SUBJECT:	FERMILAB RESEARCH ALLIANCE PROJECT MANAGEMENT	NUMBER:	12.PM-001
RESPONSIBILITY:	Office of Project Management Oversight	REVISION:	2
APPROVED BY:	Head, Office of Project Management Oversight	EFFECTIVE:	03/27/09
TITLE	Project WBS, OBS, RAM		

1.0 PURPOSE

This procedure provides guidelines and formats for the development of the project Work Breakdown Structure (WBS), WBS Dictionary, Organizational Breakdown Structure (OBS), and Responsibility Assignment Matrix (RAM). The WBS subdivides and logically organizes the entire project scope into its component elements to establish a framework for effective management control of the project's scope, schedule, and budget. The WBS Dictionary is a set of specific definitions that describe the scope of each work element identified in the WBS. The OBS is a project organization framework for identification of accountability, responsibility, management, and approvals of all authorized scope. The RAM integrates the organizational structure depicted in the OBS with the work structure depicted in the WBS, establishing ownership of the work.

2.0 SCOPE

The scope of this procedure is to describe these project tools and provide guidelines for their development. All projects using the Fermi Research Alliance, LLC (FRA) Earned Value Management System (EVMS) must have a WBS, WBS Dictionary, OBS, and RAM.

3.0 RESPONSIBILITIES

3.1 Project Manager (PM) is responsible for

- establishing project requirements and criteria
- developing the project work scope by using appropriate design and engineering resources to create a technical description
- working with the control account managers (CAMs) and functional line management to identify the resources for the project
- defining the WBS, WBS Dictionary, OBS, and RAM for the project for internal control and for external reporting
- maintaining the WBS, WBS Dictionary, OBS, and RAM as controlled documents
- ensuring the preparation of drawings, specifications, procurement documents, installation and test instructions, and other documents to establish and record the project configuration, including as-built documentation
- storage and management of documents listed above
- providing project office staff to execute project controls systems referenced in this procedure

4.0 PROCEDURE

4.1 Work Breakdown Structure (WBS)

The project WBS is a product-oriented grouping of work elements that organizes and defines the total scope of the project. The WBS is a multi-level framework that organizes and graphically displays elements representing the work to be accomplished in logical relationships. Each descending level represents an increasingly detailed definition/division of a project component. The WBS is the structure that integrates and relates all project work (technical, schedule, and budget) and is used throughout the lifecycle of a project to identify, assign, and track specific work scopes. The WBS is created to the level required by the project manager to plan and manage the project. In the Project Execution Plan (PEP),the agreed level of detail for scoping and reporting with the customer is defined. Each project will have a WBS unique to that project. A sample Work Breakdown Structure can be found in Appendix C.

4.1.1 WBS Development Process

WBS development at Fermilab will take into account the following:

- The WBS provides the framework for the scope, schedules, and budgets. It includes the entire scope for the project. The WBS does not include scope outside of that authorized as part of the scope baseline.
- The WBS contains product-oriented or services-oriented elements, which are successively subdivided into increasingly detailed and manageable work products or elements.
- Each WBS element represents an aggregation of all its subordinate elements. Valid WBS elements have a specific output (i.e., a product or service), discernible beginning and ending dates, and assigned resources.
- The WBS has elements that can be assigned to individual managers who will be responsible for the planning and control of the scope represented by each of these elements.
- The WBS is coded so that cost, schedule summarization, and roll-ups are possible from the work package level to the control account (CA) level, and to each higher-level WBS element such that the sum of all elements equals the total project.
- The WBS consists of a number of levels, and extends to at least the CA level. During initial development, CAs may not yet be defined. This guidance is meant to apply to the completed WBS at the end of the planning process.
- The total project will be referred to as level 1 in the WBS.
- At its upper levels, the WBS can have lifecycle-phase elements (i.e., initiation, definition, execution, and transition/closeout) to allow for the closeout of completed work at a high level in the WBS. In the DOE system, these lifecycle phase elements can align with specific Critical Decisions (CD).
- At its upper levels, the WBS has elements designated for reporting performance data to the funding agencies.
- All required external reporting elements (such as CD Reviews) are included.
- All of the items appearing on the WBS are traceable to items on the project schedule.

