log does not include the initiation, approval or implementation dates, only the submitted date; however, the approval date is on the BCR form with the appropriate signatures and the implementation date maybe included on the budget log although it is not labeled.

Recommendation:

- A standardized process is needed to ensure that individual changes can be tracked. It is recommended that the change logs be update to include initiation dates, approval and implementation dates, the BCR packages be consistent, and quality checks be performed to ensure completeness and accuracy of the data included in the package.

Guideline 29: Reconcile current budgets to prior budgets in terms of changes to the authorized work and internal replanning in the detail needed by management for effective control.

Reviewer Name(s): Julia Chaffin, SLAC / Lenny Mucciaro, Consultant

Compliant with EAI-748: **Yes**

Justification for Compliance: Traces were conducted on several BCRs from both the Muon g–2 and Mu2e projects, and the Committee was able to reconcile and validate the budgets on the change requests with the authorizing WADs. The BCR, WAD, schedules, pivot tables, monthly CPRs, budget log, and change logs were reviewed, traced, and validated that appropriate and

accurate changes were being made to the baseline. Although there are differences in the logs and BCR packages, the information is sufficient to meet the guideline intent.

Guideline 30: Control retroactive changes to records pertaining to work performed that would change previously reported amounts for actual costs, earned value, or budgets. Adjustments should be made only for correction of errors, routine accounting adjustments, effects of customer or management directed changes, or to improve the baseline integrity and accuracy of performance measurement data.

Reviewer Name(s): Julia Chaffin, SLAC / Lenny Mucciaro, Consultant
Compliant with EAI-748: **No—with CAR-04 (GL 28)**

There was no evidence of retroactive changes; however, the Committee could not verify the data because of the practice of bundling changes and inconsistencies and incomplete BCR packages. Establishing a standardized process with a supporting data package, and adding the initiation, approval, and implementation dates to the BCR log would help in meeting the EIA-748 GLs.

It is recommended that the BCR package include a time-phased budget before and after report from the cost identifying the changes in the BCR by month. This will provide the tractability and reconciliation of the BCR change in an easy one report check. A prime example is the Muon g-2 BCR 19, where a complete before and after monthly spread of the BCWS, October 2012 through March 2017, was provided showing the months that the BCR impacted the BCWS. This depiction of the baseline plus the approval date of the BCR will go a long way in verifying that retroactive changes are not occurring to the baseline. All of the CAMs interviewed knew that making changes to history were not allowed and only future activities could be changed.

Guideline 31: Prevent revisions to the program budget except for authorized changes.

Reviewer Name(s): Julia Chaffin, SLAC / Lenny Mucciaro, Consultant
Compliant with EAI-748: **Yes**

Justification for Compliance: The twelve BCRs that were reviewed and traced through the baseline, change control logs, and supported by an approved WAD indicated that the changes in cost, schedule, and scope were all within the projects authorized SOW. Depending on the change control approval thresholds established in the PEP, each BCR is reviewed and approved by the appropriate approving authority. All revisions made to the program budget were authorized through the documented change control procedure.

Guideline 32: Document changes to the performance measurement baseline.

Reviewer Name(s): Julia Chaffin, SLAC / Lenny Mucciaro, Consultant
Compliant with EAI-748: **Yes**

Justification for Compliance: Evidence from the data traces conducted on Muon g-2 and Mu2e BCRs indicated that schedule and budget revisions are documented, validating that the integrity of the Performance Measurement Baseline (PMB) is maintained. The projects were found to be adhering to both the intent of GL 32, as well as the EVM-SC and supporting internal procedures. All PMB changes have been properly documented through the FNAL change control process.



**Fermi Research Alliance, LLC
Earned Value Management System
Annual Surveillance Review Plan - DRAFT**

19-Feb-2016

Earned Value Management System (EVMS) Surveillance Plan Overview

The Fermi Research Alliance, LLC (FRA) EVMS was certified by the DOE Office of Engineering and Construction Management (OECM) in January 2010. FRA management maintains an effective and efficient EVMS system through surveillances, which includes an annual assessment of compliance with the FRA EVMS requirements. FRA continuously improves its EVMS processes by examining the most current techniques and processes to manage projects. The FRA EVMS Surveillance and Maintenance procedure (12.PM-008) establishes the methodology for FRA EVMS surveillances. This specific Surveillance Plan summarizes the approach to be used to complete the surveillance of the certified FRA EVMS.

