LBNF/DUNE Configuration Management Plan
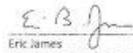

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October 2015

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CHANGE LOG

This version of the document may not be the current or approved revision. The current revision is maintained in the former LBNF/DUNE's document Management system (DocDB) where all internal Project document approvals are also managed. DocDB can be accessed through the web by authorized users (http://docs.dunescience.org/) and this document can be identified by the document and version number as indicated in the Version Control Table below.

Note: The version number in the table below and DocDB may not match. The current approved version is always available in DocDB.

Docdb #	Date	Version	Person Responsible	Change Description
lbne-doc-10760	25-Jun-2015		Dolph	1st version
dune-doc-82	13 Oct 2015		Dolph	Minor clarifications & grammar corrections throughout, new LBNF director signature, changed to dune docdb

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ABBREVIATIONS AND ACRONYMS

AD	Accelerator Division
CAM	Control Account Manager
CCB	Change Control Board
CCM	Configuration Control Manager
CD	Computing Division
CGA	Collaboration General Assembly
CI	Configuration Item
CIDL	Configuration Items Data List
CM	Configuration Management
CMP	Configuration Management Plan (this document)
CRB	Collaboration Resource Board
DCM	Document Control Manager
DCN	Document Change Notice
EC	Executive Committee of the DUNE collaboration
FESS	Facilities Engineering Services Section
FPD	Federal Project Director
IB	Institutional Board
ICD	Interface Control Document
L2 Manager	Person responsible for activities at Level 2 of the Work Breakdown Structure
L3 Manager	Person responsible for activities at Level 3 of the Work Breakdown Structure
MoU	Memorandum of Understanding
PCS	Project Control Specialist
PD	Project Director
PM	Project Manager
PO	Project Office
PMG	Project Management Group
PMP	Project Management Plan
PPEP	Preliminary Project Execution Plan
RC	Resource Coordinator of the DUNE collaboration
RLS	Resource Loaded Schedule
RRB	Resource Review Boards of the DUNE collaboration
SOW	Statement of Work
TB	Technical Board
TC	Technical Coordinator of the DUNE collaboration
TDR	Technical Design Report

1 OVERVIEW

This Configuration Management Plan (CMP) describes the configuration management (CM) responsibilities and processes that support the design and implementation of the Long-Baseline Neutrino Facility (LBNF) and Deep Underground Neutrino Experiment (DUNE) Projects. The purpose of this CMP is to identify the organization providing the configuration control, define what a configuration-controlled item is, describe the change control process, and identify the plan for configuration status accounting and verification. It is a living document that is developed and maintained by the combined efforts of the LBNF and DUNE Projects.

Fermilab has identified LBNF and DUNE as separate entities with correlated objectives. Management of these two entities is defined in the *LBNF/DUNE Project Management Plan* (PMP) [1]. Roles and responsibilities of management groups and individuals are defined in the PMP. This CMP does not attempt to duplicate information in the PMP; rather, it defines roles and responsibilities of groups and individuals for Configuration Management and refers to those defined in the PMP by title only. Due to the previously mentioned differences in the management structures of LBNF and DUNE, it is necessary to distinguish the Projects clearly in this document:

- *LBNF/DUNE* is used in reference to combined and coordinated efforts of the two Projects

- *LBNF and DUNE* is used in reference to parallel efforts undertaken independently by each project toward a common goal (e.g., CM processes unique to each Project that result in the combined LBNF/DUNE Configuration Management)

- Either *LBNF* or *DUNE* is used in reference to efforts unique to one or the other Project

1.1 Purpose

This CMP is designed to ensure that:

- LBNF and DUNE baselines are defined and documented

- LBNF/DUNE documentation is identified, released and controlled

- LBNF/DUNE Configuration Control Manager (CCM) positions are established with their roles and responsibilities defined

- Processes are established in LBNF and DUNE, and within the LBNF/DUNE global enterprise, by which Configuration Changes are proposed, controlled, managed, approved, implemented and tracked

- LBNF and DUNE Change Control Boards (CCB) are established and function according to the CMP guidelines

- Configuration status reporting is implemented

Systems and components specific to the LBNF Project are reviewed in accordance with the principles provided in ANSI/EIA-649-1998, National Consensus Standard for Configuration Management: "Configuration management practices should be applied selectively, and to a degree commensurate with the application environment." Within this Configuration Management Plan, the LBNF/DUNE Projects provide for implementation of a system of management and engineering controls that are necessary for effective execution of the Project.

1.2 Plan Overview

A CMP is employed by the LBNF and DUNE Projects to identify and control relationships during design and construction of LBNF/DUNE at both the Near Site and the Far Site. The Projects recognize the importance of maintaining clear, concise, and accurate records in order to stay on schedule, remain within cost constraints. This CMP has been established to ensure that LBNF/DUNE functional organizations are aware of their roles and responsibilities during the design, construction, and testing phases of the Projects. The records resulting from this plan are intended to provide complete information for future operation, maintenance, and decommissioning activities.