- The WBS includes elements at the control account (CA) level for major subcontracted efforts.
- The WBS does not include contingency since this does not represent project work.

4.2 **WBS Dictionary**: The WBS Dictionary is a set of specific definitions that describe the scope of each work element identified in the WBS. It defines each element in terms of the content of the work to be performed. The WBS Dictionary also documents or references the relevant requirements that pertain to this element. The WBS Dictionary demonstrates that the scope of work for the project and the WBS are fully reconciled. Each project will have a WBS Dictionary unique to that project. A sample WBS Dictionary can be found in Appendix D. This format is not required, but the information contained must be included in any format used.

4.3 **Organizational Breakdown Structure (OBS):** The project Organizational Breakdown Structure (OBS) is a functionally oriented division of the individuals and organizations responsible for performing the work on a specific project. The OBS is an organizational framework used for identifying accountability, responsibility, management and approvals of all authorized work scope. The OBS helps management focus on establishing the most efficient organization to perform project work scope by taking into consideration availability and capability of management and technical staff, including subcontractors, to achieve the project objectives.

The OBS identifies the organization responsible for completing each major segment of work. The assignment of lower-level segments to responsible managers provides a key control point for management purposes. Each project will have an OBS unique to that project. A sample OBS can be found in Appendix E.

4.4 **Responsibility Assignment Matrix (RAM):** The RAM is an essential element of the project plan that integrates the organizational structure defined in the OBS with the scope of work outlined in the WBS. The RAM establishes ownership of the work depicted in the WBS by linking the WBS and the OBS. The intersection of the WBS and OBS, as shown on the RAM, is the control account (CA). EVMS RAMs will identify the control account managers (CAMs) for these intersection points by name. The intersection point will also include the budgeted cost of work scheduled (BCWS), resulting in a "dollarized RAM." The sum of the CAs will total the total project BCWS. Each project will have a RAM unique to that project. A sample RAM can be found in Appendix F.

4.5 **Development Process:** The Project Manager will identify the staff resources and the organizations necessary to participate in the planning and execution of the project. The Project Manager will seek agreement with the line management of these organizations as to their role and extent of involvement, based on initial project requirements. The Project Manager will then assemble the project team and develop the project's OBS and RAM. The assignment of CAMs, as required to complete the RAM, will be with the concurrence of line management. For purposes of the project organization, all CAMs report to the Project Manager.

5.0 REFERENCES

DOE Order 413.3A, *Program and Project Management for the Acquisition of Capital Assets*
FRA Earned Value Management System Description
EVMS Procedure 12.PM-002, *Control Accounts, Work Packages, Planning Packages*

6.0 APPENDICES

12.PM-001A: Appendix A: Signature Page and Revision History
12.PM-001B: Appendix B: Acronyms and Glossary
12.PM-001C: Appendix C: Work Breakdown Structure (WBS) – Sample
12.PM-001D: Appendix D: WBS Dictionary – Sample
12.PM-001E: Appendix E: Organizational Breakdown Structure (OBS) – Sample
12.PM-001F: Appendix F: Responsibility Assignment Matrix (RAM) – Sample

Appendix A
SIGNATURE PAGE AND REVISION HISTORY

This procedure approved by: Dean A. Hoffer for 27-Mar-2009
Director, Office of Project Management and Oversight **DATE**
Fermi National Accelerator Laboratory
Dr. L. E. Temple

TABLE OF REVISIONS

Author(s)	Description	Revision	Date
	Initial Version	0	10/17/08
E. McCluskey	In Appendix B changed definition of Control Account and added definition for Control Account Manager.	1	12/02/08
E. McCluskey	Revised OBS definition	2	03/27/09