Surveillance Overview

A Surveillance is defined as the process of reviewing the implementation of the EVMS process on one or more programs or projects. The purpose of an EVMS surveillance is to ensure the effectiveness of the EVMS to monitor and manage cost, schedule, and technical performance for FRA and its customers. An effective surveillance process provides an assessment of the current implementation as well as encourages continuous improvement of the FRA EVMS process for use in current and future projects.

Objectives of Review

Maintaining an EVMS is a requirement within the DOE FRA contract, (DE-AC02-07CH11359). The specific goals of the annual FRA EVMS surveillance is to confirm that the FRA processes and procedures continue to satisfy the guidelines in the American National Standards Institute/Electronic Industry Alliance's (ANSI/EIA) 748-B Standard for Earned Value Management Systems as well as to ensure that FRA EVMS processes and procedures are being implemented appropriately.

An overview of the surveillance process includes a review of each of the ANSI guideline categories:

- 1 Organization
- 2 Planning, Scheduling, and Budgeting
- 3 Accounting Considerations
- 4 Analysis and Management Reports
- 5 Revisions and Data Maintenance

Scope of Review

The surveillance review scope is limited to the review of the FRA EVMS System Description (SD) and procedures as they pertain to ANSI Standard 748-B. The surveillance is not a review of the status or performance of the individual projects included in the review, because project status and performance issues are addressed separately by other reviews. This review focuses on two projects: 1. The muon-to-electron (Mu2e) conversion experiment and the Muon g-2 project. Both of these projects have been officially baselined and are required to comply with EVMS

criteria for surveillance on the FRA certified system. This review will also include a status update from Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment (LBNF/DUNE).

The LBNF/DUNE project is requesting a CD-3a approval from DOE for Initial Far Site Construction, and a DOE CD-3a review occurred in December 2015. The authorization amount being sought is approximately \$300M, whose scope includes portions of the conventional facilities (CF) to be designed and constructed on the surface, in the shafts, and underground at the Sanford Underground Research Facility (SURF) to support the LBNF cryostats and cryogenic systems and the DUNE Far Detector. The CD-3a scope covers the initial construction work prior to baselining the LBNF/DUNE Project necessary to support installation of cryostats and cryogenic systems to be ready for installation of two DUNE detectors. Construction approval (CD-3a) essentially baselines the associated scope. The LBNF/DUNE project plans to implement the Fermi Research Alliance Earned Value Management System (EVMS) on the CD-3a scope. LBNF/DUNE presented the plan to implement EVMS at the December 2015 CD-3a review, and will provide a progress update at the EVMS surveillance review.

Surveillance Membership

Surveillance membership for this review consists of participants from other labs to ensure independence of the surveillance process. Individuals participating in the surveillance review include the following:

FRA EVMS Representative

Richard Marcum – Fermilab National Accelerator Laboratory Project Controls Manager,
Office of Project Support Services (OPSS)

Surveillance Team Reviewers

Bob Wunderlich (team lead) – Consultant (DOE Retired)
Kurt Fisher – DOE-SC Office of Project Assessment
Greg Capps – Oak Ridge National Laboratory, Project Management Officer
Cathy Lavelle – Brookhaven National Laboratory, Project Management Center Manager
Jenn O'Connor – Brookhaven National Laboratory, Advanced Project Management Specialist
Betsy O'Connor – Argonne National Laboratory, OPM Financial Manager
Lynda Gauthier – Facility for Rare Isotope Beams, Michigan State University, Project
Controls Manager
Leonard Mucciari – Consultant (former DOE)
Julia Chaffin – SLAC National Accelerator Laboratory, Project Management Support Group Lead
Rick Larson – Lawrence Berkeley National Laboratory, Project Controls

Observers

Robert Franklin – Oak Ridge National Laboratory
Giorgio Apollinari – Fermilab, HL-LHC Accelerator Upgrade, Project Manager
Ruben Carcagno – Fermilab HL-LHC Accelerator Upgrade, Project Engineer
Ethan Merrill - DOE-SC Office of Project Assessment
Vivian O'Dell – Fermilab US-CMS HL-LHC Upgrade, Project Manager
Suzanne Saxer – Fermilab SLI-IERC, Project Controls