The main goal of the LBNF/DUNE CMP is to prevent unauthorized or uncontrolled changes to engineering design or analysis, hardware, controlled documents, and controlled software. The plan integrates the various Configuration Management (CM) control systems. It is also meant to focus on the control of active documents and not on longer-term records management, retention, or archiving. Records management for DOE purposes is addressed in accordance with Director's Policy 44, Records Management, and associated procedures[1].

The key elements of CM are Configuration Identification, Interface Control, Change Control, Configuration Status Accounting, and Configuration Verification. Configuration Identification defines the system through Computer-Aided Design (CAD) models, drawings and documents that specify the system components in terms of functional and physical characteristics, as well as how they are to be manufactured and tested.

For convenience, the systems are broken down into Configuration Items (CIs). The CIs are to be listed in a Configuration Items Data List (CIDL), which lists each CI and the data management system in which it is stored. The Change Control process is the vehicle by which proposed changes are reviewed and approved. It ensures that the science, technical scope, cost and schedule impacts of each major change are considered before approval is granted. Configuration Status Accounting is a means to track configuration information and relay it to key personnel in order to support management decisions and ensure that all work is performed according to the current approved design. The Configuration Verification process ensures that the current engineering, facilities, hardware, software and requirements configurations match the intended design by verifying the implementation of each approved change and by conducting periodic configuration audits.

1.3 Definitions

Baseline – The point at which an item's requirements and design are formally recorded as a starting point for change control, and after which all changes must be tracked and approved.

Change Classification - All proposed changes to Project documentation submitted to the Change Control Board for consideration are assigned thresholds as per Table 4-1 and Table 4-2 in this CMP and per the PEP. Configuration changes may affect engineering, facilities, hardware, software, requirements and the documents, drawings and procedures that define them.

Change Control Board (CCB) – A board composed of technical and administrative representatives who recommend approval or disapproval of proposed changes to a CI's current approved configuration

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[1] Director's Policy 44 can be found at fnal.gov/directorate/Directors_Policy/records_management.shtml. Associated procedures can be found at www.ccd.fnal.gov/records.

documentation. These are currently considered to be the LBNF and the DUNE Project Management Boards (PMB).

Change Request – A proposal to change the preliminary baseline or configuration baseline (defined in Section 3) of the LBNF or DUNE Project.

Configuration Item (CI) – An aggregation of hardware and/or software that satisfies an end-use function.

Configuration Items Data List (CIDL) – A term that refers to both the LBNF/DUNE Project-controlled listing that identifies all Configuration Items and the data management system that stores and controls release of the documents.

Configuration Management (CM) – The systematic control and evaluation of all changes to the configuration that affect CIs that have been baselined.

Documentation - The controlled paper and software versions of data that define Configuration Items and controlled changes (both proposed and approved).

Interface Control – The systematic control and evaluation of physical and programmatic interfaces between Configuration Items.

Interface Control Document – A document that records technical and programmatic interfaces between two Configuration Items.

Interface Matrix – A matrix associated with a Project major deliverable that defines the interface relationships of all Configuration Items with one another as regards the Project major deliverable.

Pending Changes - Pending changes are those for which conceptual design has been approved, those that have been approved for implementation, or those that are approved and unincorporated and that have been implemented in the field, but for which the document revision has not been completed.

Project Baseline Approval - The point at which the Project's performance baseline has been approved and final design can occur.

Technical Design Report – Defines the technical specifications, physical characteristics, and functional operating parameters of the LBNF/DUNE detectors, cryogenics systems, beamline, and conventional facilities.

2 SCOPE AND APPLICABILITY

2.1 Scope

The scope of the LBNF/DUNE Projects encompasses the fabrication and construction of components, systems and facilities for LBNF/DUNE. The scope of this CMP encompasses all engineering, hardware, software and documentation associated with the LBNF/DUNE Project.

2.2 Applicability

This CMP is applicable to all work performed as part of LBNF/DUNE, which includes the design, testing, integration, and assembly of non-facilities components, as well as the design and construction of technical and conventional facilities. It provides guidance for all personnel on CM activities in support of the Projects, i.e., for all subsystem teams, scientific collaborators, and subcontractors. The scope of this CMP encompasses the lifecycle of the LBNF/DUNE Projects, but not the lifecycle of the experiment itself. The CMP governs control of the following items:

- Mechanical and electrical CAD models, design drawings and text documents showing the specifications and procedures for the equipment and subcomponents
- Facility design drawings, procedures and specifications
- Technical Design Reports
- Management documents such as the Baseline Schedule, PMP, MoUs, and SOWs.
- Hardware
- Software
- Firmware

The design documents, specifications, drawings, procedures and other support documents are maintained and controlled in both paper and electronic media.

