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PPPL- 4668

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August, 2011

Prepared for the U.S. Department of Energy under Contract DE-AC02-09CH11466.

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Ensuring Compliance and Consistency in an R&D Environment: The PPPL Office of Project Management

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***Abstract*—The Princeton Plasma Physics Laboratory (PPPL) Office of Project Management (PMO) is responsible for oversight, coordination, and implementation of all project management processes. Per DOE Order 413.3B, the PMO will ensure the proper and standardized management of projects within the organization according to the Project Management System Description (PMSD) and Engineering (ENG) procedures.**

The PPPL PMO provides oversight functions for the physics research, engineering, R&D, operations, and facility projects. This oversight is provided through Work Planning, Design Verification, Cost and Schedule review, and Project Status review. A team consisting of a Cognizant individual, Planning and Control Officer, and Responsible Line Manager pilots jobs and projects through the procedure process and oversight functions to accomplish work. For capital projects, a Project Manager will oversee a team of Cognizant individuals according to a Work Breakdown Structure system. For smaller jobs, the Cognizant individual will serve as the Project Manager.

PPPL jobs are often R&D and prototypes due to the research environment. The identification of technical, cost, schedule and ES&H risks early in the project life cycle is imperative to avoid limitations and mitigate these risks. Another key function of the PMO is to manage resource conflicts and prioritize work through the use of the monthly Project Status Review Board (PSRB). Staff training is also provided by the PMO and is critical to the success of the project management function across the organization.

During the past year, the PMO effort has been focused on assessing strengths, weaknesses, opportunities, and threats (SWOT), improving procedures, mapping the work flow process, and training job and project staff for improved performance. Extensive input to the PMO from stakeholders through audit findings, report recommendations, and departmental review has also been incorporated. The PMO continues to support a Major Item of Equipment (MIE) upgrade project on the National Spherical Torus Experiment (NSTX) and is supporting preparation for Earned Value Management System (EVMS) certification later this year.

Keywords-project management, earned value management, EVMS

This work supported by the US DOE Contract No. DE-AC02-09CH11466.

I. INTRODUCTION

The Princeton Plasma Physics Laboratory (PPPL) is a part of Princeton University focusing on fusion energy research primarily funded by a contract with the Department of Energy (DOE). As a DOE contractor, PPPL is required to function under the Code of Federal Regulations and Orders set forward by DOE. In 2010, DOE issued Order 413.3B "*Program and Project Management for the Acquisition of Capital Assets*" providing project management direction for the acquisition of capital assets to be completed on time and within budget [1]. To comply with this Order, PPPL established the Office of Project Management (PMO) responsible for oversight and coordination of all PPPL project management processes and implementation of DOE Order 413.3B. Within this implementation, the PMO will ensure the proper and standardized management of projects within the organization. The PMO will also ensure compliance and consistency using the Project Management System Description (PMSD) for capital projects and Engineering (ENG) procedures at the job level.

Based upon the standards and processes of the laboratory, all jobs, including design, construction, fabrication, operations and general plant projects are managed in line with the Project Management Body of Knowledge (PMBOK) philosophies using localized titling and terminology. For example, a "job" at PPPL is a cost account with a list of tasks to complete a specific goal: e.g. design, build, and install a new diagnostic device on an operating experiment. Direct responsibility for the development and management of the PPPL Project Management System, including oversight of individual project management plans, processes, training, and procedures, has been delegated to the Office of Project Management who will be supervised by the Associate Laboratory Director for Engineering and Infrastructure (ADEI) [2]. The ADEI has delegated direct responsibility for the development, management and oversight of the PPPL Project Management System to the relatively new position of Project Management Officer.

One of the many tasks of the appointed Project Management Officer is to establish and run an Office of Project Management (PMO) at PPPL for the oversight and coordination of projects at the lab. The PMO will serve as the authority for compliance and consistency of the project

management processes at PPPL using the PMSD for capital projects and engineering (ENG) procedures at the job level. Milestones for the establishment of the OPM are as follows:

- Project Management Advisory Committee (PMAC) review: September 2010
- Procedures written and approved: October 2010
- Staff training completed: December 2010
- Earned Value Management System (EVMS) certification: August 2011

Once all current milestones are met, the OPM will have met all necessary requirements set by Order 413.3B and will continue to focus on completing the goals assigned to it at inception.

