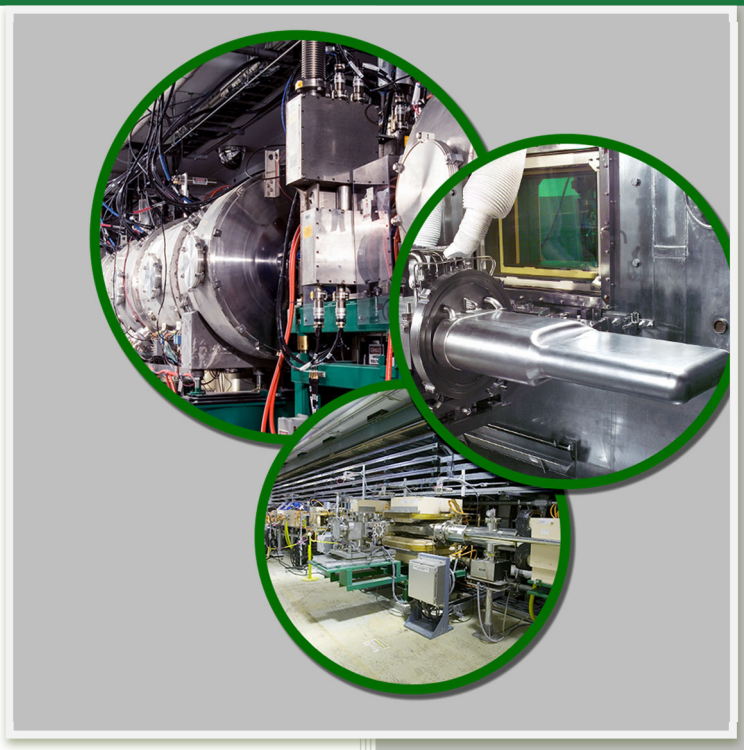
PPUP-100-PI0017-R03

PROTON POWER UPGRADE (PPU) PROJECT

Project Controls Manual



August 2021

OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE US DEPARTMENT OF ENERGY

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PROTON POWER UPGRADE (PPU) PROJECT
PROJECT CONTROLS MANUAL

August 2021

Approved by: R. Wayne Steffey Digitally signed by R. Wayne Steffey Date: 2021.08.23 22:51:15 -04'00'

Wayne Steffey, NScD Project Management Group Leader

Prepared by
OAK RIDGE NATIONAL LABORATORY, P.O. Box 2008, Oak Ridge, Tennessee 37831-6285
managed by UT-Battelle, LLC for the U.S. DEPARTMENT OF ENERGY
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Revision Log

Revision	Date	Description of Changes
Revision 0	August 2019	Initial Release
Revision 1	January 2020	Incorporated changes to the "freeze period" exceptions to include input from the ORNL PMO EVMS documentation; added NDIA Guideline reference numbers; incorporated modifications to existing processes
Revision 2	April 2021	Updated document text now that project is fully baselined.
Revision 3	August 2021	Added VAR process for control accounts with smaller values (<$100k)

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ACRONYMS

ACWP	Actual Cost of Work Performed
ANSI	American National Standards Institute
BA	Budget Authority
BAC	Budget at Completion
BCP	Baseline Change Proposal (DOE)
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled
BOA	Basic Ordering Agreement
CAM	Control Account Manager
CD	Critical Decision
CEDB	Cost Estimate Data Base
COBRA	Deltek Cobra Cost Processor
CPI	Cost Performance Index
CPR	Contract Performance Report
CV	Cost Variance
DOE	U.S. Department of Energy
EAC	Estimate at Completion
ES&H	Environmental Safety & Health
ETC	Estimate to Complete
EV	Earned Value
EVMS	Earned Value Management System
HQ	DOE Headquarters
LOE	Level of Effort
NScD	Neutron Sciences Directorate
OBS	Organizational Breakdown Structure
OECM	Office of Engineering & Construction Management
ORNL	Oak Ridge National Laboratory
P6	Primavera Enterprise
PBB	Project Budget Baseline
PCM	Project Controls Manual
PCR	Project Change Request
PEP	Project Execution Plan
PPEP	Preliminary Project Execution Plan
PMB	Performance Measurement Baseline
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMO	Project Management Office
PPU	Proton Power Upgrade
PV	Planned Value
R&D	Research & Development
RAM	Responsibility Assignment Matrix
RMP	Risk Management Plan
SPI	Schedule Performance Index
SV	Schedule Variance
TPC	Total Project Cost
VAC	Variance at Completion
WAD	Work Authorization Document
WBS	Work Breakdown Structure

1. INTRODUCTION

1.1 PROJECT BACKGROUND

The PPU project is to design, build, install and test the equipment necessary to double the accelerator power from 1.4 MW to 2.8 MW and to deliver a 2.0 MW qualified target. PPU also includes the provision of a stub-out in the SNS accumulator ring to target tunnel to facilitate a rapid connection to a new proton beamline for the STS project. Doubling of the power will be achieved by increasing the proton beam energy by 33% and peak beam current by 50%, relative to current accelerator performance. The project also includes modifications to some buildings and services. Costs for acceptance testing, integrated testing and commissioning through the demonstration of the key performance parameters (KPPs) are included in the PPU scope.

PPU will accomplish the energy upgrade by fabricating and installing new superconducting RF cryomodules, with supporting RF equipment, in the existing linac tunnel and klystron gallery respectively. The high voltage converter modulators and klystrons for some of the existing installed RF equipment will be upgraded to handle the higher beam current. The increased beam power of 2 MW will be enabled by the addition of a new high-volume gas injection system for pressure pulse mitigation in the mercury target and a redesigned mercury target vessel.

The following figure shows the major systems for PPU.

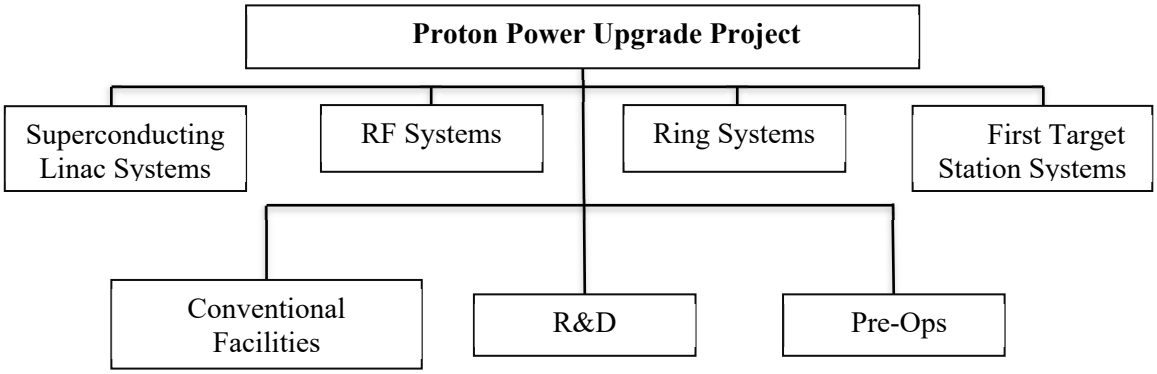

Figure 1 - PPU Major Systems

1.2 LESSONS LEARNED ON OTHER DOE PROJECTS

In addition to adopting successful practices from projects like the initial construction of the Spallation Neutron Source, an important ingredient in developing a successful Project Controls Program includes the evaluation and application of lessons learned from unsuccessful projects. The PPU Project Team must be sensitive to the practices and lessons learned on these projects and establish and use systems that ensure success for the PPU in the future.

In the past, projects have failed for various technical and management reasons. Several root causes that have led to the failure of project controls programs are summarized below:

- **Inadequate Change Control Processes and Procedures** - may lead to large scope and schedule changes, and result in large cost increases. Inadequate change control procedures can also preclude the ability to trace the reasons for cost growth from the original baseline. Reduction of these problems is through the development and strict use of a detailed change control procedure.
- **Inadequate and Inaccurate Project Status Reports -** Project Directors must continuously assess and analyze the project status. This has been impossible on some past projects due to the lack of, or improper reports, from contractors and project participants. In addition, some reports have been found to contain inaccurate data, thereby resulting in incorrect analysis and assessment. Identifying early in the planning process what information is needed to assess and analyze the project properly and requiring that information to be furnished will assist in minimizing this problem.
- **Insufficient Project Reviews -** Both the frequency and the content of project reviews have been inadequate on several historic projects. Assuring that project management personnel give the proper emphasis to the review process can minimize this problem.

Establishing and using the Project Controls Program outlined within this manual will avoid these causes of project failure and establish the framework for success.

1.3 PPU CHALLENGES

The PPU project will interface closely with its partner laboratory, Thomas Jefferson National Accelerator Facility (JLab), that is responsible for the production of the cryomodules required for the upgrade project. The project schedules between ORNL and JLab will be closely integrated and monitored. Technical and management interface relationships will be managed to ensure a comprehensive program is in place to support project success.

The PPU project is an upgrade to an existing operating facility and as such, most of the staff being utilized on the project are matrixed from other divisions within SNS. This is a great benefit to the upgrade project due to the vast knowledge among the existing staff, many of whom were part of the original construction project. The challenge for PPU will be that many of these staff will have multiple duties, with the day-to-day operation and maintenance of the existing facility and their responsibilities to the upgrade project. These topics are being carefully managed by the SNS management and efforts are being made to assist in the mitigation of this issue by the hiring and training of new staff for both the project and the existing facility.

The Neuron Sciences Directorate (NScD) Project Controls organization is the focal point to provide the leadership and direction necessary to ensure that cost estimate/budget and schedule planning, status reporting, performance measurement, and baseline change control processes are efficient and consistent. The project will have interfaces with systems and activities occurring external to the PPU. As such, the project controls system will be structured to allow these interfaces to be managed and coordinated. This will occur in a progressive and phased approach.

Working with the project management, the Project Controls Manager has the authority to assure that a sound basis and process exists across all areas, equipment, and components to support effective and timely compiling of project controls information on various reporting frequencies. This will include:

- Training required to assure a process is understood and maintained
- Participant feedback to refine the project control processes as the project evolves from one phase to another.

1.4 PROJECT CONTROLS APPROACH

The PPU Project Controls philosophy and overall approach focuses on:

- Project management leadership to ensure consistent planning and execution.
- Organizational responsibility for performance and results by each project participant.
- An optimum balance of supporting processes and details.
- Efficient reporting and performance measurement.
- A clarity of focus on controlling project schedule and cost baseline "drivers"

The PPU Project Controls program will evolve with different areas of emphasis as the project evolves through the various phases of project execution. Earned value measures, lower level schedule milestones, performance indicators, performance reports and review meetings will be refined to suit the requirements of the project in various phases.

1.5 OBJECTIVES OF THE PROJECT CONTROLS SYSTEM

The PPU Project Controls System is an integrated management control system for project planning, cost/schedule performance measurement, analysis, and reporting. Objectives of the PPU project controls system include:

- Establish consistent processes to assure auditable bases exist to support the development of budget and schedule project baselines
- Provide mechanisms to objectively identify the status of the project
- Reliably detect actual schedule or cost performance variances from baselines
- Reveal what must be done to recover from variances
- Reveal possible schedule conflicts resulting from external influences.