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Appendix B
ACRONYMS AND GLOSSARY

BCWP — Budgeted Cost of Work Performed
BCWS — Budgeted Cost of Work Scheduled
CA — Control Account
CAM — Control Account Manager
CD — Critical Decision
DOE — U.S. Department of Energy
EVMS — Earned Value Management System
FRA — Fermi Research Alliance, LLC
OBS – Organizational Breakdown Structure
PEP — Project Execution Plan
PV — Planned Value (also known as BCWS)
RAM – Responsibility Assignment Matrix
SOW — Statement of Work
WBS — Work Breakdown Structure

Contract - A contract is a mutually binding agreement that obligates the seller to provide the specified product and obligates the buyer to pay for it.

Contractor - An individual, partnership, company, corporation, or association having a contract with a contracting agency for the design, development, maintenance, modification, or supply of deliverable items and/or services under the terms of a contract.

Control Account (CA) - A key management control point located at the natural intersection point of the WBS and the OBS, where functional responsibility for work is assigned. It represents the point at which budgets (resource plans) and actual costs are accumulated and compared to earned value for management control purposes.

Control Account Manager (CAM) – The member of the project team responsible for the performance defined in a Control Account and for managing the resources authorized to accomplish the tasks.

Critical Decision (CD) - On DOE projects, a formal determination made by the Acquisition Executive and/or designated official at a specific point in a project life cycle that allows the project to proceed. Critical Decisions occur in the course of a project: at determination of Mission Need (CD-0), at the completion of conceptual design (CD-1), at project baselining (CD-2), at the commencement of execution (CD-3), and at turnover (CD-4).

Program Office - The DOE headquarters organizational element responsible for managing a program

Project - In general, a unique effort that supports a program mission; has defined start and end points; is undertaken to create a product, facility, or system; and contains interdependent activities planned to meet a common objective or mission. A project is not constrained to any specific element of the budget structure (e.g., operating expense or plant and capital equipment). Construction, if required, is part of the total project. Projects include planning and execution of construction, renovation, modification, environmental restoration, decontamination and decommissioning efforts, and large capital equipment or technology development activities. Tasks that do not include the above elements, such as basic research, grants, ordinary repairs, maintenance of facilities, and operations, are not considered projects.

Project Execution Plan (PEP) - The plan for the execution of the project, which establishes roles and responsibilities and defines how the project will be executed. Every project implementing Earned Value management will have a unique project execution plan.

Schedule - A plan that defines when specified work is to be done to accomplish program objectives on time.

Statement of Work (SOW) - The document that defines the work-scope requirements for a project. It is a basic element of control used in the processes of work assignment (scope) and the establishment of project schedules and budgets.

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System - A collection of interdependent equipment and procedures assembled and integrated to perform a well-defined purpose. It is an assembly of procedures, processes, methods, routines, or techniques united by some form of regulated interaction to form an organized whole.

Work Breakdown Structure (WBS) - A product-oriented grouping of project elements that organizes and defines the total scope of the project. The WBS is a multilevel framework that organizes and graphically displays elements representing work to be accomplished in logical relationships. Each descending level represents an increasingly detailed definition of a project component. Project components may be products or services. It is the structure and code that integrates and relates all project work (technical, schedule, and cost) and is used throughout the life cycle of a project to identify and track specific work scopes.

Work Breakdown Structure Dictionary - A listing of work breakdown structure elements with a short description of the work-scope content in each element.

Work Package - A task or set of tasks performed within a control account.

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Appendix C
EXAMPLE OF WBS (OUTLINE FORMAT)

This example is for a project scope consistent with designing and building components (four cryomodules), constructing a small building to house the completed units and developing a database to store information regarding fabrication and testing. All facilities needed to actually assemble and test the components as well as the hardware for the database already exist and are outside the project scope. All WBS elements have been expanded to their lowest level to demonstrate the detail of the project.