3   BASELINE DEFINITION AND REVIEW PROCESS

The technical configuration baseline of the Projects is defined as the technical scope at the specific date when the configuration boudaries and interfaces are defined. The Projects, or specific portions of them may be given a technical configuration baseline for the purpose implementing Change Control. The configuration baseline is defined by the design output documents, which include procurement and construction specifications, ICD, drawings, test procedures, operating and maintenance information. The baseline also includes the DOE cost and schedule associated with the technical baseline of the DOE scope. An earlier, preliminary baseline of LBNF and/or DUNE deliverables may be established as necessary to begin procurement of long lead-time deliverables.

The configuration is identified, developed, baselined, and maintained via a peer review process that involves the LBNF and DUNE Projects and includes a series of formal internal LBNF/DUNE technical and management reviews. The peer review process includes review by the LBNF PMB, the DUNE Collaboration and the Fermilab Project Management Group. In addition, technical reviews are organized by the Projects using subject matter experts from within and outside Fermilab at various stages of configuration development, but always prior to baselining designs for configured items. Formal reviews are conducted by the Fermilab Directorate, LBNF/DUNE advisory groups, the US Department of Energy, and outside consulting groups, both domestic and international.

4 CHANGE CONTROL

Change Control is the process by which the LBNF/DUNE technical scope, cost and schedule changes are managed by the LBNF and DUNE Projects. Management Boards, defined at various levels within the Projects, provide the necessary oversight of these changes. Change Control is the process that ensures adequate Configuration Management of Project baselines.

The DOE-funded portion of the Projects adheres to change control processes for technical scope, cost, and schedule as required for DOE Projects. Details regarding change control at the levels of the DOE Project Management Executive, Associate Director of High Energy Physics, and the Federal Project Director are contained in the *DOE LBNF/DUNE Preliminary Project Execution Plan* [2]. The non-DOE funded portions of the Projects utilize some of the same processes, but some aspects, in particular, cost changes, are handled quite differently.

4.1 Change Control Process common to both Projects

Once the LBNF and DUNE Projects are baselined, or any portion (individual or grouped CIs) is preliminarily baselined, all changes to that technical scope or to the performance, cost, and/or schedule associated with it, must be documented by a Change Request (CR). Table 4-1 and Table 4-2 indicate thresholds for technical, schedule and cost changes, for LBNF and DUNE, respectively, based upon the impact of the change; the thresholds define the authorization required to submit a Change Request (CR) for action. The change processes of LBNF and DUNE are dependant upon these thresholds. Figure 4-1, Figure 4-2 and Figure 4-3 identify the LBNF-only, common and DUNE-only processes, respectively, by which LBNF and DUNE manage configuration changes. These figures are intended to be viewed from left to right in the order presented. Notice that CRs originate in either the LBNF or DUNE process, and are injected into the common process only after certain conditions are reached. Also note that "Above CMP Threshold" in the process diagrams refers to processes documented in the PPEP.

The CR shall include a description of the proposed change and the proposed course of action, with appropriate backup documentation either attached or referenced. The CR shall also include an evaluation of the impact on interfaces within its Project (LBNF or DUNE) and on interfaces with the other Project. The CR must initially be submitted at the lowest applicable threshold (starting at the right-hand side of the tables).

If approval is denied at any threshold, a copy of the CR, together with the reasons for denial, is returned to the requestor, and a copy is filed.

If a change is conditionally approved at any threshold, a copy of the CR is returned to the requestor together with any conditions, qualifications, and/or requests for further analysis or documentation. The requestor compiles the additional information and resubmits the CR package to the person granting the conditional approval and to the respective Project Office.

If final approval is authorized and approved at the appropriate threshold, the CR is submitted to the respective Project's Change Control Board. The next higher threshold authority may review the change to ensure proper application of the procedure and consistency of the change with the goals and boundary conditions of the LBNF and/or DUNE Projects.

Depending on the Project in which the CR originates, either the LBNF Project Manager (PM) or the DUNE Technical Coordinator (TC) must consider whether the CR could affect the other Project. If so, the PM or TC consults with the other Project and sends the CR to the Experiment-Facility Interface Group (EFIG) for consideration. The CR then follows the Change Control Process illustrated in Figure 4-3.

4.2 Change Control Process within the LBNF Project

The change control thresholds for baselining the LBNF Project, as currently envisioned, can be found in Table 4-1. Change management is a prime responsibility of the LBNF Project Director (PD). A Change Control Board (CCB, described in Section 6.5) led by the LBNF Project Manager (PM) advises the PD on all CRs at WBS L2 or above. For the DOE-funded portion of the LBNF Project, approvals above the LBNF Project Director require approvals through the thresholds identified in the DOE PPEP Ref [2] .

The Change Control system may be audited at the Project Manager's discretion.