The PPU project satisfies these objectives by developing and using a system that provides:

- A detailed resource-loaded, logic driven schedule that is framed by a WBS that represents the full scope of the project
- An Earned Value Management System (EVMS) based on measurable work
- Monthly written performance reports to the US Department of Energy (DOE), the PPU Federal Project Director, and the DOE Office of Science (SC) Basic Energy Science (BES)
- Monthly reporting and analysis of status of cost and schedule, including variance analysis
- A formal Change Control Process utilizing Project Change Requests (PCRs)
- Routine "bottom-up" estimates-to-complete (ETC)
- Routine risk assessments and analyses
- Organizational accountability for performance/accomplishments
- Regular communication among the Integrated Project Team (IPT), and
- Active communication among project participants.

1.6 PROJECT CONTROLS SYSTEM PROCESS

The Project Control System's purpose is to effectively monitor and control project execution.

- Goals are established

- A plan is prepared
- Progress is measured and compared with the plan
- Variances from the plan are analyzed
- Alternative courses of corrective action are evaluated
- The plan is modified accordingly

This process is graphically described in Figure 2. This system will produce standardized, timely, consistent, and accurate data from which meaningful trends can be extrapolated, allowing proactive versus reactive responses to future issues.

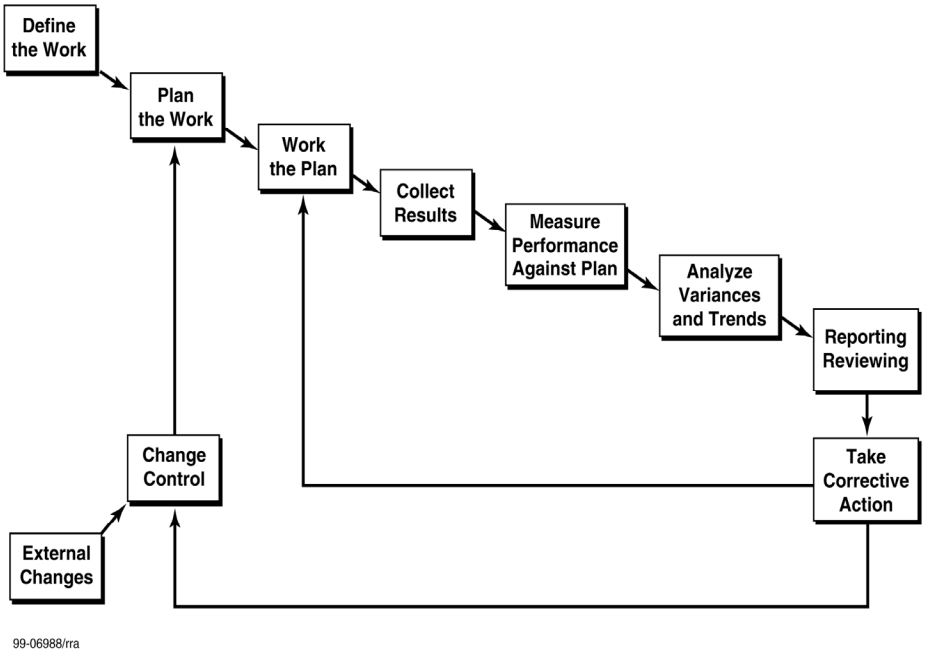

Figure 2 - Project Control Systems Process

1.7 PROJECT CONTROLS MANUAL (PCM) PURPOSE

This Project Controls Manual details the cost and schedule control systems that have been established to manage the PPU Project. The manual is intended to be a "handbook" for day-to-day use by those involved in the processes of project management, administration, control and status reporting. It is the policy of the PPU Project Director that all PPU project personnel comply with the requirements and intent of the systems described within this document. By this policy, the Project Director ensures that authorized work is being consistently performed, measured and reported in accordance with DOE requirements specified in the Project Execution Plan.

The Manual is a system description that defines the processes and procedures for implementing an Earned Value Management System (EVMS) on the PPU project conducted by Oak Ridge National Laboratory (ORNL). The PCM supports the ORNL mission by facilitating the achievement of project success regardless of project size or complexity. Earned Value Management is an acknowledged management process for the organization, planning, performance measurement, and controlling of projects. A project's

technical scope of work is integrated logically with its schedule and budget to form an approved project baseline. Accomplished work and accrued costs during project execution provide essential earned value information to measure performance for comparison to this baseline. Project management gains valuable insight into the health of the project by examining these earned value indicators.

Earned Value Management is a systematic framework to communicate project progress and performance across all levels of the project management team and to the project customer. The EVMS is more than just a method to report the status of a project. It is a vital management tool that allows project leadership to "manage by exception" and focus on the critical issues of a project. The earned value indicators provide quantifiable project data for identifying, analyzing, understanding, and resolving problems. The project management team can be proactive in engaging potential problems before they have a major impact to the project and thus prevent surprises that cost the project time and money.

The Project Controls Manual is organized along the EVMS guidelines established in the American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA) Standard-748-D and the National Defense Industrial Association (NDIA) Earned Value Management Systems EIA-748-D Intent Guide. This project management standard defines 32 "best practice" criteria for implementing the Earned Value Management process. By implementing the Earned Value Management processes and procedures documented in this manual, the project management team can:

- Establish a standard approach to organizing the various elements of a project.
- Facilitate the formation of a comprehensive time-phased budget by thorough schedule planning and cost estimating.
- Control project activity flow by defining how work is formally authorized.
- Capture actual costs on the project via the ORNL and partner lab accounting systems.
- Determine specific work progress on the project at a detail level.
- Perform variance analysis on the resultant earned value data to measure performance against the approved project baseline.
- Establish a consistent process for controlling changes to the project baseline.

Successful implementation of the EVMS at PPU has resulted in numerous benefits to the organization and to the project management team:

- Detailed planning at the beginning of a project often addresses problems that may surface later in the effort, preventing schedule slips, increased costs, and/or technical rework. Project leaders can easily identify problem areas and pin down the specific sources of the problems with detailed planning.
- Better visibility into the performance of the project is gained due to the integrated method of extensive planning, earned value analysis, and baseline control.
- Project accountability is fostered, and overall project quality is enhanced by the identification of a responsible person/organization at each work level.
- Project risk reduction is enhanced by the availability of earned value metrics allowing project management to mitigate impacts by making early adjustments to the project. Accurate estimates of schedule completion and projected final costs can be produced.
- A single, integrated management control system provides reliable data for analysis. Integrity of the project performance data will be enhanced, and informed decisions can be made based on objective data collected by the project.

2. ORGANIZATION

The PPU project is a DOE capital asset project which will result in the upgrade of an existing facility owned by DOE. The PPU Project is being managed, according to the policies, principles, and processes of DOE Order 413.3B

In order to exercise disciplined management of the PPU Project during the extended period between CD-1 and CD-2, DOE employed an Annual Work Plan (AWP) approach that established a cost and schedule performance plan for accomplishing work during the current fiscal year. The work plans consisted of an obligation plan and key milestones for the current year. The AWP provided an oversight tool for DOE to monitor the performance of the PPU project prior to baselining at CD-2.

Prior to CD-2, the PPU project:

- Did not have a Performance Measurement Baseline (PMB) and the project monitored performance against a preliminary budget and key milestones.
- Work authorization was provided by the AWP, and not individual Work Authorization Documents (WADs). WADs were incorporated for long lead procurements when the project received approval to expend funds thru a phased CD-3 approach. Since receiving CD-2 approval, the project now utilizes WADs for authorization to open control accounts and perform new work scope.
- The PPU project received CD-3A and CD-3B approval, which allowed the project to procure key components earlier. The project utilized EVMS on the procurement scope associated with the phased CD-3 and provided monthly reporting within the DOE PARS-IIe system.

Since receipt of CD-2, the project now monitors performance against the approved PMB, and the project's authorization is through the project PEP and the individual control account WADs.

The PPU project is focused on meeting the intent of DOE Order 413.3B and adheres to the criteria established by ANSI/EIA 748-C Earned Value Management Systems. The overall goal is to ensure that the project reflects the "best practices" of Project Management.

UT-Battelle received EVMS Certification from OECM conforming to OMB Circular No. A-11 (2003) Part 7 Section 300 and ANSI/EIA-748 in December 2008. UT-Battelle has maintained its' annual certification since then.

2.1 WORK BREAKDOWN STRUCTURE (WBS) *(NDIA GUIDELINE 1)*

The Work Breakdown Structure with its associated WBS dictionary is the key element for organizing a project. Its purpose is to divide the project into manageable segments of work to facilitate planning and control of technical scope, schedule, and cost. The WBS is a structural organization of related elements that defines the total work scope required to accomplish the project objectives. It is a multi-level hierarchical framework depicting the overall project deliverable down to the smallest system component. Each descending level represents an increasingly detailed definition of a project system. The project WBS describes the technical content of the project, and is the basis for project management, cost estimating and budgeting, schedule management, cost, and schedule control, and reporting of cost and schedule performance.

A high-level WBS was developed early in the conceptual stage of the project with more detail added as the project definition was refined. The level of detail in a WBS is a function of the size of the project and a balance between complexity, risk, and the Project Director's need for control. As project requirements

change, the WBS will evolve with the project. Revisions to the WBS may be required due to the expansion or contraction of project scope and/or the movement of a project through its various stages (i.e., R&D, Design, Fabrication, Testing and Shipping). Modifications to the WBS are implemented through the Change Control process after CD-2.

The following figure depicts a sample of one leg of the PPU WBS and its required levels. Additional levels of the WBS (below the Control Account) may be included by the CAMs and L2 managers as needed to extend the WBS to a level of detail necessary to reflect the complexity of the work scope. Not all legs of the WBS must be composed of the same number of levels, and not all legs will be comprised of the same phases.