EVMS Surveillance Team Assignments

Team Member	Responsible Area	Guidelines
Kurt Fisher	Organization	1-3,5
Greg Capps Cathy Lavelle Jenn O'Connor	Planning, Scheduling, and Budgeting	6-12,14,15
Betsy O'Connor	Accounting Considerations	4,13,16-21
Lynda Gauthier Rick Larson	Analysis and Management Reports	22-27
Julia Chaffin Lenny Mucciario	Revisions and Data Maintenance	28-31

Process and Guideline Selection

All aspects of the FRA EVMS will be considered during this comprehensive system surveillance. The surveillance will address the full content of the FRA EVMS SD and will also consider the results of other DOE related reviews, as appropriate.

As discussed above, this FRA EVMS surveillance will be based upon the remaining work and content that is specific to the Muon g-2 and Mu2e projects being reviewed. The selection of EVMS guidelines and processes to be reviewed will be relevant to the projects' phases.

This surveillance is organized to provide a structured setting to assess the Muon g-2 and Mu2e projects' approach to the FRA EVMS process implementation and their consistent use across the projects' Control Account Managers (CAMs). This is facilitated by:

- A clear code of conduct;
- Understanding of how results will be used;
- Including contractor and customer project office personnel as observers on the surveillance team;
- Obtaining out-briefings and discussions of potential Corrective Actions and Continuous Improvements before a report is generated;
- A clearly defined format for reporting Corrective Actions and Continuous Improvements.

Code of Conduct

Responsibilities

The surveillance team will provide adequate advanced notification of specific control accounts and processes that will be reviewed based on data that will be provided by the project team prior to the initiation of the on-site surveillance. It is the intent of this surveillance to minimize any impacts with on-going project work to the extent possible. The surveillance team will not require

extensive presentations or preparations, but rather focus on the review and interpretation of data provided in the selected projects' native formats. The review will be conducted in a professional manner and in a spirit of constructive assessment and discovery. The surveillance team leader is solely responsible for the final determination of Corrective Actions and Continuous Improvements and ensuring that the results are communicated to the project and Laboratory management.

Project personnel should be prepared to demonstrate through objective project information that they are complying with applicable FRA EVMS policies and procedures. The project team members should coordinate with the surveillance team to ensure that CAMs responsible for areas of specific interest are available while minimizing the impact on ongoing project activities. The project personnel should also ensure that adequate data and project policies are available to the surveillance team sufficiently in advance of the review to allow for meaningful analysis. For this review, "sufficient data" is defined as three consecutive months of recent project data provided at least two weeks prior to review. In this case, the three most recent and available months are November and December 2015, and January 2016.

The surveillance team leader will ensure that the review focuses on system compliance rather than non-system-related issues or project specific performance issues. Additionally, the surveillance team leader will make certain corrective actions identified during any previous review were addressed appropriately.

Observer Participation

Observers are guests approved by the team leader to accompany the team, and observe the review process to ensure that the system under review is compliant. The non-DOE Observers may be assigned to assist team member(s) with their assigned responsible area. The purpose of having non-DOE observers participate in this process is for them to learn what the requirements are for a compliant EVMS and how surveillances are performed to validate that compliance. This experience is to enhance their EVMS knowledge and to aid them with their current and future job responsibilities.

Project Information

Successful surveillance is predicated upon demonstration of compliance with the FRA EVMS System Description and procedures through explanations and illustrations using objective project information consisting of documents, computer files, working papers, notes, or other forms of data and communication which demonstrate compliance/non-compliance with a policy, procedure, or process. Objective project information is created in the normal conduct of business and is not prepared solely for the review of a surveillance team. The surveillance team will be located in a central location that facilitates access to project information within the Laboratory. Examples of objective project information include work authorizations, critical decision documentation, cost and schedule status databases, variance analysis reports, and estimate-to-complete rationale. A complete list of required documents will be provided to the

project team prior to the review date but additional documents may be requested during or prior to the actual review. It is the intent that required documents will be available via web access to the surveillance team at least two weeks prior to the review.

Orientation

An orientation will be included at the start of the on-site EVMS review to introduce members of the surveillance and project teams and to discuss key EVMS-related forms and procedures. The surveillance team will use the orientation period to explain the goals and scope of the review, the code of conduct, the disposition of Corrective Actions/Continuous Improvement, and the resolution process.