II. Legacy PPPL Project Management Processes

PPPL has been using the principles of project management for decades. However, the legacy processes for management of projects at PPPL were widely subjective. Each job custodian, usually an engineer, maintained their own process and methodology for the management of their jobs based on prior experience and PPPL procedures. Due to the research and development nature of the lab, the project management processes performed at PPPL were also largely research and development projects of their own. The laboratory is a small entity, employing less than 500 persons, the majority of whom are technical personnel with niche specialties. Consequently, it is imperative that subject matter experts are able to focus their energy on the application of their expertise instead of on the detailed management of projects. This reality necessitated creation of a means of interfacing between the technical persons and business managers of the lab. From this need, the Planning and Control Division was created to provide resources for the Budgeting and Accounting divisions to get the data they needed without interfering with the ability of the engineers to complete their jobs. The job engineer would have the first authority to create a job cost estimate, which the Planning and Control Officer (P&CO) would take and translate into the necessary formulation for the budgeting and accounting systems. The job engineer was required to status the job with the P&CO and then the P&CO would deliver the necessary data to the business management division. The P&COs are individuals well versed in business systems, but are also capable of some project management duties. Essentially, they serve as the aide-de-camp to several job engineers at once. In this way, the traditional duties attributed to "project managers" were split between the P&CO and the job engineer. In addition, the P&CO attends to a broad array of jobs for a given department that are managed as a portfolio and thus serves as the hub of the portfolio, linking the jobs together.

III. DOE Order 413.3B and the PPPL Graded Approach

The DOE Order 413.3B (2010), "Program and Project Management for the Acquisition of Capital Assets," is "to provide program and project management direction for the acquisition of capital assets with the goal of delivering projects within the original performance baseline (PB), cost and schedule, and fully capable of meeting mission performance, safeguards and security, and environmental, safety, and health requirements unless impacted by a directed change" [1]. Several principles such as line management accountability, disciplined up-front planning, well-defined and documented requirements, well-defined and managed performance baselines, and effective project management systems (e.g., quality assurance, risk management, change control, performance management, etc.), as well as several others, are required to be met by following this Order [1]. Additionally, the Order provides definition for Project Management Support Offices and their required tasks.

All PPPL jobs receive some level of project management oversight through the P&CO. These jobs are rolled into the total laboratory budget, which could consist of approximately 150 small jobs and indirect general and administrative level of effort (LOE) jobs in a typical fiscal year. Per Order 413.3B, for a job to qualify as a capital project, it must meet specific criteria, one of which is total project cost of greater than or equal to $20 million, on a case basis [1]. 413.3B can be applied to projects of all sizes, given it is tailored without omitting requirements. By following this directive, PPPL applies a graded approach to the project management processes detailed by 413.3B to every project conducted at the lab in order to ensure proper project management of all jobs. This graded approach takes into account the risk, complexity, visibility, cost, safety, security, and schedule of a project in order to appropriately select the project management systems, processes, and procedures to be applied [2]. The level of application of 413.3B must be described at the initiation of the project in its Project Execution Plan (PEP), if one is deemed necessary.

IV. The PPPL Plan

The PPPL plan for application of DOE Order 413.3B with a graded approach has led to the establishment of several new practices and procedures through the Office of Project Management. The PMO will ensure compliance and consistency of the project management procedures throughout the lab through the Work Planning Review Board (WPRB), job estimate Work Approval Form (WAF) reviews, design reviews and their Chairpersons, earned value processes conducted by the Planning and Control (P&C) division, Project Status Review Board (PSRB), overseeing the Project Management System Description (PMSD) and its applications, as well as staff member training. The procedures instituted by the PMO will apply to any PPPL activity requiring established and regular status reporting and oversight as part of proper and consistent project management [3]. As an example of this implementation, the monthly PSRB oversees a portfolio of "hot" jobs that contains jobs with high visibility and impact to multiple laboratory projects that requires close monitoring. This enables the Board to reallocate resources to avoid negative impacts to laboratory business.