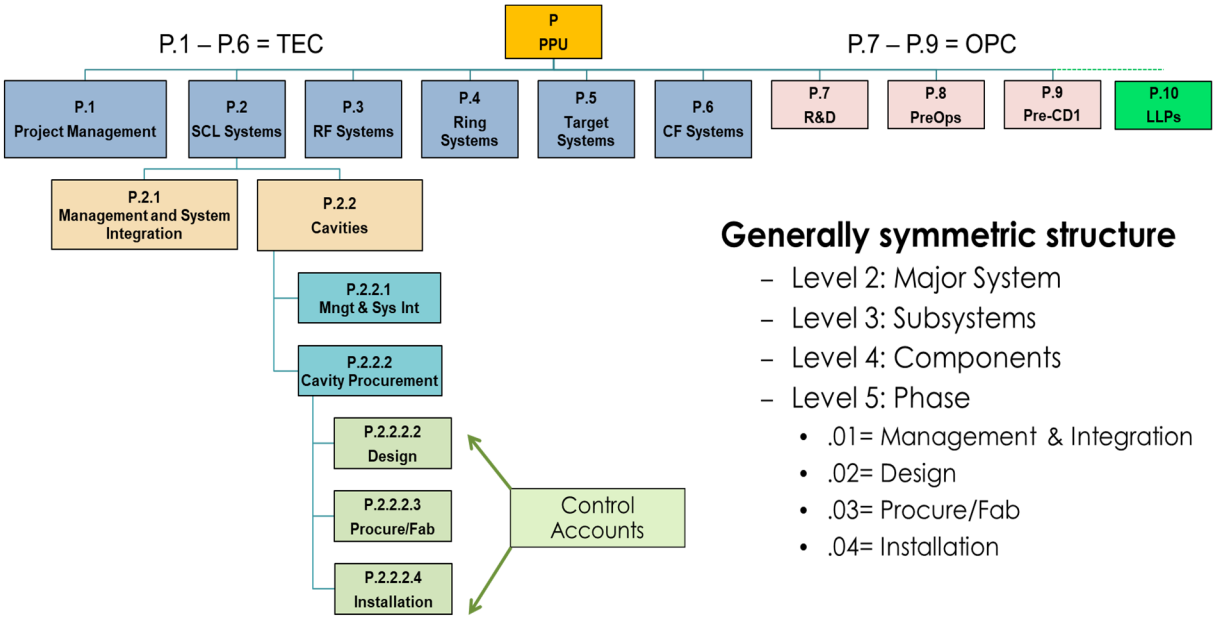

Figure 3 - PPU Product Oriented WBS

2.2 WBS DICTIONARY

A complete Work Breakdown Structure requires an associated dictionary to provide descriptive information for each WBS element. The WBS dictionary thoroughly describes the scope of each work element (including key deliverables) identified in the WBS. As with the WBS itself, the WBS dictionary is revised to reflect project changes via the Change Control process after CD-2. The dictionary is maintained throughout the life of the project.

2.3 ORGANIZATIONAL BREAKDOWN STRUCTURE (OBS) *(NDIA GUIDELINE 2)*

The PPU project is accomplished through the assistance of a partner laboratory external to the Oak Ridge National Laboratory (ORNL) management organization. This partner laboratory, JLab, will provide the resources required to perform its project work activities. JLab is responsible for WBS elements P.02.03 - Cryomodule Integration and P.10.02.07 LLP Cryomodule Integration. The following table provides a listing of the PPU responsible organizations and their associated WBS elements:

Oak Ridge National Laboratory	
WBS	WBS Title
P	Proton Power Upgrade (PPU) Project
P.01	PPU Project Management
P.02	SCL Systems
P.03	RF Systems
P.04	Ring Systems
P.05	First Target Station Systems
P.06	Conventional Facilities
P.07	R&D
P.08	Pre-Ops
P.09	Pre-CD-1 Activities
P.10	Long Lead Procurements

Thomas Jefferson National Accelerator Facility (Jlab)	
WBS	WBS Title
P.02.03	Cryomodule Integration
P.10.02.07	Cryomodule Integration (LLPs)

Figure 4 - Responsible Organizations and Associated WBS Elements

2.4 PROJECT CONTROL SYSTEMS INTEGRATION *(NDIA GUIDELINE 3)*

The project's performance baseline is measured utilizing an integrated system in which the resource requirements and associated estimates required for accomplishment of the defined work scope will be planned and scheduled utilizing sequences of logic driven, resource loaded activities that are structured in accordance with the WBS.

The PPU project controls system prohibits retroactive adjustment to any data, whether it is earned value (BCWP), actual costs (ACWP) or plan (BCWS) data. All corrections due to errors are made within the current reporting month. Any other changes are made in accordance with freeze period guidance discussed in Section 6.3 of this manual. While this policy may result in widely fluctuating current month data, it preserves the integrity of historical information and permits an auditable path for all changes to the project baseline.

The PPU utilizes Oracle Primavera P6 and Deltek Cobra which offers an integrated scheduling and performance reporting system. The interface between these two systems ensures data integrity between the schedule data and the performance baseline data. The schedule baseline (required resources phased across time via activities) will be established in P6. These data will then be burdened and escalated in Cobra, establishing the cost baseline. P6 will be utilized for the schedule preparation and status and Cobra will integrate this information with actual costs from the participant accounting systems to provide monthly performance data.

The detailed estimate provides the foundation for the cost baseline. Each WBS Level 2 (L2) manager or Control Account Manager (CAM) is required to complete a detailed estimate of the labor and material resources required for the successful design, procurement, construction/fabrication, assembly, and testing of their equipment. A controlled set of reviewed resources was established for PPU that includes those resources most likely to be utilized on PPU. The labor resources are consistent with the labor wage pools and associated burdens established in the organization performing the work. By ensuring uniform use of a standard resource library, the PPU project controls system can ensure that resource rates and reporting will be consistent and correct. All scope required to meet the project completion requirements defined in the Project Execution Plan will be included in the estimate. The resource-loaded activities in the project schedule establish the scope baseline which is defined in the WBS Dictionary.

The project controls system includes:

- The WBS Dictionary, which defines the work

- The detailed estimate, which defines the resources required to accomplish the work
- The detailed schedule (Oracle Primavera), which sequences the work and associates resources with particular activities
- The cost system (Deltek Cobra) which:
    - Applies appropriate resource rates, burdens and escalation to the activities identified in the detailed schedule
    - Establishes the cost baseline
    - Serves as the source for performance reporting by integrating monthly status and actual costs with the baseline information
- The risk management system, which provides a central repository of project risks and potential impacts, along with mitigation strategies and other project uncertainties.

The project controls system will:

- Integrate the Project budget with the DOE funding profile and with the approved scope and schedule;
- Establish a time-phased budget baseline in a manner to facilitate cost/schedule performance measurement; and
- Maintain the integrity of the time-phased budget baseline. The baseline budget represents the estimated cost for a specific scope of work and is based on the allocation of resources to scheduled activities. Integrating the budgeting process with the schedule assures that at CD-2, a Performance Measurement Baseline (PMB) is properly established and maintained throughout the entire period of performance.

The following diagram illustrates the integration and information exchange of the key components of the PPU Project Control Systems.

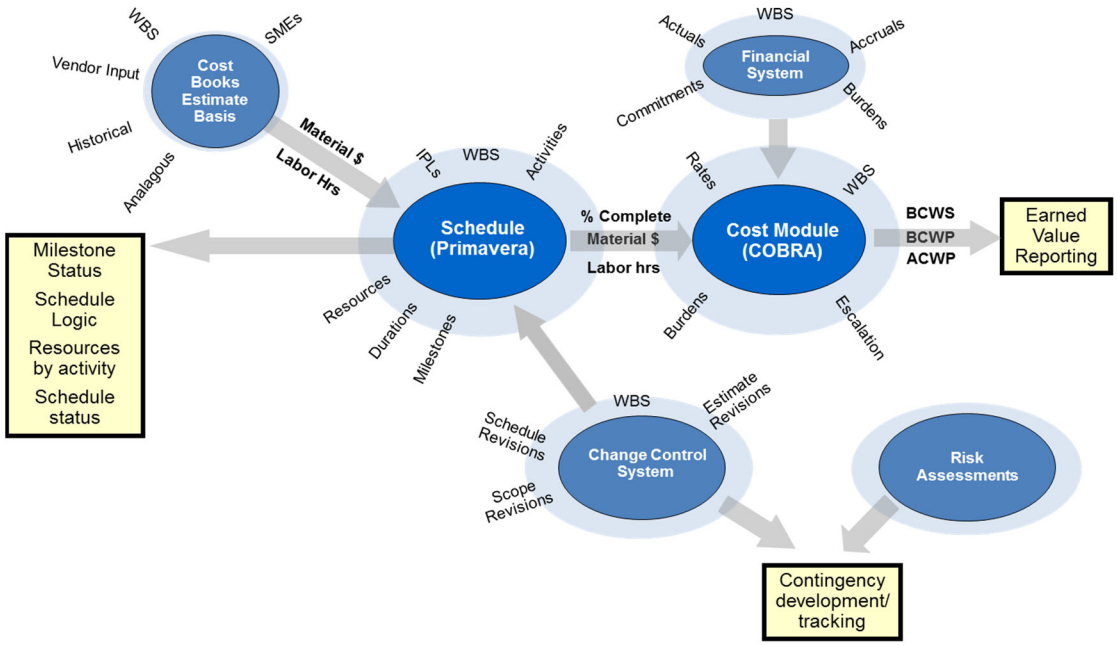

Figure 5 - Project Control Systems Diagram

2.5 OVERHEAD MANAGEMENT *(NDIA GUIDELINE 4, 13)*

The Business Manager is responsible for financial management of PPU. The PPU will comply with the Lab's approved Cost Accounting System Disclosure Statement to account for cost and commitments. The PPU Business Manager will interface with the participants' Business Divisions as needed to address project accounting requirements. The PPU Business Manager will also interface directly with Accounting, Property and Materials Management, Tax Administration Offices, and legal staff of participant organizations, including the DOE-ORO to address business and project requirements. The official financial records for the project will be maintained in the Lab's financial system, SAP.

The PPU complies with the DOE Financial Management Handbook, Cost Accounting Standards, and the Lab's approved Disclosure Statement.

Overhead rates, accounting systems, and business rules have the potential to change over time. Every year, the Business Manager will obtain current labor and overhead rates for the project partner laboratory. These rates will be assessed, and the Project Director will decide whether the new rates should be implemented in the baseline or rather retained as an impact amount in terms of the Estimate at Completion.

The project receives special ORNL overhead rates since application of full overhead to this project would result in an allocation of cost not commensurate with services provided.

2.6 CONTROL ACCOUNTS *(NDIA GUIDELINE 5)*

Integrating the Organizational Breakdown Structure (OBS) with the Work Breakdown Structure (WBS) ensures accounting of all project work and that each element of work is assigned to the level of responsibility necessary for planning, execution, tracking progress, accumulating costs, and reporting. At selected levels of the WBS, the Project Controls Manager establishes the project control accounts. A control account is comprised of a WBS work element and a CAM assigned from the OBS with the responsibility and authority to accomplish this work. Control accounts represent a management control point where work performance can be measured using Earned Value Management methods. Control accounts consist of one or more work packages or planning packages.

2.6.1 Work Packages

Work packages constitute the basic building blocks used in planning, execution, measuring, and controlling project work. Work packages consist of one or a series of discrete, apportioned, or level of effort activities that have been planned, scheduled, and budgeted in detail. Work packages are a subdivision of a control account and normally reside at the lowest level of a WBS branch. Once work for a control account is authorized, a charge code is assigned to the control account allowing costs to be accumulated in the financial systems. For PPU, a work package is equivalent to an activity.

2.6.2 Planning Packages

Planning packages are created during initial baseline planning when work scope within a control account is identified, scheduled, and budgeted, but not defined in enough detail for proper execution. Planning packages exist at similar levels in the WBS as work packages and are normally developed for far-term work scope where precise estimates of work, schedule or budget are not possible. Planning packages must be refined with more detail to become work packages before charge codes can be assigned and work started.

The detailing of the planning packages should occur at least 3 months prior to the start of the work scope, except for procurement award activities which are discussed in the following paragraph.