A brief overview of the nature of the selected projects will be provided by FRA to the surveillance team to ensure they understand the goals of the projects, unique language usage, and any unusual organizational relationships.

Data Gathering

The surveillance review will be conducted both through interviewing FRA management, CAMs, and project staff and by verifying the integrity of objective project information. The initial number and scope of interviews will be defined after the project team has provided a dollarized Responsibility Assignment Matrix (RAM), with the intent that it be provided no later than three weeks prior to the review date. At least two weeks prior to the review, the surveillance team will provide a list of CAM and project staff interviews to the project teams. The surveillance team request is to be a balance between obtaining sufficient data, meeting the time limitations for the review, and minimizing the impacts to ongoing project activities. The project teams will coordinate the scheduling of these interviews and provide an agenda to the surveillance team prior to the on-site review. Based on surveillance results, additional interviews may be conducted.

Interviews will generally be conducted in a location close to the CAM's office, which will facilitate ease of access to objective project information. During each interview, the surveillance team will assess the level of understanding and compliance with FRA EVM policies, procedures, and processes, while monitoring local practices to assess how well they comply with the intent of the EVM guidelines. The surveillance review will be thorough and structured. This involves developing a list of subject areas to facilitate scheduled interviews, ensuring that discussions address the complete EVMS process.

CAM interviews are a key component of EVMS surveillance because CAMs are the source of much of the EVMS information. CAM interviews are supplemented with data integrity tests performed independently. The ultimate objective is to determine the CAMs' use of the information derived from the EVMS as an effective management tool. All interviews will incorporate the common attributes based on the National Defense Industrial Association (NDIA) Program Management

Systems Committee (PMSC) Intent Guide, May 2011 edition. The purpose of the interview is to assess the CAMs' understanding and implementation of the following subjects:

1. Organization

- a. Verify that the Work Breakdown Structure (WBS) contains (Guideline 1 Intent Guide)
 - i. All project work, including revisions for authorized changes.
 - ii. All contract line items and end items.
 - iii. All external reporting elements.
 - iv. Elements extended to the control account level.
 - v. Maps to the WBS dictionary.
- b. Verify that a Work Authorization with scope, schedule, and budget exists at control account level (Guideline 2 Intent Guide). Verify that external Work Authorization with the identified Customer exists, at least, at the project level.
- c. Verify that the Organizational Breakdown Structure (OBS) is documented (Guideline 3 Intent Guide).
- d. Verify that the same WBS is linked between schedules, work authorization, and control account plans (Guideline 3 Intent Guide).
- e. Verify that there is a documented process and organizations established to specifically manage and control indirect costs (Guideline 4 Intent Guide).
- f. Verify that Responsibility Assignment Matrix or equivalent documents control accounts at appropriate level (Guideline 3 & 5 Intent Guide).

2. Planning, Scheduling and Budgeting

- a. Ensure Project Schedule specifics (Guideline 6 Intent Guide)
 - i. WBS/OBS identifiers exist in the project schedule at activity level for summarization.
 - ii. Project schedule reflects entire WBS Dictionary.
 - iii. Critical target/contractual dates are identified in the project schedule.
 - iv. The project schedule identifies significant interdependencies.
 - v. Task durations are meaningful and relatively short.
 - vi. Longer tasks use objective earned value techniques.
 - vii. Resource estimates are reasonable and consistent with the schedule.
 - viii. The baseline is reasonable to achieve project requirements as demonstrated through schedule analysis techniques.
 - ix. The project schedule baseline is established.
 - x. The schedule provides current status and forecasts of completion dates for all discrete work.
 - xi. The project has a critical path.
- b. Verify that objective completion criteria are used as basis to determine achievement (Guideline 7 Intent Guide).
- c. Verify that CAM updates schedule status (Guideline 7 Intent Guide).
- d. Verify that the integration of scope, schedule and budget at the control account level (Guideline 8/9 Intent Guide).