WBS Number	CA	Proj/Task #	
1.			**Cryomodule Production Project**
1. 1.	Y	25/25.1.1	**Project Management**
1. 1. 1.			**Overall Project Management**
1. 1. 2.			**DOE 413.3 Documentation**
1. 1. 2. 1.			CD-1 Documentation
1. 1. 2. 2.			CD-2 Documentation
1. 1. 2. 3.			CD-3 Documentation
1. 1. 2. 4.			CD-4 Documentation
1. 1. 3.			**ES&H**
1. 2.	Y	25/25.1.2	**Conventional Facilities**
1. 2. 1.			**Conceptual Design Phase**
1. 2. 1. 1.			Consultant Support - Concept Design
1. 2. 1. 2.			FNAL Support - Concept Design
1. 2. 2.			**Preliminary Design Phase**
1. 2. 2. 1.			Consultant Support - Prelim Design
1. 2. 2. 2.			FNAL Support - Prelim Design
1. 2. 3.			**Site Prep Package**
1. 2. 3. 1.			Final Design - Site Prep
1. 2. 3. 1. 1.			Consultant Support - Site Prep
1. 2. 3. 1. 2.			FNAL Support - Site Prep
1. 2. 3. 2.			Construction Phase - Site Prep
1. 2. 3. 2. 1.			Subcontractor - Site Prep
1. 2. 3. 2. 2.			Advanced Procured Items - Site Prep
1. 2. 3. 2. 3.			Construction Phase Support - Site Prep
1. 2. 3. 2. 3. 1.			Consultant Support - Site Prep Construction
1. 2. 3. 2. 3. 2.			FNAL Support - Site Prep Construction
1. 2. 4.			**Building Package**
1. 2. 4. 1.			Final Design - Building
1. 2. 4. 1. 1.			Consultant Support - Building Final Design
1. 2. 4. 1. 2.			FNAL Support - Building Final Design
1. 2. 4. 2.			Construction Phase - Building
1. 2. 4. 2. 1.			Subcontractor - Building
1. 2. 4. 2. 2.			Advanced Procured Items - Building
1. 2. 4. 2. 3.			Construction Phase Support - Building
1. 2. 4. 2. 3. 1.			Consultant Support - Building Construction
1. 2. 4. 2. 3. 2.			FNAL Support - Building Cnstruction
1. 2. 5.			**Outfitting Package**
1. 2. 5. 1.			Final Design - Outfitting
1. 2. 5. 1. 1.			Consultant Support - Outfitting Final Design
1. 2. 5. 1. 2.			FNAL Support - Outfitting Final Design
1. 2. 5. 2.			Construction Phase - Outfitting
1. 2. 5. 2. 1.			Subcontractor - Outfitting
1. 2. 5. 2. 2.			Advanced Procured Items - Outfitting
1. 2. 5. 2. 3.			Construction Phase Support - Outfitting
1. 2. 5. 2. 3. 1			Consultant Support - Outfitting Construction
1. 2. 5. 2. 3. 2			FNAL Support - Outfitting Construction
1. 3.			**Cryomodule with Quad**
1. 3. 1.	Y	25/25.1.3.1	**Cryomodule Final Design**
1. 3. 2.	Y	25/25.1.3.2	**Cryomodule Prototype (CM1)**
1. 3. 2. 1.			EDIA for CM1 Components
1. 3. 2. 2.			CM1 Dressed Cavities (8/CM)
1. 3. 2. 2. 1.			Raw Niobium for CM1 Cavity
1. 3. 2. 2. 2.			CM1 Cavity & Helium Vessel
1. 3. 2. 2. 3.			CM1 Cavity Processing
1. 3. 2. 2. 4.			CM1 Cavity Qualification
1. 3. 2. 2. 5.			CM1 Cavity Tuners
1. 3. 2. 2. 6.			CM1 Cavity Dressing
1. 3. 2. 2. 7.			CM1 Cavity Shipping & Handling
1. 3. 2. 3.			CM1 Magnetic Package
1. 3. 2. 3. 1.			EDIA for CM1 Magnetic Package
1. 3. 2. 3. 2.			CM1 Quad & Corrector Package
1. 3. 2. 3. 3.			CM1 BPM
1. 3. 2. 3. 4.			CM1 Helium Vessel & Parts
1. 3. 2. 3. 5.			CM1 Current Leads
1. 3. 2. 3. 6.			CM1 Magnet Testing