For PPU, the future procurement awards are considered planning packages. The planning packages will be decomposed after contract award and discussions with the selected vendor have occurred. These discussions are necessary to determine contract milestones, such as payment or deliverable milestones that will be used for performance measurement. The procurement award planning packages do not need to be detailed 3 months prior as are other planning packages; however, the establishment of the needed milestones should occur as soon as possible after discussions with the selected vendor.

2.7 RESPONSIBILITY ASSIGNMENT MATRIX (RAM) *(NDIA GUIDELINE 5)*

The Responsibility Assignment Matrix correlates the relationship between the project work scope and an appointed authority, the CAM, responsible for accomplishing this work. The matrix is created such that the intersection of a WBS element and a project organization identifies the control account. The RAM is "dollarized" by annotating the control account cell with the amount of project budget (derived from the Cost Management System) that is allocated to the control account. The RAM is updated when baseline changes are made to the control account.

The following is an example of a dollarized RAM:

Responsibility Assignment Matrix
Proton Power Upgrade (PPU)

					ORNL			
					M. Plum	R. Saethre	J. Price	T. Roseberry
	P.04.01 Mgmt & System Integration	P.04.01.01 Mgmt & System Integration			$ 1,162			
		P.04.01.02 Design	P.04.01.02.01	System Design Reviews - Ring System	$ 138			
	P.04.02 Injection region	P.04.02.01 Mgmt & System Integration	P.04.02.01.01	Mgmt & System Integration		$ 231		
		P.04.02.02 Magnets	P.04.02.02.02	Design		$ 1,171		
			P.04.02.02.03	Procure/Fab		$ 2,188		
			P.04.02.02.04	Installation		$ 36		
		P.04.02.03 Power Supplies	P.04.02.03.02	Design		$ 281		
			P.04.02.03.03	Procure/Fab		$ 69		
			P.04.02.03.04	Installation		$ 33		
		P.04.02.04 Vacuum Systems	P.04.02.04.02	Design			$ 205	
			P.04.02.04.03	Procure/Fab			$ 784	
			P.04.02.04.04	Installation			$ 217	
		P.04.02.05 Primary & Secondary Stripper Foil Mechanisms	P.04.02.05.02	Design				$ 250
			P.04.02.05.03	Procure/Fab				$ 221
			P.04.02.05.04	Installation				$ 17

Figure 6 - Sample Dollarized Responsibility Assignment Matrix

3. PLANNING, SCHEDULING AND BUDGETING

3.1 SCHEDULE DEVELOPMENT *(NDIA GUIDELINE 6, 7, 10)*

The objective of the schedule control system is to ensure that PPU work is effectively planned and scheduled and to provide a mechanism for measuring progress against the plan.

This chapter provides an overview of the PPU project schedule and general guidance on the schedule creation and management.

3.1.1 PPU Schedule Definition and Mission

A schedule is defined as a series of discrete components of work (activities) performed during the project. These activities normally have an estimated duration, estimated cost, and estimated resource requirements. Schedule activities are connected to other schedule activities or milestones with logical relationships which establishes how the work will be accomplished and the timeframes for accomplishment. The networked schedule is the basis for critical path analysis which provides a method for identifying and assessing schedule priorities and impacts.

It is the intent of the PPU project to produce and maintain a schedule that complies with the above definitions, and the following directives, guidance, and best practices:

- Department of Energy (DOE) Order 413.3b,
- DOE Manual 413.3,
- American National Standards Institute/Electronic Industry Alliance's (ANSI/EIA) 748-D,
- Government Accountability Office (GAO) Cost Estimating and Assessment Guide (GAO-09-3SP),
- GAO Schedule Assessment Guide (GAO-16-89G),
- Project Management Institute (PMI) - Project Management Body of Knowledge (PMBOK).

3.1.2 Project & Schedule Overview

Each WBS L2 Manager is required to develop and maintain detailed schedules that describe their methodology for completing their scope of work. To assist with the management of the PPU scope of work, three scheduling tools are used by the project: An Overview Schedule Illustration, a Baseline Schedule, and a Monthly Project Schedule Status for performance measurement.

3.1.3 Schedule Execution

3.1.3.1 Software

Primavera P6 was selected as the scheduling software for use on the PPU project. This software is also used by the partner laboratory, JLab.

3.1.3.2 Schedule Organization

The project schedule will be organized according to the approved PPU WBS. As a good scheduling practice and to ease identification, a standard project naming and activity ID naming convention should be utilized. Code fields will be utilized to assist in filtering and reporting.

3.1.3.3 Activities

The scope of each lowest level WBS element is to be decomposed into discrete activities with durations that are as short as practicable and represent a clear and distinct scope of work that has a clear start and finish. Durations should be quantifiable and should represent the most likely duration for that activity. Durations should not contain time contingency.

It is desired that activities be less than 3 months in duration. Activities that are greater than 3 months' duration should remain less than one year in length, unless a justification is provided. This also applies to planning packages. Any activities that are longer than 3 months should be documented in the "PPU – Duration Justification" code field.

Using a rolling wave approach, long length activities must be decomposed into shorter (less than 3 months duration) at least 3 months prior to execution of the work scope. An exception to the 3-month decomposition rule is for procurement/fabrication activities which are not detailed until after contract award and discussions with vendor.

Any effort that has no definable product or milestones and for which measurement is impracticable will be planned as Level of Effort (LOE). However, LOE planning is traditionally used for management support, oversight, planning, and some R&D tasks. It is acceptable for Level of Effort activities to be scheduled with durations of one year.

For activities such as procurements and shipping, activity templates and suggested durations are contained in the PPU Cost Estimating Guidance.

Activities will be created in Primavera with the following attributes:

- Task Dependent, Fixed Duration & Units and Physical Percent complete.
- The use of steps can be used to facilitate activity updates.
- Activity ID - It is suggested that the Activity ID coding start with the project code ("P") followed by the WBS L2, L3 and L4 numbering. In addition, a single alpha may be added to identify the project Phase associated with this task. This will assist in the identification of activities.

Project ID	L2 WBS	L3 WBS	L4 WBS	Phase	Unique Identifier
P	2	4	2	D	1000

Phases: M-Management, D-Design, P-Procure, I-Install, MS-Milestone

3.1.3.4 Milestones

Milestones are used to identify key events, such as the beginning or end of significant scopes of work and the receipt of incoming receivables or outgoing deliverables. Milestones are used for assessing progress of the work scope and for providing project status. Milestones should be both definable and quantifiable; and all DOE reportable milestones will have specific completion criteria. Milestones are represented as zero duration activities and are a part of the logic flow.

3.1.3.5 Logic

The schedule is to be entirely logic driven. Every activity and milestone should have logic ties to the appropriate predecessors and successors. Exceptions exist for activities that are Project Start or Project Completion milestones. The use of constraints should be kept to a minimum and follow project guidance and documentation rules.

It is imperative that the logic be correct to allow for accurate float calculations to determine the project critical path. Project float on the critical and near critical paths will be monitored monthly. Any activities with less than 21 working days of float will be identified as critical.

The required amount of schedule contingency is based on uncertainty, event risk and management assessment. Schedule contingency will be determined for all final component deliveries, DOE critical decision milestones and other key milestones as determined by DOE and management.

3.1.3.6 Resources

Activities are to be resource loaded where reasonable, and according to the direction in the PPU Cost Estimating Guidance. Resources are to be loaded in labor hours and material dollars. A standard resource table is maintained by the project office. The resource table contains resources and rates for all the PPU partners and is updated, as needed, with new rates and escalation changes.

3.1.3.7 Coding

The PPU WBS will be the primary sort code for the project schedule. All activities in the schedule will be coded with their appropriate WBS number. To allow for various sorts of the schedule for analysis and reporting, additional codes have been created per PPU needs.

3.1.3.8 Calendars

A standard set of calendars has been established for the PPU project and the partner laboratory for calculating schedule durations. These calendars are based on each laboratory's workweek and holidays and are maintained for accuracy.

3.1.3.9 Schedule Rate Types

Primavera has 2 rates types that are utilized for specific purposes as described below. All official rates are calculated and stored in Cobra but are also represented in Primavera to allow users to analyze, as needed.

- **Burdened & Escalated**: Table contains burdened and escalated rates and can be used to estimate the ETC. Note that this is an estimate only and official escalated values used for the performance baseline are generated via Cobra.

- **Prime**: Table contains the prime dollar value for all resources.

3.1.3.10 Baseline

The baseline schedule provides the basis from which the Budgeted Cost of Work Scheduled (BCWS) is calculated, and foundation from which performance will be measured. The baseline will be adjusted with approved Project Change Requests (PCR's), which may result from changes in scope, contract awards and periodic Estimate to Complete exercises.

3.1.3.11 Objective Progress Statusing

The project's goal is to provide accurate performance reporting. To accomplish this goal, it is essential to have objective indicators that will guide the team in correctly reporting monthly performance. For short term activities with a duration less than 3 months, the project is not required to have objective indicators established. For activities with a duration greater than 3 months, performance indicators are required by documenting the performance approach through milestones, steps or a code field within P6. The project primarily utilizes an Activity Status Plan code field (PPU – Percent Complete ASP) to capture the performance criteria for each activity that is greater than 3 months.

The following are two examples of how PPU captures quantifiable backup data to support monthly performance reporting:

- Future fabrication activities will normally have high durations. These activities will be decomposed upon award of the subcontract and contract deliverables will be established. These milestones and activities will be utilized to properly assess the fabrication performance. The fabrication activities are documented in the project ASP code field.
- Partner lab scope is represented by a summary activity with the project master schedule. The detailed backup is contained in a separate vendor schedule that is submitted monthly. The vendor schedule contains P6 steps for documenting and assessing their procurement performance.

3.1.3.12 Schedule Status and Submittal

The project schedules will be updated with progress monthly. The data date for the updates will be the first calendar day of the following month.

The schedules will be finalized by the 8th calendar day of each month for review and monthly metrics reporting.

3.1.3.13 Schedule Analysis and Reporting

Monthly analysis of the project schedule will be meticulous and involve a comparison of the current project schedule to both the baseline and previously updated status schedules.

Standard reports are created monthly by the project office and focus on milestone dates and float on delivery and other key milestones. These standard reports will be included in the monthly metric meetings and portions will be included in the monthly report.

All Primavera schedules and any associated files are archived monthly.

3.1.4 Responsibilities

The Project Director, the WBS L2 Managers and the CAMs are ultimately responsible for their project schedule. The project controls staff is to support the project and WBS L2 Managers in developing and maintaining their project schedules.