- e. Verify that the time-phased Performance Measurement Baseline (PMB) equals the work authorization and summarizes above the control account to the contract value (Guideline 8/9 Intent Guide).
 - f. Verify that control account budgets identify elements of cost including subcontractor (Guideline 9 Intent Guide).
 - g. Verify that management reserve and undistributed budget, if any, track to logs (Guideline 9/14 Intent Guide).
 - h. Verify that schedule and cost variances are collected at control accounts (Guideline 10 Intent Guide).
 - i. Verify the work packages are uniquely identified, have a budget, and have an earned value technique (Guideline 10 Intent Guide).
 - j. Verify that planning packages are not in the current month and reflect the manner in which the work will be performed (Guideline 10 Intent Guide).
 - k. Verify that the control account work packages and planning packages (if any) add to the control account total budget (Guideline 11 Intent Guide).
 - l. Identify level of effort designated work is appropriately categorized and identifiable (Guideline 12 Intent Guide).
 - m. Verify there is a documented process for managing indirect costs with an organizational structure identifying ownership, responsibility, authority levels, and distribution of indirect costs reflected in the program budgets at the appropriate level. (Guideline 13 Intent Guide).
 - n. Verify that management reserve and undistributed budget logs reconcile with last two months of Cost Performance Reports (CPR) (Guideline 14 Intent Guide).
 - o. Verify that baseline control logs reconcile with performance measurement baseline (Guideline 15 Intent Guide).
3. Accounting Considerations
- a. Verify that Actual Cost of Work Performed (ACWP) in the CPR reconcile with books of record (Guideline 16 Intent Guide).
 - b. Verify that WBS and OBS summarize direct costs from one control account (Guideline 17/18 Intent Guide).
 - c. Verify that indirect costs are applied to the direct costs per Laboratory Policy (Guideline 19 Intent Guide).
 - d. Verify that unit cost are identified when needed (Guideline 20 Intent Guide).
 - e. Verify that effective performance measurement is assessed on material no earlier than point of receipt and consistent with the method budgeted (Guideline 21 Intent Guide).
 - f. Verify that an established process exists for reporting subcontractor costs and material actual costs (Guideline 21 Intent Guide).
4. Analysis and Management Reports
- a. Verify that variance analysis is performed to the project thresholds as required (Guideline 22 Intent Guide).
 - b. Verify that variance analysis contains cause, impacts, and corrective action as appropriate (Guideline 22/23 Intent Guide).

- c. Verify that corrective actions are assessed and closed in a timely manner (Guideline 23/26 Intent Guide).
 - d. Identify budgeted and applied (or actual) indirect costs at the level and frequency needed by management for effective control, along with the reasons for any significant variances (Guideline 24 Intent Guide).
 - e. Verify that variance analysis as reported to the customer reconciles with the analysis at the control account level (Guideline 25 Intent Guide).
 - f. Verify Estimate to Complete (ETC)/Estimate at Complete (EAC) (Guideline 26 Intent Guide)
 - i. Verify that Comprehensive EACs are updated per requirements and take into account efficiencies.
 - ii. Verify that CAMs review achievability of control account EAC monthly.
 - iii. Verify that time-phased ETC reconciles with the EAC as reported externally.
 - iv. Verify that risks and opportunities are integrated into summary schedule and ETC resource plans.
5. Revisions and Data Maintenance
- a. Verify that work authorization plus any baseline change documentation equal current control account budget (Guideline 28/29 Intent Guide).
 - b. Trace last change proposal authorized. Verify schedule and cost integration at control account level and that the WBS is updated as appropriate (Guideline 28/29 Intent Guide).
 - c. Verify that change logs reconcile and contain justification (Guideline 28/29 Intent Guide).
 - d. Verify that retroactive changes are made only for correction of errors, accounting adjustments, effects of customer management directed changes to improve accuracy of data. If any have been made, verify that they are consistent with disclosed EVMS policy (Guideline 30 Intent Guide).
 - e. Verify, in at least one control account, that last month's changes as reported to the customer and this month's PMB reconcile to entries in the contractual baseline log (Guideline 30 Intent Guide).
 - f. Verify that negative earned value status, if any, has been adequately explained (Guideline 31/32 Intent Guide).
 - g. Verify that all baseline changes within a month reconcile to baseline control requests or the equivalent (Guideline 31/32 Intent Guide).

Additional interviewees may include the project manager, the project controls manager, and line management.