Table 4-1 LBNF Change Control Thresholds and Authorities

	LBNF RRB	**LBNF Project Director**	**LBNF WBS L2 PM**	**LBNF WBS L3 PM**	**LBNF CAM**
Technical Scope Baseline	Any transfer of scope between LBNF funding agencies	DOE affected: See PPEP [2] Table 6 non-DOE only: Major changes to WBS below Level 3 where performance is diminished	Any technical scope change to a single WBS Level 2 or below that does not diminish performance	Any technical scope change of a single WBS Level 3 or below that does not diminish performance	Any technical scope change within the control account that does not diminish performance
Schedule Baseline	Any change in a Tier 2 milestone that affects multiple LBNF funding agencies	See PPEP [2] Table 6	Any change that results in a greater than 1 month delay of a Tier 5 milestone (see RLS)	Any change that does not result in a greater than 1 month delay of a Tier 6 milestone	Any change that does not result in a delay of a milestone
Cost Baseline	Single change request with base cost increase that affects multiple LBNF funding agencies	DOE affected: See PPEP [2] Table 6 non-DOE only: Single change request with CORE cost increase greater than TBD that affects a single funding agency	DOE affected: Single change request with base cost increase greater than $250k* non-DOE only: Single change request with CORE cost increase greater than TBD that affects a single funding agency	DOE affected: Single change request with base cost increase greater than $100k* non-DOE only: Single change request with CORE cost increase greater than TBD that affects a single funding agency	DOE affected: Single change request with base cost increase less than $100k* non-DOE only: Single change request with CORE cost increase greater than TBD that affects a single funding agency

	LBNF RRB	LBNF Project Director	LBNF WBS L2 PM	LBNF WBS L3 PM	LBNF CAM
APPROVALS REQUIRED	CCM(s) PCS(s) CAM(s) L3 MANAGER(s) L2 MANAGER(s) LBNF PM LBNF PD LBNF RRB	CCM PCS CAM L3 MANAGER L2 MANAGER PM PD	CCM PCS CAM L3 MANAGER L2 MANAGER*	CCM PCS CAM L3 MANAGER*	CCM PCS CAM*

*Subject to LBNF PD approval upon accumulation of Level 2 WBS changes of greater than $5M.

4.3 Change Control Process within the DUNE Project

The Change Control thresholds for baselining the DUNE Project, as currently envisioned, can be found in Table 4-2 below. A Change Control Board (CCB, see Section 7.6) led by the Technical Coordinator (TC) advises the Technical Coordinator on changes at the TC level or above. For the DOE-funded portion of the DUNE Project, approvals above the DUNE Technical Coordinator may require approvals through the thresholds identified in the DOE PPEP.
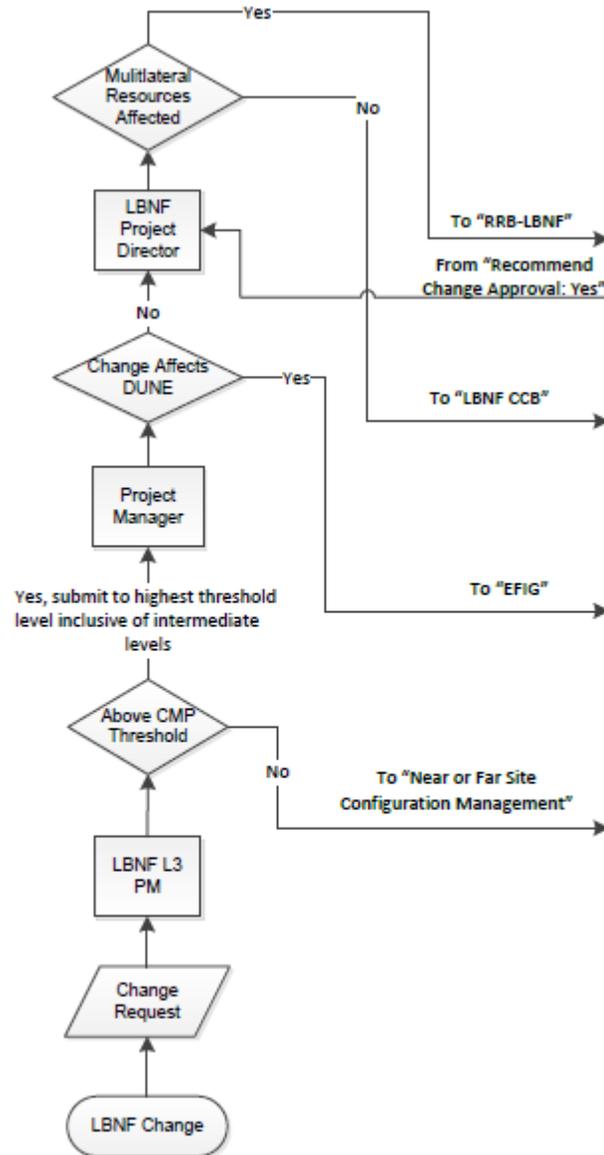
Table 4-2 DUNE Change Control Thresholds and Authorities