The Project Controls Manager, the Senior PC Lead and the WBS Project Control Analysts are responsible for assisting the management in creating and maintaining their schedules. The specific scheduling duties of each are:

Project Controls Manager:

- Primary interface with DOE for reporting on schedule data
- Approval / concurrence of all PCR's

Senior PC Lead:

- Oversight of the creation and maintenance of the schedule, milestones & reporting
- Administration of Primavera software
- Coordination of schedules between PPU systems
- Project level schedule reporting
- Review of all PCR's for schedule accuracy
- Analysis of awarded procurements for project milestones and schedule impacts
- Maintenance of the schedule baseline

WBS Project Controls Analyst:

- Systems project schedule development and maintenance
- Project / WBS level schedule reporting
- PCR creation, as directed by the CAM and/or WBS L2 Managers
- Analysis of all procurements for project milestones and schedule impacts
- Maintenance & updates to system project baselines

3.2 ESTIMATE AND BUDGET DEVELOPMENT *(NDIA GUIDELINES 8, 10, 11, 12, 20)*

3.2.1 Cost Planning

Cost planning is a major planning activity required for the development of an integrated cost and schedule project baseline. The purpose of cost planning is to identify the resources needed to accomplish the scope of work and estimate the associated costs. Cost represents the dollar value required to accomplish the technical work scope within schedule and programmatic constraints. A preliminary cost estimate can be started after an initial Work Breakdown Structure is developed. Cost estimate integration with the WBS occurs when the work scope in each project work and planning package has a definitive cost/resource estimate associated with it. Once the cost estimate is approved at all management levels and CD-2 Energy System Acquisition Advisory Board (ESAAB) approval is obtained, the cost baseline is established.

Elements of the cost estimate include both direct costs and indirect costs. Direct costs are applicable to, and identified specifically with, the project work scope. Examples of these types of costs include labor, travel, material, subcontractor costs, etc. Indirect costs cannot be consistently identified against a specific project and are spread over the total laboratory project portfolio based on the Cost Accounting Standards Disclosure Statement.

3.2.2 Control Account Plans

Each control account must have an established time-phased budget that includes all costs necessary for the successful execution of that control account. It is the CAM's responsibility to develop, monitor and manage their control account plans (CAP) with the assistance of the project controls staff. The CAP is a summation of all the work packages (activities) and planning packages associated with the control account. Each activity within the control account should have resources assigned, consisting of units and an associated rate for labor and material. Each activity estimate should have adequate supporting information to justify the costs. These bases of estimates (BOE) are maintained and stored within the project's Cost Estimate Database (CEDB) with hyperlinks to supporting documentation.

A single control account should not combine LOE and discrete work efforts. If this does occur, the CAM must be able to assess the performance of the discrete work separately from the LOE effort. Also, when LOE and discrete efforts are mixed, the amount of LOE should not exceed 15% of the control account value. Efforts should be taken to ensure that separate control accounts are established for each type of effort.

3.2.3 Detailed Baseline Estimate

The detailed cost estimates (as well as all subsequent estimates prepared due to change requests), are the primary data source in determining budget values. Each WBS L2 Manager and CAM will be responsible for their cost estimates. Changes to the project cost baseline will only be through approved change requests.

A disciplined and systematic cost estimating process will promote integrity in the PPU project. As project performance will be measured against the project baselines, it is important that an accurate cost estimate be determined prior to the establishment of the cost baseline. This necessitates an extensive project management evaluation of the proposed project cost be accomplished. Areas can be identified where actions must be taken to restructure work scope or reassess resource requirements to meet anticipated fiscal year and total project funding constraints. Through validation of the cost estimate, a cost baseline can be established for the project. Cost estimating is a continuous process conducted throughout project execution for refining future work costs.

Estimates will:

- Be based on labor hours (with appropriate labor rates for labor costs) and vendor estimates for procured equipment costs to the maximum extent practical.
- Be prepared in current year dollars for material and travel resources. As an example, if the estimate is being prepared in FY19, the material procurements should be estimated in FY19 dollars.
- Reflect the decisions made during the acquisition planning process. Acquisition planning will consider equipment and services to be procured, equipment manufactured in-house, needs for upgrading industry and/or laboratory facilities, and other applicable activities needed to fabricate, inspect, test, and deliver equipment or systems.
- Clearly identify any material or equipment being purchased as spares.
- Include any required testing and equipment check-out effort.
- Incorporate all costs associated with activities. This includes items such as travel, general supplies and equipment, shipping charges, and equipment rental.
- Be costed utilizing the project's labor rate table. This table is developed by the Business Manager and is the only authorized source of rates and burdens.
- Be escalated utilizing escalation rates supplied by the Project Controls Manager.

The cost estimate is loaded into the Primavera schedules for time phasing. Data is then transferred to Deltek Cobra where the application of resource rates, burdens and escalation occur. Cost estimate sheets, books or electronic notebooks for each system are maintained by the CAMs which provide the basis of the project's current cost estimates.

3.2.4 Estimate to Complete

A detailed ETC will be prepared annually (at a minimum) during the life of the project. These will represent a comprehensive "bottom-up" re-evaluation of the resources necessary to complete the remaining scope of

work. In addition to the guidelines established above, the estimate to complete process will incorporate knowledge gained thus far in the project. Procurements that have been awarded yet not received (outstanding, un-costed commitments) will be coded utilizing a unique fixed-cost resource code to preclude escalation from being applied. Procurements that have not yet been awarded will be estimated in current year dollars.

The WBS L2 Manager and CAM retain all backup material, vendor quotes, detailed estimates, and any other information needed for providing the basis for their estimate. The completed ETC will be retained for information or be incorporated into the project baseline. Any changes to the baseline will follow the Project Change Request process. Re-baselining, as a result of an approved estimate to complete, may not include the elimination of variances by setting BCWP & BCWS=ACWP (unless approved by management).

3.2.5 Performance Measurement Baseline (PMB)

The PMB is the time-phased budget against which performance is measured and is developed by the integration of the cost estimate resource data with the time phased schedule activities. The PMB resides in Deltek Cobra. Changes to the performance measurement baseline occur only through approved Project Change Requests. The PMB is approved at CD-2.

Prior to CD-2, PPU does not have a Performance Measurement Baseline and will monitor performance against a preliminary plan and budget.

3.2.6 Responsibilities

The Project Director, the WBS L2 Managers and the CAMs are ultimately responsible for their project cost estimates. The project controls staff is to support the project and WBS L2 Managers in developing and maintaining their system cost estimates.

The Project Controls Manager, the Senior PC Lead and the WBS Project Control Analysts are responsible for assisting the management in creating and maintaining their system cost estimates. The specific duties of each are:

Project Controls Manager:

- Interface with DOE and Management for reporting on cost data
- Approval and concurrence of all PCR's

Senior PC Lead:

- Oversight of the creation and maintenance of the system cost estimates
- Project level cost reporting
- Review of all PCR's for estimate accuracy
- Maintain the project cost baseline

WBS Project Controls Analyst:

- Systems cost estimate development and maintenance, as directed by the CAM and/or WBS L2 Manager
- Project / WBS level cost reporting
- PCR creation, as directed by the CAM and/or WBS L2 Manager
- Analysis and incorporation of procurements into schedules
- Maintenance & updates to system project cost baselines

3.3 WORK AUTHORIZATION SYSTEM *(NDIA GUIDELINE 9, 10)*

A work authorization system is required during the project execution phase to control the flow of work to be accomplished within the authorized project budget and available funding. This formal procedure is used to sanction project work with limits being imposed on managers in their authority to commit and expend resources that will be charged to the project. These limitations provide assurance to the Project Director that no work is authorized unless it has been properly planned and budgeted. Work authorization is the specific mechanism where CAMs receive the authority to begin the work defined in their Control Account Plans.

3.3.1 Work Authorization Process

After the Project Director receives authority to commence work and funding has been provided, the work authorization process is employed to initiate project execution. The authorization process is a key communication link between senior project management and the Control Account Managers because it confirms the cost, schedule, and scope of work required to meet project objectives. Control Account Managers are formally delegated the responsibility for their work scope and the schedule and budget performance parameters.

To authorize the expenditure of effort and budget for a control account, the Project Director will issue a Work Authorization Document (WAD) to the Control Account Manager at the appropriate period in the project schedule. The WAD contains the control account information, a list of associated work/planning packages, approval signatures, and acceptance signature of the Control Account Manager and Project Director (or assignee). The signed WAD empowers the Control Account Manager to implement the Control Account Plan. Once all relevant parties have signed a WAD, the project finance officer will open control account charge numbers to allow charges to be made against the control account's work packages.

Funding will be authorized based on schedule status and funding availability and communicated to CAMs. The approved control account can only be changed through the appropriate project change request and approval process. After a Project Change Request (PCR) is processed, the CAM will be notified of the authorization for performance of the approved work scope. This notification serves as the revised work authorization document.

3.3.2 Work Authorization Implementation

The above Work Authorization process will be fully implemented once the project is baselined at CD-2. Also, any phased CD-3 work scope prior to CD-2 will also implement the Work Authorization process. Until the project is baselined at CD-2, annual work authorization is provided through the development, approval and implementation of annual Performance Plans, key milestone lists or similar documents.

3.4 CONTINGENCY, MANAGEMENT RESERVE AND UNDISTRIBUTED BUDGET *(NDIA GUIDELINE 14)*

During development of the project cost plan, contingency funds may be identified to provide budget that covers future risk elements to the project or uncertainty in the estimate. These funds are part of the Total Project Cost but reside outside the approved Performance Measurement Baseline (PMB). Contingency is developed "bottom-up" from a risk and uncertainty assessment of individual work elements within the project WBS. This contingency is then extracted from the individual WBS elements, assessed by management, and summed into a project contingency account. Funds held in the contingency account are nominally controlled by the Federal Project Director. Management reserve may be allocated to the Project

Director from project contingency funds for their approval authority. Management reserve funds provide flexibility in managing baseline changes to control accounts within the project.

The release of contingency/management reserve funds is managed through the change control process and determined by approval thresholds defined in the Project Execution Plan. Transactions for these accounts are documented in the project change control system. As a project nears completion, the Federal Project Director will determine the final disposition of any unused contingency or management reserve.

Undistributed budget is budget for work scope that has been authorized but has not yet been distributed to a specific control account. The PPU project does not have undistributed budget.

4. ACCOUNTING CONSIDERATIONS

4.1 PROJECT FUNDING AUTHORIZATION

The U.S. Department of Energy (DOE) Headquarters (HQ) provides funds to the PPU Project Office through the normal financial plan process and authorization to perform work through the DOE work authorization system. The DOE financial plan provides funds for the project. Actual expenditures and commitments are limited by the amount of funds authorized by DOE. At no time shall cost plus the outstanding commitment balance exceed the funds authorized by DOE.

In anticipation of the receipt of funds and work authorization, agreement will be reached with each WBS L2 Manager and CAM on the work scope, milestones, and budgets for the ensuing fiscal year.

The Business Manager will prepare the necessary documents to authorize costing and commitment of funds and allocate funding to appropriate cost accounts within the ORNL financial system. The Business Manager will also maintain the official files for authorizing documentation that will include the DOE work authorization documents and financial plans.

4.2 ACCOUNT STRUCTURE *(NDIA GUIDELINE 16, 17, 18, 19, 21)*

The Business Manager will design the PPU account structure based on the following principles:

- Actual costs on the PPU will be reported at the control account or lower. Therefore, at a minimum, each control account will be assigned a unique charge code for cost collection. An individual WBS L2 Manager may elect to collect costs at a lower level

- The charge accounts replicate the structure of the PPU WBS elements and are associated with the appropriate OBS element.