WBS Number	CA	Proj/Task #	
1. 3. 2. 4.			CM1 Cold Mass Parts (not cavities)
1. 3. 2. 5.			CM1 Vacuum Vessel
1. 3. 2. 6.			CM1 Instrumentation
1. 3. 2. 7.			CM1 Couplers
1. 3. 2. 7. 1.			CM1 Power Coupler
1. 3. 2. 7. 2.			CM1 HOM Coupler
1. 3. 2. 8.			CM1 Assembly & Integration
1. 3. 2. 8. 1.			EDIA for CM1 Integration
1. 3. 2. 8. 2.			Assembly of CM1 Cavity String (in clean room)
1. 3. 2. 8. 3.			Assembly of CM1 Cryomodule (out clean room)
1. 3. 2. 8. 4.			CM1 Qualification Test
1. 3. 3.	Y	25/25.1.3.3	**Cryomodule Production Components**
1. 3. 3. 1.			EDIA for Cryomodule Components
1. 3. 3. 2.			Dressed Cavities (8/CM)
1. 3. 3. 2. 1.			Raw Niobium for Cavity
1. 3. 3. 2. 2.			Cavity & Helium Vessel
1. 3. 3. 2. 3.			Cavity Processing
1. 3. 3. 2. 4.			Cavity Qualification
1. 3. 3. 2. 5.			Cavity Tuners
1. 3. 3. 2. 6.			Cavity Dressing
1. 3. 3. 2. 7.			Cavity Shipping & Handling
1. 3. 3. 3.			Magnetic Package
1. 3. 3. 3. 1.			EDIA for Magnetic Package
1. 3. 3. 3. 2.			Quad & Corrector Package
1. 3. 3. 3. 3.			BPM
1. 3. 3. 3. 4.			Helium Vessel & Parts
1. 3. 3. 3. 5.			Current Leads
1. 3. 3. 3. 6.			Magnet Testing
1. 3. 3. 4.			Cold Mass Parts (not cavities)
1. 3. 3. 5.			Vacuum Vessel
1. 3. 3. 6.			Instrumentation
1. 3. 3. 7.			Couplers
1. 3. 3. 7. 1.			Power Coupler
1. 3. 3. 7. 2.			HOM Coupler
1. 3. 4.	Y	25/25.1.3.4	**Cryomodule Production Assembly & Integration**
1. 3. 4. 1.			EDIA for Cryomodule Integration
1. 3. 4. 2.			Assembly of Cavity String (inside clean room)
1. 3. 4. 3.			Assembly of Cryomodule (outside clean room)
1. 3. 4. 4.			Cryomodule Qualification Test
1. 3. 4. 5.			Cryomodule Shipping & Handling
1. 4.	Y	25/25.1.4	**Database Management**
1. 4. 1.			**Database Design**
1. 4. 1. 1.			Requirements Document
1. 4. 1. 2.			Interface Document
1. 4. 1. 3.			Database Schema
1. 4. 2.			**Database Construction**
1. 4. 2. 1.			Coding
1. 4. 2. 2.			Sample Data Set
1. 4. 3.			**Beta Test**
1. 4. 4.			**Production Release**
1. 4. 4. 1.			Training Materials
1. 4. 4. 2.			Database Integration
1. 4. 4. 3.			Database Deployment
1. 4. 4. 4.			Transition Support to Ops Team

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Appendix D
EXAMPLE OF WBS DICTIONARY

Continuing with the Cryomodule Project example from Appendix B, this example of a WBS Dictionary show the level of detail to which the Scope of Work should be defined.