	DUNE RRB	DUNE Executive Committee	DUNE Technical Coordinator	DUNE Working Group
Technical Scope Baseline	Any transfer of scope between DUNE funding agencies	Any change related to diminished performance	DOE: See PPEP [2] Table 6	Any change to technical specifications that does not diminish performance
			non-DOE only: Any change in scope of a single Working Group that does not diminish performance	
Schedule Baseline	Any change in a Tier 2 milestone that affects multiple DUNE funding agencies	Any change in a milestone below Tier 2	DOE: See PPEP [2] Table 6	Any change that does not result in a delay of a Tier 5 milestone
			non-DOE only: Any change in a milestone below Tier 3	
Cost Baseline	Single change request with base cost increase that affects multiple DUNE funding agencies	DOE affected: Single change request with base cost change greater than $500k, cumulative change in base cost of greater than $1M	See PPEP [2] Table 6*	DOE affected: Single change request with base cost change less than $100k*
		non-DOE only: Single change request with CORE cost greater than TBD that impacts a single funding agency	non-DOE only: Single change request with CORE cost greater than TBD that impacts a single funding agency	non-DOE only: Single change request with CORE cost less than TBD that impacts a single funding agency
APPROVALS REQUIRED	CM PCS TC EC RC RRB	CM PCS TC EC	CM PCS TC	CM PCS Working Group

*Subject to DUNE EC approval upon accumulation of changes of greater than $1M.

4.4 Changes that affect both Projects

As noted in sections above, a CR from either Project could affect the other. When this is the case, the Change Request originates and progresses through each Project's management process as usual and then is sent to the EFIG by the LBNF Project Manager and/or DUNE Technical Coordinator. The EFIG considers the change and either recommends approval or rejection to the LBNF Project Director and DUNE Technical Coordinator. If the CR is approved by both the LBNF PD and DUNE TC, it is sent back through each Project's Change Control process. If it is rejected thereafter, this too is documented, and notice is provided to both Projects.

Figure 4-1: LBNF Change Control Process
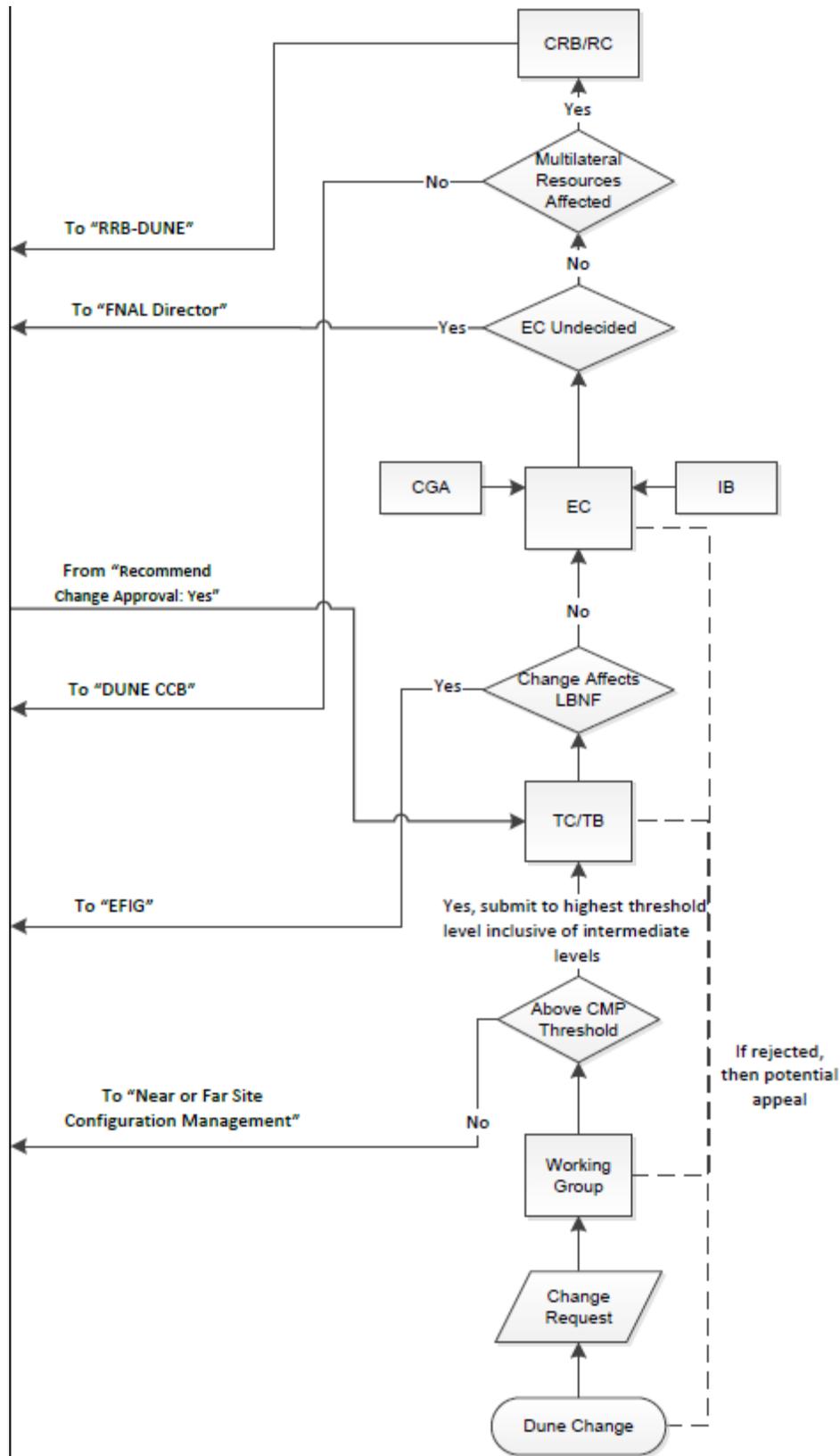
Figure 4-2: LBNF/DUNE Common Change Control Process