- PPU accounts/work orders will be used exclusively to collect project costs (i.e., no funds will be allocated directly to other internal divisions/groups)

- All direct labor, materials, subcontracts and other direct costs will be charged directly to the charge codes associated with the control account. Indirect charges are also captured in these charge codes as applied rates against the appropriate direct charges. The established charge codes will ensure that all actual costs are collected such that a direct comparison to the associated budgets can be made at the appropriate WBS/OBS levels.

The participant financial organization will open all accounts/work orders. All accounts/work orders opened will be assigned a budget consistent with the total in the approved funding package.

All participant organizations will follow the above business/accounting principles.

4.3 ACTUAL COST REPORTING

All requested cost adjustments/transfers will be reviewed and approved by the PPU Business Manager or the appropriate participant's Business Manager. Retroactive cost adjustments that change historical data are prohibited. All transfers must be reflected in current month cost data. All participant organizations will provide a flat file of actual costs each month. These costs must reconcile to the official accounting system of each laboratory.

4.4 BUDGET AUTHORIZATION (BA)

The Business Manager will allocate BA based on approved work scopes. Even though the work scope will reflect the budget for the entire fiscal year, the work may be incrementally funded during the year. Each WBS L2 Manager is responsible for controlling expenditures and commitments so that BA authorized through the official financial system is not exceeded. Multi-year procurements will be phase-funded, if possible, to optimize BA utilization.

4.5 ACCOUNTING ACCRUALS

For the earned value project management system to be effective, it is essential that costs be recorded in the official accounting system in the same period that work is performed. Recognizing that subcontractor billings normally lag the actual period of performance, accruals will be entered in the monthly cost. Automatic accruals will be entered absent specific guidance from WBS L2 Managers. If a manual accrual is required, the WBS L2 Managers will contact the Project Controls Analyst who consolidates accruals and submits to the Finance Officer to accrue estimated subcontractor costs for materials/services that have arrived/been performed during the month for which an actual invoice has not been received. Accruals will consist of the cost of work completed, but not yet billed, by subcontractors through the end of the month.

Accruals should be based upon information submitted by subcontractors in accordance with the terms of the subcontract. While documentation in the form of subcontractor invoices is the best support for cost accruals, in the absence of such documentation, other alternatives may be used (e.g., other project information submitted by the subcontractor and input from scientists/engineers). As with all documentation that is entered into an official laboratory accounting system, the documentation or basis for estimating cost for accrual purposes must be assessed for adequacy and reasonableness of estimates. Cost accounting accruals should be recorded exclusively in the official laboratory accounting system and will flow to the project controls system. No accruals will be entered directly into the project's earned value reporting system bypassing the official accounting system. All financial information used to manage the PPU is required to originate in the official laboratory/participant accounting system.

4.6 ANNUAL BUDGET REQUEST TO DOE

DOE will fund the PPU through the federal appropriations process. The PPU Business Manager prepares an annual budget request based on project requirements and submits it to DOE.

The DOE Field Work Proposal (FWP) format is used to request funds for the project. If funds authorized by Congress and the President do not support the cost and schedule baselines, the schedule will be revised to adjust activities so that resource requirements will fit within funding constraints. DOE will be informed of future funding requirements to complete the work and subsequent budget requests will reflect the new

requirements. Funding constraints that impact either the TPC or the project summary schedule as documented in the PEP will be documented under the configuration management system.

4.7 PROPERTY MANAGEMENT

Materials and equipment purchased for the PPU project will be managed in accordance with the ORNL Property Management or Partner Laboratory processes and procedures.

5. ANALYSIS AND MANAGEMENT REPORTS

This section describes how the Performance Measurement System is part of the closed-loop project controls system.

The Project Controls group develops the performance measurement and reporting system, maintains the system, generates project-wide reports, and distributes reports to appropriate personnel. The WBS L2 Managers will generate performance data via the detail schedules, evaluate earned value data, analyze variances and implement corrective actions if needed. The essential ingredient in measuring performance is the up-front definition of what is to be measured.

5.1 EARNED VALUE MEASUREMENT

All project work scope will be managed using earned value techniques.

Budget at Completion (BAC) – total authorized budget for accomplishing the scope of work. It is equal to the sum of all allocated budgets; does not include Contingency or Management Reserve.

Budgeted Cost of Work Scheduled (BCWS) - the time-phased budget that represents the value of work to be accomplished through a given period of time; also known as Planned Value (PV).

Budgeted Cost of Work Performed (BCWP) – the budget of the work that is completed/performed through a given time period; also known as Earned Value (EV).

PPU utilizes two earned value techniques for updating schedule status:

- **Level of Effort** (Duration Percent Complete) – earned value is equal to the plan for the given time period; BCWP = BCWS; used when productivity is not measurable (i.e., management oversight)

- **Physical Percent Complete –** earned value is based on the physical progress towards completion of the work (% completion of the total work to be performed). Percent complete should never be calculated based on the dollars spent.

The following guidelines are followed in determination of BCWP:

- Earned value is determined via physical percent complete of the work. Level of effort activities earns their value as a percent of duration.
- The selected measurement method does not change for the duration of the activity.
- Earned value is determined in a manner that is consistent with the way BCWS is planned.
- BCWP is recorded at the end of each month.
- Retroactive adjustments are not made.
- BCWP can never exceed BAC.

Actual Cost of Work Performed (ACWP) – total cost incurred for the work completed/performed through a given time period; also known as Actual Cost.

5.2 VARIANCE ANALYSIS

5.2.1 Requirements *(NDIA Guideline 24)*

The following requirements are used to determine cost and schedule variances:

- Status is determined monthly for all activities.
- ACWP data is obtained directly from the financial systems.
- Current month and cumulative-to-date cost and schedule variances are calculated and reported.
- At-completion variances are calculated based on performance to date and the project cost for work to be performed, considering corrective actions being implemented and forecasted increases/decreases, schedule changes, and scope changes.
- Cost and schedule variances that exceed the established thresholds are analyzed, variance analysis reports prepared and reported in the Contract Performance Report (CPR) at the designated levels.
- Actual costs are compared to the budgeted values for indirect costs to analyze any variances that may exist.
- Corrective actions are prepared and executed by the responsible WBS L2 Manager and/or Control Account Manager.

5.2.2 Variance Analysis Reporting *(NDIA Guideline 22, 23, 25)*

Variance analysis is performed to identify whether cost or schedule problems exist, whether they are improving or getting worse, who is responsible for the work associated with the issue, what overall impact the problem may have on the project, and what may be done to recover from or mitigate the impacts of the issue. Variance thresholds are established in the PEP.

Cost and schedule variances for each control account that have a cumulative CPI or SPI less than .85 or greater than 1.20 require a variance analysis if the variance is greater than $100k. For control accounts that have a BAC < $100k, then the project requires a variance analysis if the variance is greater than 50% of the BAC. Once a control account is marked as Closed, further variance analyses are not required each month.

The variance analysis section of the monthly report will contain an explanation of the cause of the problem, its impact on the project, and the description of the corrective action taken or planned. The PPU project will utilize a Contract Performance Report, Format 5 (CPR5) for addressing variances outside of thresholds. The CPR5 reports are signed by the CAM and the Project Manager.

It is the responsibility of the CAM to provide monthly performance variance analysis reports to the WBS L2 Manager for review. After review, the performance reports are presented to the Project Director and Project Manager through the monthly reports and metrics presentations.

The methods for calculating variances are as shown below:

Cost Variance—Cost performance is measured by comparing accomplished work (BCWP) to actual cost (ACWP). Cost variances are expressed as follows:

Cost Variance (CV) = BCWP - ACWP
Percent Cost Variance = [(BCWP - ACWP)/BCWP] x 100

Positive variances indicate a cost under-run while negative variances indicate a cost over-run. Examples of causes for cost variances include poor initial estimates, technical difficulties requiring the application of additional resources, and cost of labor or materials different from planned.

Cost Performance Index - The ratio of the Budgeted Cost of Work Performed to the Actual Cost of Work Performed is used to represent the cost efficiency of the project.

Cost Performance Index (CPI) = BCWP/ACWP

- CPI values less than 1.0 represent "cost over-runs," spending more for the performed work than originally budget.
- CPI values greater than 1.0 represent "cost under-runs," spending less for the performed work than originally budgeted.

Schedule Variance—Schedule performance is measured by comparing work accomplished (BCWP) with work scheduled (BCWS). Schedule variances are expressed as follows:

Schedule Variance (SV) = BCWP - BCWS
Percent Schedule Variance = [(BCWP - BCWS)/BCWS] x 100

Positive variances indicate an ahead-of-schedule condition while negative variances indicate a behind schedule condition. Examples of causes for negative schedule variances include an uncompleted constraining task, resources not available, and work completed later than planned.

Schedule Performance Index – The ratio of the Budgeted Cost of Work Performed to the Budgeted Cost of Work Scheduled is used to represent the schedule efficiency of the project.

Schedule Performance Index (SPI) = BCWP/BCWS

- SPI values less than 1.0 represent "behind schedule" and that work is being accomplished slower than planned.
- SPI values greater than 1.0 represent "ahead of schedule" and that work is being completed faster than planned.

The EVMS performance indicators provide an early warning on the current project conditions. In order to determine the source of the problems, it is necessary to carefully examine and monitor the control account schedule and cost reports. After analysis is completed, an appropriate correction action should be created, implemented and monitored.

5.2.3 Corrective Action Monitoring *(NDIA Guideline 26)*

It is the WBS L2 Manager and CAMs responsibility to monitor and report corrective actions through to resolution and to highlight the current status of the corrective actions until the variance is resolved or the control account is marked as closed. The Project Director / Project Manager reviews the status of corrective action plans during routine reviews with the WBS L2 Manager and CAMs and during monthly Metrics meetings.

5.3 ESTIMATE AT COMPLETION *(NDIA GUIDELINE 27)*

The Estimate at Completion (EAC) is the forecasted value of the project when it completes. It is calculated by the Cobra costing system plus the total of any EAC Listing values. PPU management maintains an EAC Listing of items derived from routine meetings with the WBS L2 Managers, CAMs and PCAs. The items on the EAC Listing are potential events, issues or needs that could influence the final cost or schedule of the project but have not been incorporated into the project preliminary plan and therefore are not included in the project BAC. These items are recorded, monitored and discussed with management on a routine basis to determine their impact, likelihood and the need for implementation into the project preliminary plan using the change control process.

In addition to the standard method of calculating the project EAC, there are many formulas that allow the project to predict the EAC based solely on historical performance metrics. Three of the more common are shown below:

EAC = BAC / CPI
Assumes that the historical cost performance will continue throughout the rest of the project

EAC = ACWP + (BAC – BCWP)
Used when the historical cost performance is abnormal due to a specific event

EAC = ACWP + [(BAC – BCWP) / (CPI x SPI)]
Used to incorporate the historical cost and schedule performance as part of the calculation.

5.4 VARIANCE AT COMPLETION

The Variance at Completion (VAC) is calculated as the difference between the BAC and the EAC. It represents the amount of expected project cost over-runs (negative value) or under-runs (positive value).