Though the terminology used by PPPL to refer to the industry-standard project management knowledge areas is quite different from that used by the Project Management Body of Knowledge (PMBOK), Fig. 1 is a graphical representation of

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring & Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Execution	4.4 Monitor and Control Project Work 4.5 Perform Integrated Change Control	4.6 Close Project or Phase
5. Project Scope Management		5.1 Collect Requirements 5.2 Define Scope 5.3 Create WBS		5.4 Verify Scope 5.5 Control Scope	
6. Project Time Management		6.1 Define Activities 6.2 Sequence Activities 6.3 Estimate Activity Resources 6.4 Estimate Activity Durations 6.5 Develop Schedule		6.6 Control Schedule	
7. Project Cost Management		7.1 Estimate Costs 7.2 Determine Budget		7.3 Control Costs	
8. Project Quality Management		8.1 Plan Quality	8.2 Perform Quality Assurance	8.3 Perform Quality Control	
9. Project Human Resource Management		9.1 Develop Human Resource Plan	9.2 Acquire Project Team 9.3 Develop Project Team 9.4 Manage Project Team		
10. Project Communications Management	10.1 Identify Stakeholders	10.2 Plan Communications	10.3 Distribute Information 10.4 Manage Stakeholder Expectations	10.5 Report Performance	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses		11.6 Monitor and Control Risks	
12. Project Procurement Management		12.1 Plan Procurements	12.2 Conduct Procurements	12.3 Administer Procurements	12.4 Close Procurements

WP
PEP

WAF

QA/QC

COG
RLM
P&CO

WPRB (quarterly)
WAF Review (as needed)
PSRB (monthly)
Rollover Mtg (weekly)

WP
WAF
Risk Registry

M&S
Req

Figure 1. PMBOK to PPPL Tools Translation

the correspondence between the two nomenclature systems. The PPPL Project Management System Description (PMSD) details the entire project management plan at the laboratory, covering all the requirements of Order 413.3B, Earned Value Management System (EVMS) guidelines and the PMBOK.

The Work Plan (WP) is an online form for the COG and the RLM that captures planning for project management, technical scope, cost and schedule, Integrated Safety Management, and interfaces. The WAF is a standardized Excel spreadsheet template developed at PPPL for delineating tasks, durations, hours, linkages, rates, procurements and risks, among other things. Design reviews follow a prescribed process and are

chaired by a Design Review Chairperson. Project status reports are again Excel spreadsheet templates used by the COG and P&CO to report monthly status, milestones and EVMS data. Job cost reports are prepared by Accounting.

V. The Goals and Benefits of the PMO

The ultimate goal of the PPPL PMO is to do more with less. The implementation of Order 413.3B will help PPPL do more than can be done with its current processes and personnel. Standardization of the project management processes of the Lab will enable better budgeting, planning, estimation, tracking, and execution of the multitude of jobs completed by the lab, from the miscellaneous general purpose projects to the major capital projects. The difficulties inherent in cost tracking will be minimized, which will ease the reporting of Earned Value metrics. The PMO effort will also serve to improve workflow, safety, efficiency and use of resources. The PMO will be able to provide data that can facilitate the adjustment of PPPL's limited resources if needs require it, reducing the bottlenecks that occur when a subject matter expert is needed on more than one job at a time. The prioritization of jobs will be enhanced with the information that the PMO will be able to provide. Additionally, management awareness of work progress as it applies to mission needs will be enhanced.

VI. The Challenges of the PMO in the Current Climate

The largest challenge faced by the PMO is due to the technical nature of PPPL. Generally, engineers view project management as a secondary, and largely unimportant, part of their jobs since the laboratory's bottom line is delivery of world-class research. This makes them highly resistant to adding what they may view as "unnecessary" tasks to their already loaded plates since the laboratory is also resource thin. The PMO seeks to minimize resistance by making the standardized project management processes another link in the chain that began with Work Plans and Work Approval Forms. However, within this standardization, another challenge is created. Linking the industry standard practices into the existing processes requires a use of jargon that does not necessarily match with that of common industry practice (see Fig.1). With the permeation of jargon in internal procedures, it can be difficult for Sponsors and outsiders to easily understand how close the in-house project management practices mesh with those of industry and PMBOK standards. Additionally, a growth of the P&C Division will be required if job engineers will not be required to conduct more detailed project management processes, increasing the responsibilities of the P&COs and requiring them to conduct more than the financial reporting and tracking portions of the process.