Figure 4-3: DUNE Change Control Process

4.5 Further LBNF/DUNE Change Control Procedures for Configuration Management

Formal Change Control procedures are used to track technical, schedule, and cost changes in the Projects. Each such change requires the preparation of a Change Request, as discussed earlier in Section 4, and submittal to the Change Control database. The LBNF Project Manager and/or the DUNE Technical Coordinator may review each Change Request. The Configuration Control Manager maintains current records of all Change Requests and their disposition through a common LBNF/DUNE Change Control database.

A Document Change Notice (DCN) is used by the CCM to process technical changes and to notify the LBNF and/or DUNE Project teams, as appropriate, that an approved change has been implemented. The Change Request accompanies the DCN through the process. As identified above, the Change Request provides the information about the technical performance, cost and schedule impacts of the change.

More detailed procedures implementing the Change Control process will be developed prior to the baseline of any portion of the Projects.

5 CONFIGURATION MANAGEMENT PROCESS

Configuration Management refers to the set of techniques, processes and tools used to track the configuration of all the components of the Project at all times throughout the Project life-cycle. The LBNF/DUNE Projects use several tools to achieve this objective, as described in Section 9.

The Configuration Management process consists of four ongoing stages: (1) configuration identification, (2) change control, (3) configuration status accounting, and (4) configuration verification.

5.1 Configuration Identification

Configuration identification is the ongoing process of identifying and documenting all CIs, deliverables' interfaces and functional and physical characteristics from initial requirements selection through design, development, fabrication, test, assembly, delivery and installation. Configuration identification provides both unique identities to LBNF/DUNE deliverables and configuration documentation.

5.1.1 Configuration Items

In order to facilitate CM, the Project systems and components are broken down into manageable units, called Configuration Items (CIs). CIs are identified through a top-down analysis that divides the total system into logically related and subordinate aggregates of components. The main criteria for identification as a CI are the ability to distinctly define the item's physical characteristics and independently define, test and manage its performance parameters.

5.1.2 Configuration Items Data List

All CIs are listed in a Configuration Items Data List (CIDL). The CIDL is a spreadsheet containing relevant information about each CI: its title, responsible organization and manager, and data management tool/location. The CIDL also identifies the documents that define the CI. Where the design incorporates commercial off-the-shelf (COTS) hardware or software, the design data and documentation are owned by the vendor; it is therefore not subject to or included in LBNF/DUNE Configuration Management. The process for making controlled changes to the CIDL is shown in Figure 5-1 through Figure 4-3.