			CA	
WBS Element Number		**1.2.4.2.2**	N	
Contained in Control Account				Proj/Task # 25/25.1.1
WBS Element Title				**Advanced Procured Items - Building**
Assumptions	1			Technical requirements of cyromodule production complete
	2			Preliminary Design Phase (WBS 1.2.2) Complete
	3			Final Design 50% complete
Relates to Requirements		1.2.2		Linac technical design parameters
		1.1.1.6		Building power requirements
Scope of Work				This WBS includes the long lead time procurements for the Building including
	1			Overhead Bridge Crane
	2			1500 kVA Pad Mounted Transformer
	3			2,000 Amp Electrical Switchgear
Deliverables	1			The deliverables for this WBS element includes the delivery to Fermilab of the following:
	2			Overhead Bridge Crane
	3			1500 kVA Pad Mounted Transformer
	4			2,000 Amp Electrical Switchgear
WBS Element Number		**1.3.3.2.3**	N	
Contained in Control Account				Proj/Task # 25/25.1.3.3
WBS Element Title				**Cavity Processing**
Assumptions	1			Cavities are fabricated by a qualified cavity vendor and are free of weld defects
	2			Cavity delivery from vendors is sufficient to always keep processing facility operational
	3			Maximum number of process cycles/cavity is three
	4			60% of the cavities receive 1 cycle, 30% 2 cycles and 10% 3 cycles
	5			BCP and EP process procedures are performed per PN-12345
Relates to Requirements		1.2.2		Linac technical design parameters
		1.5.5.6		Maximum accelerating gradient in the Linac
Scope of Work				The Scope of Work includes all activities associated with cavity processing including
	1			Receive cavities from vendors and perform QC per PN-23456
	2			Setup and perform BCP and EP cycles as defined in PN-12345
	3			Perform final HPR per PN-45678
	4			Leak check and seal cavity per PN-78910
	5			Ship sealed cavity to VTS
Deliverables	1			Cavities that are processed, sealed and ready for vertical testing
	2			Total number of cavities processed equals 320
WBS Element Number		**1.4.2.1**	N	
WBS Element Title				**Coding**
Contained in Control Account				Proj/Task # 25/25.1.4
Assumptions	1			Requirements documents specify reasonably achievable functionality and performance requirements for deliverables.
	2			Database schema is constructed to allow existing RDBMS tools to perform replication and backup services.
	3			Best practices will be applied to the code development process including:
				Automated unit and regression suites are developed and maintained with the code.
				All source code, build procedures, and tests are maintained in a supported CVS repository.
				Code must be CVS-tagged, pass all internal test suites, and undergo a code review before delivery.
Relates to Requirements		1.4.1.1		Database Design: Requirements Document
		1.4.1.2		Database Design: Interface Document
		1.4.1.3		Database Design: Database Schema
Scope of Work				The Scope of Work includes:
	1			Develop code to manage and display data involved in Construction, Testing, and QC that meets the stated design criteria.
	2			Make-Or-Buy: Where appropriate, FOSS libraries and tools may be used provided they are well supported.
	3			Conduct periodic code, process, and performance reviews to insure best practices are used and progress towards goals.
	4			Maintain documentation of the code design, implementation, and frameworks in parallel with the coding work.
Deliverables	1			Applications and Tools to manage Construction, Testing, and QC data in a relational database system.
	2			Code, build procedures, and test suites that are used to create these Applications and Tools.
	3			Documentation of the code design, implementation, and platform choices to support long-term maintenance.
	4			Document describing the expected operations requirements and performance of the deliverables once in production.