Surveillance Results

Concerns Identified During the Surveillance

The surveillance team will gather data through reviewing documentation and conducting interviews. A key component of the surveillance is communicating timely, pertinent, and candid feedback. Surveillance team members and project personnel should seek clarification to fully understand questions asked, the data sought, and the responses provided. If, after fully

understanding the information provided, a surveillance team member believes that there may be a question of compliance; the surveillance team will discuss the observation. If the surveillance team determines that the observation is still a question of compliance; the FRA project lead representative and pertinent members will be notified by the surveillance team of the concern no later than during the out-brief discussions at the end of each day. This gives the project the opportunity to supply the surveillance team additional information to clarify the observation. This may result in the “concern of the observation” being resolved, or may result in a recommendation for Continuous Improvement, or an observation of non-compliance requiring Corrective Actions. Corrective Actions/Continuous Improvement are defined as:

Corrective Actions - Corrective Actions fall into two broad categories: 1) non-compliance with the accepted EVMS description or procedures and 2) non-compliance with the ANSI/EIA 748B EVMS guidelines. Failure to resolve Corrective Actions reduces confidence in the ability of project management to effectively use the EVMS process to achieve project goals and objectives of the stakeholders. A Corrective Action Plan is required for each finding.

Continuous Improvements - The team members may recommend EVM implementation enhancements such as sharing of successful practices, tools, or other items that come to their attention. Continuous Improvements, however, are not the same as Corrective Actions and, therefore, need not be tracked for closure. However, should a recommendation have an asterisk (*), the team members have elected that this practice is critical enough to require tracking to closure.

Surveillance Final Out-Brief

The surveillance team will evaluate what they have observed and the information received during the interviews from the project team and come to a consensus if any Corrective Actions/Continuous Improvement items should be issued. Also, the surveillance team should identify if the observations are systemic rather than isolated issues. Any Corrective Actions/Continuous Improvement items are to be presented by the surveillance team to the project team at the Final Out-Brief.

It is possible that the project teams may disagree with the final surveillance results. When a finding is not due to a team’s misunderstanding, the FRA EVMS Representative must be able to explain the impact of deviating from FRA policy and the benefits to the project and management team of non-compliance with the intent of the EVMS guidelines.

Final Report

The surveillance team will develop a preliminary report and give the FRA EVMS Representative the opportunity to provide any additional feedback in a reasonable timeframe. The surveillance team will take into consideration any feedback received when developing the final report. The final report will be issued by the surveillance team leader to the FRA EVMS Representative (head

of OPSS), and the Chief Project Officer (CPO). Dates for report delivery will be agreed to at the Final Out-brief.

Corrective Action Plan

The FRA EVMS Representative will develop a Corrective Action Plan (CAP) to address any Corrective Actions or Continuous Improvements identified in the Final Report from the surveillance team. The CAP should include a schedule with realistic dates for when the corrective actions are to be completed. The project personnel will provide input regarding corrective actions, including estimated completion dates. The surveillance team will receive a copy of the CAP for information only; unless it is determined at the Final Out-brief that further actions are required by the surveillance team – such as a follow-on review.

Corrective Action Plan Processing and Tracking

Problem areas identified during the assessment that are determined to be non-compliant with management system requirements or the organization’s implementing requirements will be reported as Corrective Actions , documented on Corrective Action Plans (CAPs), and processed in accordance with the Fermilab Corrective & Preventive Action Procedure, 1004.1001.

Surveillance Review Close-out

The FRA EVMS Representative is to ensure that CAP has been acceptably completed. The close-out of the CAP and any follow-up verification performed should be documented and retained for future EVMS surveillances.

Table of Revisions

Author	Description	Revision	Date
M. Kaducak	Initial Draft	Draft V0	10/12/2015
M. Kaducak	Included review committee membership	Draft V1	2/8/2016
M. Kaducak	Updated Observer list	V2 (published)	2/19/2016

Appendix B Review Participants

**Department of Energy/Office of Science
EVMS Surveillance Review of the
FRA-FNAL**

REVIEW COMMITTEE PARTICIPANTS

Committee Lead

Bob Wunderlich, DOE retired

Committee Members

Area 1: Organization (Guidelines 1-5)

Kurt Fisher, DOE/SC, Chairperson

Area 2: Planning, Scheduling and Budgeting (Guidelines 6-15)