PPPL currently has a single capital project, the National Spherical Torus Experiment Upgrade (NSTX-U) as well as more than fifty smaller jobs running in parallel. This large project has a specialized work breakdown structure (WBS) populated with jobs that are required for completion of the project. A graphic representing this WBS and its associated jobs can be found in Table I. For capital and job level projects, PPPL is a strong matrix organization. Secondary to that, it functions as a weak matrix for resources. This causes challenges when staffing projects due to the limited resources available for jobs requiring special expertise.

Last year, an internal audit of the project management systems at PPPL recommended more PMO resources were needed to fully develop a comprehensive project management program, considering that a significant amount of work was still necessary to fully implement the program [5]. The audit cited the need to complete several implementing procedures referenced in the PMSD which were still to be determined. The audit also found that training would be required for all involved personnel and had not yet begun. At the date of this paper, all of the audit findings were addressed and closed.

An inherent challenge for the PMO is due to the funding source. Funding from DOE and programmatic effects are difficult to track since they tend to change due to continuous improvement. With the limited staff of the laboratory, tracking these effects becomes nearly impossible. Additionally, with the nature of DOE funding, this year's production determines next year's budget. With this condition set, projects at the laboratory are schedule-driven and require cost and technical requirements to be balanced against the scheduling constraint. As a result, the actual management of the R&D projects at PPPL becomes an R&D project in itself.

TABLE I. NSTX Upgrade Work Breakdown Structure

Level 1	*Level 2*	*Level 3*	*Description*
1	NSTX UPGRADE PROJECT		
	1.1	Torus Systems	
		1.1.0	Project Integrated Model
		1.1.1	Plasma Facing Components
		1.1.2	Vacuum Vessel and Support Structure
		1.1.3	Magnet Systems
	1.2	Plasma Heating and Current Drive Systems	
		1.2.1	High Harmonic Fast Wave (HHFW)
		1.2.2	Coaxial Helicity Injection (CHI) Current Drive
		1.2.3	Electron Cyclotron Heating (ECH)
		1.2.4	Neutral Beam Injection (NBI)
	1.3	Auxiliary Systems	
		1.3.1	Vacuum Pumping System
		1.3.2	Coolant Systems
		1.3.3	Bakeout Heating System
		1.3.4	Gas Delivery System
		1.3.5	Glow Discharge Cleaning System
	1.4	Plasma Diagnostics	
		1.4.1	Plasma Diagnostics
	1.5	Power Systems	
		1.5.1	AC Power Systems
		1.5.2	AC/DC Converters
		1.5.3	DC Systems
		1.5.4	Control and Protection System
		1.5.5	General Power Systems and Integration

1.6	Central Instrumentation and Controls (I&C)	
	1.6.1	Control System
	1.6.2	Data Acquisition System
1.7	Project Support & Integration	
	1.7.1	Project Management and Integration
	1.7.2	Project Physics
	1.7.3	Integrated Systems Tests
1.8	Site Preparation and Assembly	
	1.8.1	Site Preparation
	1.8.2	Torus Assembly and Construction

VII. Conclusion

Through the use of legacy processes and by introduction of several new processes, the PPPL Office of Project Management has established oversight and coordination of projects at PPPL. By establishing a keychain of implementing procedures via the updated Work Planning system, review boards, and design reviews, the PMO is implementing DOE Order 413.3B, the Project Management System Description and updated internal procedures with a graded approach for all projects across the laboratory complex. Milestones have been met and preparation is underway for the upcoming Earned Value Management System certification. The PPPL PMO can proudly call itself a fully functioning division of the PPPL Organization.

Acknowledgment

T. Dodson would like to extend special thanks to Timothy Stevenson, the PPPL Project Management Officer, for the opportunity to participate in the establishment and implementation of the PPPL PMO.

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