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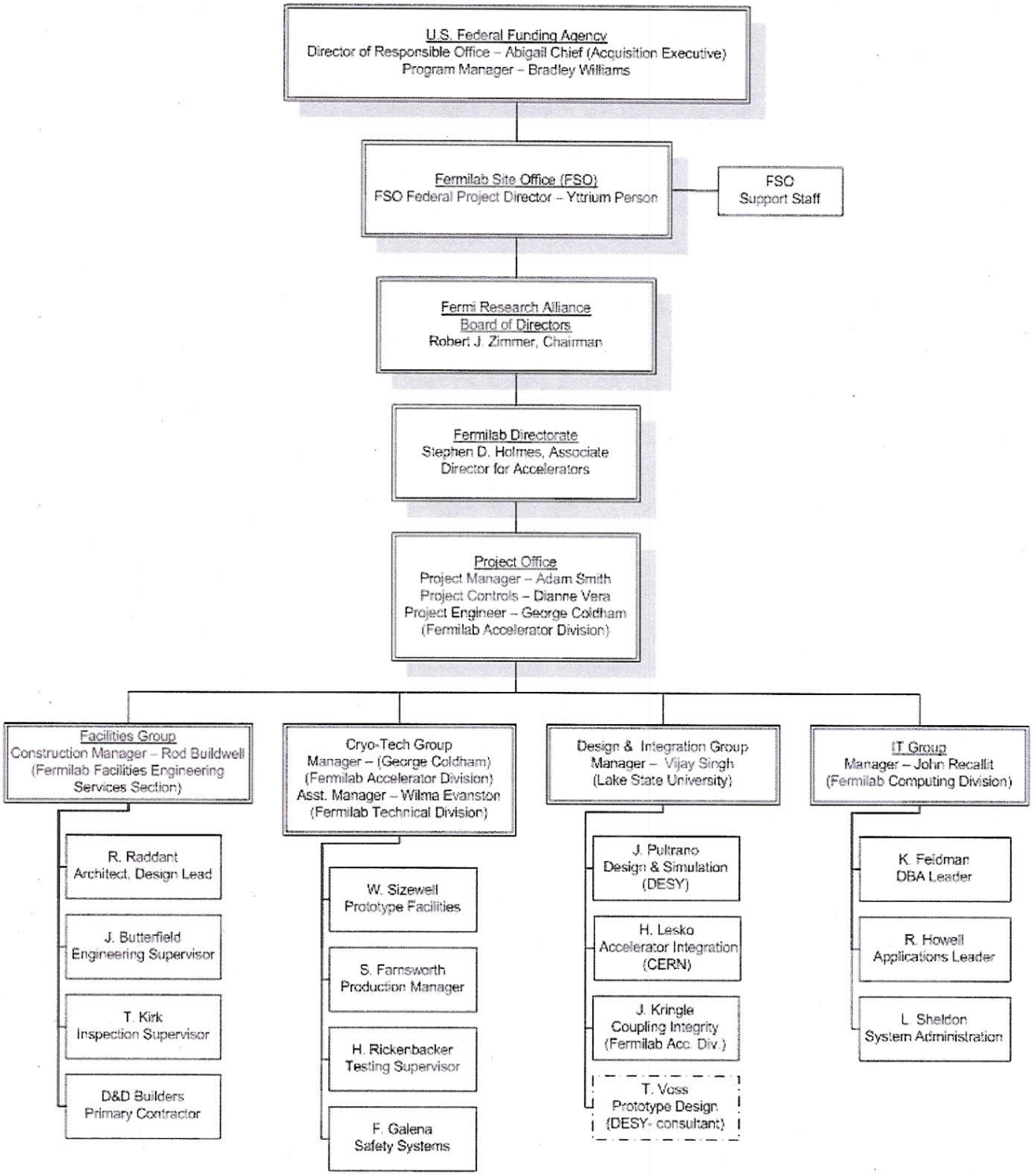
Appendix E
EXAMPLE OF OBS

Continuing with the Cryomodule Project example from Appendix B, this example OBS shows an organizational structure from the funding agency Program Office through the host laboratory to the project's control account managers and supervisory staff.