5.1.3 Interface Control

The LBNF/DUNE Systems Engineer is responsible for implementing a configuration management system, including interface control. Configuration Items (CI) of the DUNE and LBNF Projects, including and correlated with partners' deliverables, are logically combined into groups and as a whole form the CIDL for LBNF/DUNE. A DUNE or LBNF CI generally has a multitude of physical and programmatic interfaces with other deliverables of one or both Projects. A CI may also have interfaces with the existing and/or transitional Near Site or Far Site facilities, which are not considered LBNF deliverables. All interfaces are managed via matrices, with each matrix representing a portion of the DUNE/LBNF combined Projects. See Figure 5-2 for a sample matrix for one portion of the Project. Each interface matrix cell represents an Interface Control Document (ICD) describing the interface between the two entities. The CIDL plus the full set of DUNE/LBNF Interface matrices with ICDs represents the full scope of the DUNE and LBNF Projects.
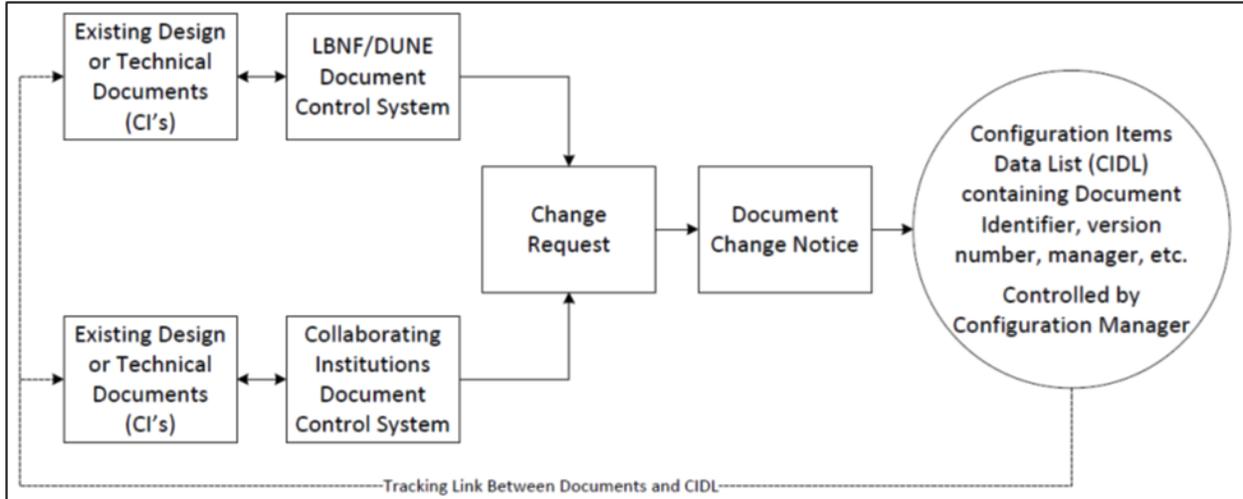
Figure 5-1: LBNF/DUNE Documentation Identification and Control Process

DUNE-LBNF Far Detector-Cryo-CF-SURF Interface Matrix														
System Design/Construction	CF, Far Site - Surface	CF, Far Site - Shaft & Drift	CF, Far Site - Cavern	Far Detector Design	Far Detector Construction	Cryostat Design	Cryostat Construction	Cryogenics Ar System-Design	Cryogenics Ar System-Construction	Cryogenics N System-Design	Cryogenics N System-Construction	Cryogenic Fluids	SURF
CF, Far Site - Surface													
CF, Far Site - Shaft & Drift	1												
CF, Far Site - Cavern	2	12											
Far Detector Design	3	13	22										
Far Detector Construction	4	14	23	31									
Cryostat Design	5	15	24	32	39								
Cryostat Construction	6	16	25	33	40	46							
Cryogenics Ar System-Design	7	17	26	34	41	47	52						
Cryogenics Ar System-Construction	8	18	27	35	42	48	53	57					
Cryogenics N System-Design	9	19	28	36	43	49	54	58	61				
Cryogenics N System-Construction	10	20	29	37	44	50	55	59	62	64			
Cryogenic Fluids	11	21	30	38	45	51	56	60	63	65	66		
SURF	67	68	69	70	71	72	73	74	75	76	77	78	

Figure 5-2: A Sample Interface Control Matrix

5.2 Configuration Status Accounting

Changes to a given CI are tracked through the individual data management system of the site responsible for the CI. The site produces technical documentation such as 3-D models and drawings that get integrated into the LBNF/DUNE CIDL. Integration of CI data from sites occurs on a regular basis. CIs will be periodically audited prior to actual delivery for integration into the CIDL to ensure that the as-built configuration conforms to the configuration documentation.

5.3 Configuration Verification

The LBNF and DUNE Project Managers are responsible for implementing and closing the CCB-approved changes to CIs (i.e., CRs) that are under their respective control. A signoff on a CI's Document Change Notice (DCN) serves as notice that a change has been implemented and verified. The verification of hardware, installation or construction changes is reported by signing the bottom of the Change Request and returning it to the LBNF PM or DUNE TC, as appropriate. In this manner, all changes can be tracked to completion and easily audited.

6   LBNF RESPONSIBILITIES IN CHANGE CONTROL

This section identifies the roles and responsibilities of LBNF personnel in the implementation, management and maintenance of configuration changes in accordance with this CMP. The LBNF personnel and groups described in this section are represented within the LBNF Change Control process in Figure 4-1.

6.1   LBNF Project Director

The LBNF Project Director (PD), or designee, approves all changes to the LBNF Project technical, cost and schedule baselines at the assigned threshold.

6.2   LBNF Project Manager or designee

The LBNF Project Manager (PM), or designee, is responsible for the following tasks:

- Chair the LBNF Change Control Board.

- Advise the LBNF CCB of pending changes that must be approved by higher levels of management.

- Advise the Experiment Facilities Interface Group (EFIG) of proposed changes that affect DUNE.

- Oversee and coordinate Project CM activities.

- Notify the LBNF CCB of any need for a change as soon as that need is identified and determined to be valid.

- Ensure that all Project CIs are identified and controlled.

- Ensure that any changes to controlled documents are appropriately recorded, tracked, and incorporated into existing CAD models, drawings and/or documents in a timely manner.

- Ensure that any additional testing or certification required as a result of a change is explicitly identified and included in the appropriate places.