Greg Capps, ORNL

Cathy Lavelle, BNL

Jenn O'Connor, BNL

Area 3: Accounting Considerations (Guidelines 16-20)

Betsy O'Connor, ANL

Area 4: Analysis and Management Reports (Guidelines 22-27)

Lynda Gauthier, MSU

Rick Larson, LBNL

Area 5: Revisions and Data Maintenance (Guidelines 28-32)

Julia Chaffin, SLAC

Lenny Mucciario, Consultant

Observers

Ethan Merrill, DOE/SC

Georgio Apollinari, FNAL

Ruben Carcagno, FNAL

Vivian O'Dell, FNAL

Marc Kaducak, FNAL

Suzanne Saxer, FNAL

Robert Franklin, ORNL

Appendix C Review Agenda

Department of Energy/Office of Science EVMS Surveillance Review of the SU-SLAC

PURPOSE:

This will be a formal review of the Fermi Research Alliance, LLC (FRA) Earned Value Management System (EVMS) implemented at Fermi National Accelerator Laboratory (FNAL). Discussions will occur and interviews will be performed to determine how the current EVMS works and its implementation across all of FNAL (including such information as accounting, procurement, software tools and interfaces, scheduling, cost estimating, reporting, CAMs, WADs, etc). The outcome of this meeting will be a formal assessment of the FRA-FNAL EVMS by an independent Committee, including corrective actions and continuous improvements.

AGENDA:

Monday – March 7 th				
Time	Subject	Session	Leader/Speaker	Location
8:00 - 8:30	Committee In-room Setup and Discussions	Closed	Committee	Wilson Hall, Hornet's Nest, 8 th floor crossover (between elevators)
8:30 - 9:00	Welcome / Safety Review / Committee In-Briefing	Closed	Committee, Marc Kaducak	
9:00 - 11:00	Office of Project Support Services Overview (20 min)	Open	Marc Kaducak	
	EVM System Overview, Corrective Actions (30 min)	Open	Richard Marcum	
	Mu2e Project Overview (20 min)	Open	Ron Ray	
	Muon g-2 Project Overview (20 min)	Open	Chris Polly	
	LBNF EVMS Implementation Update (20 min)	Open	McCluskey/O'Sullivan	
	Break (10 min)			
11:00 - 12:00	Committee Orientation / Documentation Review & Traces / Team Discussions (Lunch Will Be Served)	Closed	Committee	

12:00 - 1:30	CAM Interview #1 – Mu2e (CAM TBD)	Closed	Committee	
1:30 - 3:00	CAM Interview #2 – Mu2e (CAM TBD)	Closed	Committee	
3:00 – 4:30	CAM Interview #3 – Mu2e (CAM TBD)	Closed	Committee	
4:30 - 5:30	Committee Meeting	Closed	Committee	
5:30 – 5:45	Informal Daily Out-Brief	Open	Committee, FRA	

Tuesday – March 8th				
Time	Subject	Session	Leader	Location
8:00 - 9:00	Committee Preparation	Closed	Committee	Hornet's Nest
9:00 - 12:00	Acctg Interviews – Mike Rhoades [Others As Needed]	Closed	Interview Team – Acctg	Director's Conference Room, Wilson Hall 2 nd floor East
9:00 - 10:30	CAM Interview #4 – Muon g–2 (CAM TBD)	Closed	Committee	Wilson Hall, Hornet's Nest, 8 th floor crossover (between elevators)
10:30 - 12:00	CAM Interview #5 – Muon g–2 (CAM TBD)	Closed	Committee	
12:00 - 2:00	Committee Work Session / Team Discussions / Data Traces (Lunch Will Be Served)	Closed	Committee	
2:00 - 3:00	Management Interview [If Needed] – Marc Kaducak and/or Mike Lindgren, others as requested	Closed	Interview Team (Select Members)	
3:00 - 5:00	Resolve Any Remaining Issues & Interview Needs / Committee Consensus / Writing of any CARs, CIOs	Closed	Committee	
5:00 - 5:30	Formal Out-Brief and Review of Next Steps	Open	Committee, FRA	