Variance at Completion (VAC) = BAC – EAC

5.5 EVALUATING TRENDS

In the sections above, various performance measures were discussed and the method of calculating each was defined. It is also necessary to monitor these on a continuing basis to track the project trends and more precisely trends on individual elements of the WBS and major tasks.

In addition, other performance measures and analyses are used for monitoring project status and assessing trends. Section 8 lists routine reports that the project will use for this purpose. Performance measures and reports will change as appropriate to ensure they are relevant to the goals and objectives of the different phases of the project.

6. REVISIONS

6.1 BASELINE CHANGE CONTROL PLAN

The PPU project utilizes a Project Change Request (PCR) system to enter, approve and document any requested changes to the project baselines. The system is managed and controlled by the Project Controls group. The change control process is described in the PPU Baseline Change Control Plan (PPUP-101-PN003).

6.2 CHANGE CONTROL RESPONSIBILITY *(NDIA GUIDELINE 28, 29, 31)*

The Project Controls Manager is responsible for administrative operation and coordination of the overall baseline change control system in support of the PPU. In this capacity, the Project Controls Manager will provide administrative control and support for processing all PPU Project Change Requests. This begins upon receipt of draft PCRs from the responsible WBS L2 Manager / CAM or designee and continues through various reviews to the issue and distribution of approved PCRs. The Project Controls Manager is responsible for implementing approved cost/budget and schedule/milestone baseline changes to the official PPU project baseline documents and files based upon the input created by the CAMs or their appointees. All changes to the project baseline will be reviewed and confirmed to ensure that the integrity of the baseline is preserved after implementation of the PCR.

PCRs submitted within the reporting month will be processed / implemented no later than 10 working days into the following month. This allows PCRs to be approved past the end of the reporting month, but prior to the monthly closeout.

If a PCR exceeds a DOE threshold, the Project Controls Manager is responsible to prepare a DOE Baseline Change Proposal (BCP). The BCP will be forwarded to DOE for approval after all project management concurrences and approvals are obtained on the PCR.

The WBS L2 Managers / CAMs are responsible to implement all approved baseline changes including cost, schedule, and technical/design basis changes to the official PPU project technical baseline documents and supporting technical design.

6.3 CHANGE CONTROL IMPLEMENTATION *(NDIA GUIDELINE 15, 30, 32)*

The PPU project maintains a rigorous Change Control system for baselined scope that requires documentation, review, and approval of any changes to the project scope, cost, or schedule (key milestones). The project does not allow retro-active changes other than a current month point adjustment, if any should be required for the correction of errors. All PCRs are documented in the Change Control Log (Rainbow Chart) and the contingency available is modified to reflect the incorporated PCRs. An example of a PCR documented in the Change Control Log is shown below. The log provides the project with the current baseline amount, available contingency, and the total project cost.

Burdened, Escalated $k	L3 LL-2021-10 **Klystron Gallery Construction Extension and Associated Adjustments**	L3 RI-2021-04 **Injection Dump Imaging System (IDIS) Window Coating and Window Awards**	L2 TG-2021-08 **Mol Sieve Redesign Schedule and Scope Omission**
P.01 Project Management			
P.02 SCL Systems	1,422		
P.03 RF Systems	9,037		
P.04 Ring Systems		(17,124)	
P.05 First Target Station Systems			1,021,407
P.06 Conventional Facilities			
P.07 R&D			
P.08 Pre-Ops			
P.09 Pre CD-1 Activities			
P.10 LLPs	222,316	-	-
Total PPU Impacts	**232,776**	**(17,124)**	**1,021,407**
Total Impacts	**232,776**	**(17,124)**	**1,021,407**
Revised Baseline (BAC)	**210,206,152**	**210,189,028**	**211,210,434**
Management Reserve	6,091,976	6,109,100	6,109,100
Contingency	55,268,872	55,268,872	54,247,466
Total Project Costs (TPC)	**271,567,000**	271,567,000	271,567,000

Figure 7 - Sample PCR Log Entries

Upon CD-2, the project will incorporate a 2-month freeze period (current month + 1) approach to Change Control which limits any changes to the near term without Management approval. This approach eliminates the ability to make baseline changes due to monthly variances and encourages the CAMs to monitor their schedules and assess the future for upcoming issues/concerns. There are a few allowable exceptions to the freeze period as shown in the following list:

- **Contract Awards** – The baseline may be adjusted per the vendor's schedule when a contract is awarded.
- **Contractual Changes** - The baseline may be adjusted for any approved contract or SOW modifications.
- **Field Change Orders** – The baseline may be adjusted when a field change order significantly impacts the future schedule logic and/or the project EAC. Field changes on construction-related scope are often related to near-term work and must be implemented as soon as practicable to minimize schedule slippage.
- **Scope Changes** – Activities that are new scope or discoveries of scope omission may be incorporated into the schedule during the freeze period. In addition, activities deemed to be un-necessary to accomplish the work scope (after activities were scheduled to start or be completed) may be removed from the baseline with a current period adjustment. Allowing modified or deleted scope to be trapped in history reduces the integrity of the baseline.
- **Realization of Risks** – The baseline may be adjusted if a risk is realized, and additional mitigation activities are needed to address the issue.
- **ETC Planning** – The baseline may be adjusted annually (at a minimum) when a project conducts a thorough ETC exercise. If the plan has significantly changed, the baseline change is needed since the EV metrics may not provide accurate information for sound management decisions.

- **Funding Issues** – When available funding is inconsistent with prior funding guidance, then the project may re-baseline to incorporate new funding guidance.
- **Rate Changes** – When a lab-wide rate change occurs that significantly impacts the EAC, the project may process a PCR to update the future rates within the freeze period.
- **Errors** – When errors occur due to implementing or modifying a baseline which do not accurately reflect how the baseline was to be implemented, a correction PCR may be implemented within the freeze period.

When a PCR cannot be implemented in compliance with the freeze period, the PCR will state that the PCR is not in compliance and list the reason(s) for the exception. The PD/PM will determine if the exception to the freeze period is valid, prior to final approval of the PCR. If there is a need for an exemption to the freeze period that is not listed above, the PCR will note the reason for the needed exemption and the PD/PM will determine the validity of the request by their approval or rejection of the PCR.

7. RISK MANAGEMENT

The PPU Project Risk Management Program is defined in and implemented through the *Risk Management Plan* (RMP). The RMP presents the process for proactive, continuous risk management as part of the overall management of the PPU project. It describes the methods used to identify, assess, and manage the project's risks and uncertainties through the project's risk management system and detailed schedules, defines the roles and responsibilities of the project personnel in performing risk management functions, and provides the process to monitor and track risks and eventually retire them. Emphasis is placed on three risk areas:

- Technical: The possibility that the fabricated or procured hardware requirements may change
- Cost: The possibility that the cost may differ from the baseline budget
- Schedule: The possibility that project activity durations may differ from the baseline schedule

The RMP conforms to the guidance in DOE Order 413.3b and serves as the basis for:

- Identifying risks so they can be controlled and the likelihood of the project meeting the technical, cost, and schedule objectives are maximized.
- Identifying opportunities so they can be exploited and increase the likelihood of meeting technical, cost, and schedule objectives.
- Identifying alternative methods for achieving cost, schedule, and performance goals.
- Assisting in making decisions on budget and funding priorities.
- Monitoring the health of the project as it proceeds.

The goal of the PPU risk management approach is to have a process that is disciplined, forward looking, and continuous. The nine-step, iterative process is summarized in the following steps:

1. **Identify risks** throughout the successful completion of the project. Risks (threats and opportunities) associated with project work scope, cost, and schedule are identified by systematically challenging the assumptions, logic, and scope of the project.

2. **Assess the risks** by determining their probability of occurring and impact (consequence) on the project's cost, schedule and/or work scope.

3. **Prioritize the risks** to enable efficient allocation of resources to control and mitigate them. Risk prioritization/categorization considers the risk consequence and the probability of the risk occurring.

4. **Select and determine the risk-handling strategy,** whether it is to avoid, transfer, mitigate, or accept the threat, or to enhance, exploit, facilitate, or accept the opportunity.

5. **Assess the risks (post-mitigation)** to determine the probability of occurrence and impacts assuming the mitigation is successful.

6. **Evaluate uncertainty** for cost and schedule estimates.

7. **Analyze risk events and uncertainty** to determine impacts to contingency and the project's success.

8. **Implement risk-handling strategies** to reduce or eliminate threats and exploit opportunities.

9. **Perform routine risk reporting and monitoring** through a risk management information system in which the effectiveness of risk-handling actions is constantly evaluated, new risks are discovered, and existing risks are reassessed.

8. REPORTS, MEETINGS AND REVIEWS

8.1 PERFORMANCE REPORTING *(NDIA GUIDELINE 25)*

Reporting is an integral part of the PPU Performance Measurement System, with the Monthly Progress Report being one of the key reports. Monthly status reporting is provided by the WBS L2 Manager and CAM to the Project Office for summarization with other reports. This report will include a narrative description of technical accomplishments for the month, current issues and concerns as well as variance analyses for those variances outside the established reporting threshold.

The Project Controls Manager will summarize the data provided and prepare a monthly report for DOE. The Monthly Progress Report may include reports such as Cost Performance Reports - Format 1 / 5, variance analysis, milestone status and/or other information, as defined by the PEP and required by the Federal Project Director. The project also uses additional project management reports which may change or be supplemented as the project progresses into different phases. The following table provides a sample list of these reports.

Performance Area	Report Title	Originator	Frequency	Description
Work scope / cost / schedule / variance analyses	Monthly Progress Report	WBS L2 Manager / CAM	Monthly	Narrative accomplishments and issues; variance analysis reports with corrective actions, EAC input
Work scope / cost / schedule / variance analysis	Monthly Progress Report to DOE	Project Controls Manager	Monthly	Same as above with data and variance analyses summarized.
Work scope / cost / schedule / risks / variance analyses	Metrics Package	Project Controls Manager	Monthly	Presentation of the overall status of the project supported by detailed slides for each system
Contingency / Cost	PCR Listing	Project Controls Manager	As changed	Provides changes in contingency due to approved PCRs; for FPD
Funds Management	Financial Report	Business Manager / Finance Officer	Monthly	Shows BA authorization, cumulative actual costs, and outstanding commitments
Procurement	Key Procurement Status	Procurement/Project Controls	Monthly	Provides procurement information for items >$150k or deemed critical
Performance	PARS reporting	Project Controls/DOE Federal Project Director	Monthly for baselined work scope	Monthly performance and assessment data
Baseline Management	Project Change Control Log	Project Controls Manager / Baseline Change Control Manager	As changes requested for approval	Listing of all PCRs to date and impacts.

8.2 MEETINGS AND REVIEWS

In addition to performance measurement and reports, PPU relies heavily upon a series of regularly scheduled meetings and reviews to manage project technical, schedule, and cost status. These meetings provide early indications of developing trends and problems, prior to being viewed later in the report data. They also provide a forum for resolving emerging problems.