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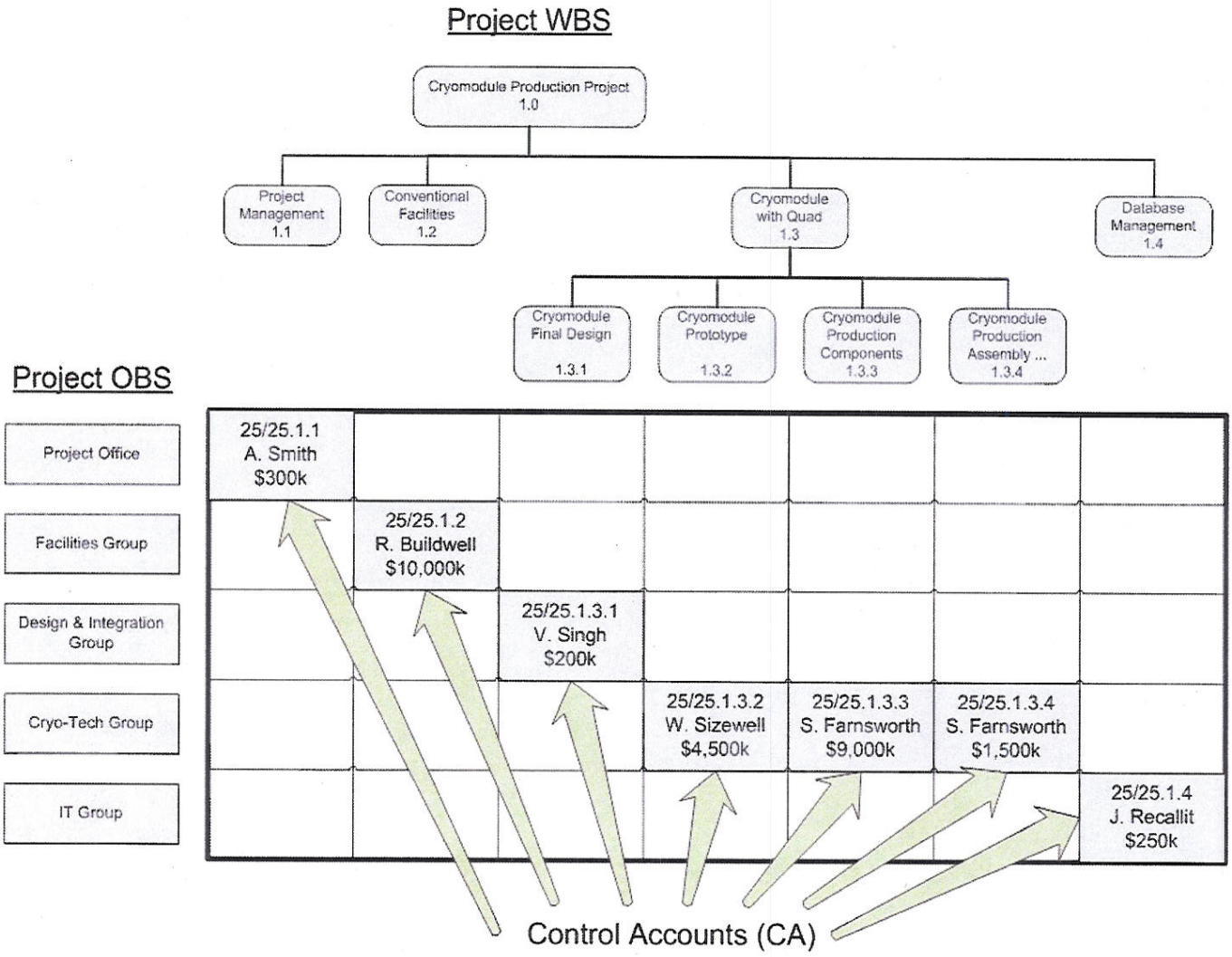
Appendix F
EXAMPLE OF RAM

Continuing with the Cryomodule Project example from Appendix B, this example of a simple RAM shows how the control accounts are intersections of the Project WBS and OBS. Since the budgets for each CA are shown, this is a "dollarized" RAM.



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