Appendix D Documents Reviewed

Department of Energy/Office of Science EVMS Surveillance Review of the FRA-FNAL

DOCUMENTS REVIEWED

1. FRA-FNAL EVMS Policies, Procedures, and Desktop Instructions
2. Mu2e and Muon g-2 Project Execution Plans and Project Management Plans.
3. LBNF/DUNE EVMS Implementation Plan for CD-3a Scope
4. Mu2e, Muon g-2 and an example of LBNF/DUNE Project WBSs, OBSs, RAMs, as well as FNAL and Project specific organizational charts
5. Mu2e, Muon g-2 and an example of LBNF/DUNE Project schedules, including milestones, critical and near critical path schedules
6. Mu2e, Muon g-2 and an example of LBNF/DUNE Project cost estimates
7. Mu2e, Muon g-2 and an example of LBNF/DUNE Project schedules, including milestones, critical and near critical path schedules
8. Mu2e, Muon g-2 and an example of LBNF/DUNE Project risk registers
9. Mu2e, Muon g-2 and an example of LBNF/DUNE Project Change Request Information (logs, requests)
10. Mu2e, Muon g-2 and an example of LBNF/DUNE Project Corrective Action Plans (CAPs)
11. Mu2e, Muon g-2 and an example of LBNF/DUNE Project Work Authorization Documents (WADs)
12. Mu2e, Muon g-2 and an example of LBNF/DUNE Monthly Status Reports, Contract Performance Reports (CPRs) and Variance Reports
13. FNAL CAS Disclosure Statement
14. Overhead Budget Reports
15. Mu2e, Muon g-2 and an example of LBNF/DUNE Contingency and MR Logs
16. Previous FRA-FNAL EVMS Surveillance Review Report and Corrective Action Plan
17. CAM e-Notebook examples

Note: LBNF/DUNE material was limited to CD-3a scope, cost, and schedule.

Appendix E Personnel Interviewed

Department of Energy/Office of Science EVMS Surveillance Review of the FRA-FNAL

PERSONNEL INTERVIEWED

FNAL Management

Mike Lindgren
Marc Kaducak
Richard Marcum

Mu2e Project

Ron Ray
Thomas Hamernik
Mike Lamm
George Ginther

Muon g-2 Project

Chris Polly
Jim Morgan
Peter Winter (ANL)

LBNF/DUNE Project

Robert O'Sullivan

FNAL Accounting

Jim Wollwort

Appendix F Acronym List

Department of Energy/Office of Science EVMS Surveillance Review of the FRA-FNAL

ACRONYM LIST

A/E – Architect/Engineer	G&A – General and Administrative
ACWP – Actual Cost of Work Performed	GL – Guideline
BAC – Baseline at Completion	LBNF/DUNE – Large Baseline Neutrino Facility/Deep Underground Neutrino Experiment
BCR – Baseline Change Request	LOE – Level of Effort
BCWP – Budgeted Cost of Work Performed	MIE – Major Item of Equipment
BCWS – Budgeted Cost of Work Scheduled	MR – Management Reserve
EIA – Electronics Industries Alliance	Mu2e – Muon to Electron Conversion
FRA – Fermi Research Alliance, LLC.	OBS – Organization Breakdown Structure
FNAL – Fermi National Accelerator Laboratory	OPA – Office of Project Assessment
BOE – Basis of Estimate	P6 – Primavera
CAM – Control Account Manager	PCR – Project Change Request
CAP – Corrective Action Plan	PEP – Project Execution Plan
CAR – Corrective Action Request	PMB – Performance Measurement Baseline
CD – Critical Decision	PMP – Project Management Plan
CFO – Chief Financial Officer	PMG – Project Management Group
CIO – Continuous Improvement Opportunities	PMT – Project Management Techniques
CM/GC – Contract Manager/General Contractor	POG – Performance Oversight Group
CPI – Cost Performance Index	RAM – Responsibility Assignment Matrix
CPR – Contract Performance Reports	SC – Office of Science
CR – Change Request	SOW – Statement of Work
DOE – Department of Energy	SPI – Schedule Performance Index
EAC – Estimate at Completion	TPC – Total Project Cost
ETC – Estimate to Complete	UB – Undistributed Budget
EVMS – Earned Value Management System	VAC – Variance at Completion
EVM-SD – Earned Value Management System Description	VAR – Variance Analysis Report
EV – Earned Value	WAD – Work Authorization Documentation
EVT – Earned Value Techniques	WAP – Work Authorization Plan
	WBS – Work Breakdown Structure