8.2.1 Performance Review Meetings (Metrics)

Routine meetings are held to review the status of the tasks from the viewpoint of cost and schedule. The Project Controls Manager will chair the meetings. The status meeting format will be simple, straightforward, and concise. Utilizing trend charts for cost and schedule performance, each WBS L2 Manager or CAM will present task status including the following:

- Performance
- Schedule and Cost Status
- Variance Reporting, as needed
- Corrective Actions, as needed
- Procurement Status
- Top Issues (including status)
- Key Risks
- Current work scope

Additionally, the following will be prepared / discussed by the appropriate managers, as needed:

- Project Overview
- Human Resources
- Quality Assurance, Environmental Safety & Health (ES&H)
- Procurements
- Communications

8.2.2 Other Meetings

Routine meetings will be scheduled with the DOE Project Director, DOE Federal Project Director, Project Director, Project Manager and Project Controls Manager during which performance may be one of the items discussed.

9. PROCUREMENT OPERATIONS

9.1 INTRODUCTION

This section describes the procurement framework for use on the PPU Project. Key topics addressed include procurement management, procurement planning, and overall guidelines for accomplishing procurements on the PPU project. For partner laboratories, detailed procurement practices and operations are to be conducted in accordance with their established and approved procurement operating policies and procedures.

9.2 PROCUREMENT PLANNING AND REPORTING

Each laboratory is responsible for planning, tracking, and executing all procurements required to complete their project scope. WBS L2 Managers / CAMs are responsible for general coordination with all of the organizations involved in procurement planning to ensure that (1) procurement requirements are properly defined; (2) major procurements are included in the project schedule, and required delivery dates are identified to allow for adequate lead-time for all phases of the project; and (3) procurements are budgeted properly such that the project baselines are consistent with the procurement requirements and schedule. Procurement planning is important to ensure that current year funds are allocated consistent with project requirements. The PPU procurement planning tool is used as a benchmark to measure progress in executing planned procurement actions. Amounts included in the PPU procurement plan will have a strong influence on the amount of BA included in the work package.

Each WBS L2 Manager / CAM will address planned procurement methods and strategy for their segment of the project. Detailed procurement planning will include potential fallback positions in case a vendor is unavailable or fails to perform as expected.

Procurement strategies include:

- Subcontract/Purchase Order
- Basic Ordering Agreement (BOA)/Outline Agreement
- Task Order
- Standardized Items/Bulk Purchase
- Fixed-Price
- Cost-Reimbursement
- Time and Materials
- Incrementally Funded
- Subcontract/Purchase Order with Options

Two of the most common types of subcontracting methods are fixed-price and cost-reimbursement. Cost-reimbursement subcontracts are commonly used in the procurement of R&D or other complex work where performance uncertainties make it difficult to estimate the cost of performance in advance. Cost-reimbursement and time and materials subcontracts provide the minimum incentive for the subcontractor to control costs and impose the maximum obligation on the appropriate WBS L2 Manager and CAM to monitor the subcontractor's performance and costs. Fixed-price subcontracts place the responsibility for performance within the stated price on the subcontractor. It is the PPU procurement strategy to use fixed-price procurements at every opportunity.

9.3 PROCUREMENT MANAGEMENT

9.3.1 PPU Project Office

The PPU Procurement Manager is responsible for PPU procurement activity and reports to the PPU Project Director. ORNL's business infrastructure systems will be used to support procurement operations. The PPU Procurement Manager will interface with ORNL Procurement colleagues as needed to address project procurement requirements. The Procurement Manager will also interface directly with ORNL Procurement, ORNL Property and Materials Management, ORNL Tax Administration Office, ORNL Office of General Counsel, DOE-ORO, and participating laboratory financial staff, etc., in order to address PPU procurement requirements. The PPU Procurement Manager is responsible for maintaining the official procurement records for the ORNL portion of the project.

The Procurement Manager will develop and direct the overall Project Office procurement strategy as approved by the Project Director in support of operations. The Project Office procurement strategy will be based on the following principles: (1) timely support will be provided to meet schedule requirements, (2) cost-effective, efficient, best business practices will be used at every opportunity, (3) partner procurement operations with the opportunity to seek support and use PPU practices to meet schedule requirements, (4) innovative procurement concepts will be employed whenever necessary to improve the quality of acquisition support to project personnel.

10. APPENDICES

10.1 APPENDIX A - DEFINITIONS

Accounting accrual - Expenses or an estimate of expenses that have been incurred and posted in the cost accounting systems but have not actually been paid.

Activity - A unique work task, a few weeks to a few months' duration, identified in the schedule**.**

Activity Codes - Alphanumeric identifiers assigned to each project activity (in Primavera) to facilitate survey and grouping of activities for analyzing, reporting, plotting, and summarizing, activities.

Activity ID - Unique number assigned to an activity (in Primavera) much like a serial number.

ACWP - actual cost incurred as reported through laboratory cost accounting systems + accruals

BAC - budget at completion is the total estimate for a work package or activity (excludes contingency)

BCWP - budgeted cost of work performed or "Earned Value" is the value earned for accomplishment of specific pieces of the defined work. This is not the same as what it has cost to achieve the progress made (50% of the cost spent does not necessarily mean that the work is 50% complete)

BCWS - Cost plan based on the budgeted value of a scope of work, time-phased based on the schedule for the scope of work.

Budget authority (BA) - Total budget available (including carryover funds) to cover both cost and commitments.

Budget outlays (BO) - Funds required to cover estimated cost, typically BCWS.

Cobra - Deltek Cobra is the selected software used for earned value and cost reporting.

Commitments - Funds allocated to subcontractors or vendors where the work has been authorized through contract but not yet expensed.

Contingency - An amount budgeted to cover costs that may result from incomplete design, unforeseen and unpredictable conditions, or uncertainties. The amount of contingency will depend on the status of design, procurement, and construction and the complexity and uncertainties of the component parts of the project. Contingency is not to be used to avoid making an accurate assessment of expected cost and time.

Control Account manager (CAM) – Designated by a WBS L2 Manager to manage components of their assigned scope. Control Account Managers are assigned to specific control accounts and report progress to the WBS L2 Manager.

Cost Performance Index (CPI) - Represents the relationship between the actual cost expended and the value of the physical work performed. CPI = BCWP/ACWP.

Cost Variance Percent (CV%) - The cost variance as a percent of the Earned Value.
CV% = [CV/BCWP] x 100.

Control Account - Defines the functional (WBS) responsibility for a block of work, BCWS, and BCWP; provides the cost collection point for ACWP. May contain one or more charge codes.

Cost Estimate - A documented statement of costs estimated to be incurred to complete the project. Cost estimates provide baselines against which cost comparisons are made during the life of the project.

Cost variance - CV = BCWP - ACWP

Critical path - A sequential path of activities in a network schedule, which determines the necessary duration of a project. Any slippage of the tasks in the critical path will increase the duration of a project. Also, the sequential path of activities with the least float.

Data Date - The data date is the "as of" date; the date status has been included in the schedule.

Earned value - An objective measure of progress that is based on the budgeted value of work performed.

Estimate at completion (EAC) - Forecast final cost of a scope of work based on the current calculated performance to date, plus the ETC, plus a management assessment of any outstanding cost impacts to the project that have not been included in the project plan

Engineering, Design, and Inspection (ED&I) - ED&I activities include the engineering and design activities in Title I and Title II and the inspection activities associated with Title III.

ETC - estimate to complete is the latest estimate of budget required to finish the work remaining.

Indirect Costs - Costs incurred by an organization for common or joint objectives, and which cannot be identified specifically with a particular activity or project (e.g., laboratory overhead).

Milestone - Activity representing a significant schedule occurrence at a point in time.

Obligation Plan - Time-phased plan of how the project plans to commit their Allocated BA. Labor and materials and supplies are typically time-phased as expended, while procurements are typically time-phased at award of contract plus award of any contract options.

Performance Measurement Baseline - The time-phased budget plan against which project performance is measured.

Planned Progress to-date - The sum of the cumulative BCWS to-date for all WBS elements. The percentage is calculated by dividing the sum of the cumulative BCWS to-date by the Budget at Completion for all WBS elements.

Primavera - Primavera P6 Enterprise Project Portfolio Manager is the selected schedule software for the project.

Project Office - When used in this document, the term "Project Office" means the contractor PPU Project Office in Oak Ridge that provides project management functions for all participants.

Project Phase - Design, procurement, fabrication, installation, testing, etc. that is defined in the lower levels of the WBS.

Research and Development Activities - Research and development activities generally include all work, up to the time when the ideas or conceptual design for the project or individual components are crystallized and are ready for the preliminary design work (Title I) leading to a specific construction or fabrication project.

Schedule Performance Index (SPI) - Represents the relationship between the value of the initial planned schedule and the value of the physical work performed or Earned Value. SPI = BCWP/BCWS.

Schedule variance - SV = BCWP (Earned Value) - BCWS

Schedule Variance Percent (SV%) - The schedule variance as a percent of the performance baseline. SV% = [SV/BCWS] x 100.

Total Project Cost (TPC) - Consists of all the costs included in the TEC of a project plus the contingency.

Unburdened Cost - Cost calculated from listings of materials or equipment and quantities, man-hours needed and labor rates, or other fundamental cost estimating techniques but not including overhead costs.

Undistributed budget - Part of the Performance Budget Baseline that has not been distributed to a specific WBS element or organizational element. PPU does not have any undistributed budget.

Variance - The difference between the expected/budgeted/planned and the actual results.

Variance at completion (VAC) - The algebraic difference between budget at completion and estimate at completion (VAC = BAC - EAC).

WBS L2 Manager (WBS Manager)—The manager responsible for work, budget, schedule, deliverables and reporting for a WBS Level 2 scope of work until the equipment or other deliverable is transferred to Operations.

Work Breakdown Structure (WBS) - A breakdown of a project into those sub elements that define a project. The WBS provides a consistent organization framework throughout the project.

10.2 APPENDIX B - GOOD PRACTICE GUIDELINES

- DOE O 413.3B, Program and Project Management for the Acquisition of Capital Assets
- DOE M 413.3-1 Project Management for the Acquisition of Capital Assets
- Association for Advancement of Cost Engineering International (AACEI) – Recommended Practices, RP 17R-97
- Association for Advancement of Cost Engineering International (AACEI) – Recommended Practices, RP 18R-97
- National Defense Industrial Association (NDIA) Program Management Systems Committee (PMSC) ANSI/EIA-748-B Earned Value Management Systems Intent Guide,
- Project Management Institute (PMI) – Project Management Body of Knowledge (PMBOK)
- Spallation Neutron Source Project Completion Report, June 2006

- U.S Department of Energy, Program and Project Management Practices, 8/14/00
- GAO Report to the Committee on Science, House of Representatives, National Ignition Facility, Management and Oversight Failures Caused Major Cost Overruns and Schedule Delays GAO/RCED-00-141, August 2000
- GAO Cost Estimating and Assessment Guide, Best Practices for Developing and Managing Capital Program Costs, GAO-09-3SP, March 2009
- Kerzner, Harold. (1998), Project Management: A Systems Approach to Planning, Scheduling, and Controlling.