- Maintain a list that identifies the controlled documents, their owners and the locations of these documents.

- Periodically audit the CMP to determine the effectiveness of this Plan. This may include reviewing controlled copies of documents to ensure their accuracy and their consistency with the master copies, the electronic master, or CAD models.

6.3   LBNF Level 2 and Level 3 Project Managers

LBNF WBS L2 and L3 Project Managers have the following responsibilities:

- Serve on the LBNF Change Control Board.

- Identify the management level required for each change based on thresholds in Table 4-1 and the DOE PPEP [2] (for changes to DOE-funded scope).

- Determine whether there is a potential change impact upon DUNE.

- Maintain CM control over subcontractors and their areas of responsibility.

- Notify the LBNF PM of any need for a change as soon as that need is identified and determined to be valid.

- Ensure that the PM is informed of as-built changes and revisions to controlled documents.

- Assess impacts of proposed changes on cost, schedule, resources, risk, technical performance, and scientific objectives.

- Submit Change Requests and implement approved changes to technical, cost and schedule baselines.

6.4 LBNF WBS Level 4 and 5 Managers (CAMS)

LBNF WBS L4 & L5 Managers (these managers also serve as Control Account Managers, or CAMS) have the following responsibilities in their areas of the Project:

- Compile all technical, cost and schedule data associated with Change Requests to the baseline configuration.

- Keep track of progress on work activities, including work by subcontractors and collaborations.

- Notify the L2 or L3 Project Manager of any need to change a CI as soon as that need is identified and determined to be valid.

- Ensure that all persons working in their area of the Project use the latest versions of documentation available.

- Submit changes made as a result of fieldwork for processing in an orderly and timely manner.

6.5 LBNF Change Control Board

The LBNF Change Control Board (LBNF CCB) is composed of the LBNF PMB. The CCB makes recommendations to the LBNF Project Director on changes that affect the Project baseline cost, schedule, and technical specifications at Change Control thresholds in accordance with Table 4-1. The DOE Federal Project Director (FPD) and members of the Project Management Group are invited to participate as observers. The LBNF CCB is chaired by the PM unless he/she designates another member as the chair. The Board meets at regular intervals, except when there are no pending actions. Notices of approval or rejection of all Change Requests by the CCB are distributed to the relevant Managers by the Project Office. The CCB also evaluates CR impact on DUNE and refers the CR to the EFIG as necessary.

6.6 LBNF Technical Boards

The LBNF Beamline Technical Board is composed of the LBNF L3 Manager, the respective L4 Managers and technical representatives. This Technical Board is described in the LBNF/DUNE PMP [1], and is responsible to review and recommend approval/rejection of Change Requests to the LBNF L3 Manager within the threshold assigned by the Change Control process.

6.7 LBNF Document Control Managers

The LBNF Project encompasses multiple international institutions. Each institution is responsible for separate LBNF Configuration Items. Each institution/site must have a Document Control Manager whose responsibilities include transmission of the site's documentation to document management systems as described in Section 9.1.

Each site's Document Control Manager (DCM) and the LBNF/DUNE Document Control Manager are responsible to ensure that the latest versions are disseminated and available, and that they clearly replace any older versions. If outdated documentation is requested for any reason, it shall be labeled as outdated or obsolete in a clear and distinctive manner. DCMs are responsible for the data management system in their organization.

7 DUNE RESPONSIBILITIES IN CHANGE CONTROL

This section identifies the roles and responsibilities of DUNE personnel in the implementation, management and maintenance of configuration changes in accordance with this CMP. Figure 4-3 displays these roles within the Change Control process.

7.1 DUNE Technical Coordinator

The DUNE TC, or designee, is responsible for the following tasks:

- Chair the DUNE Change Control Board.

- Advise the DUNE CCB of pending changes that must be approved by higher levels of management.

- Advise the Experiment Facilities Interface Group (EFIG) of proposed changes that affect LBNF.

- Oversee and coordinate Project CM activities.

- Notify the CCB of any need to change documentation or a system as soon as that need is identified and determined to be valid.

- Ensure that all Project CIs are identified and controlled.

- Ensure that any changes to controlled documents are appropriately recorded, tracked, and incorporated into existing CAD models, drawings and/or documents in a timely manner.

- Ensure that any additional testing or certification required as a result of changes is explicitly identified and included in the appropriate places.

- Maintain a list that identifies controlled documents, their owners and the locations of these documents for the Project.

- Periodically audit the CMP to determine the effectiveness of this Plan. This may include reviewing controlled copies of documents to ensure their accuracy and their consistency with the master copies, the electronic master, or CAD models.

7.2 DUNE Resource Coordinator

The DUNE RC has the following responsibilities:

- Chair the DUNE Collaboration Resource Board (CRB).

- Advise the DUNE CRB of pending CRs that must be approved by higher levels of management.

- Advise the LBNF/DUNE RRB of pending CRs that must be approved by the RRB.

7.3 DUNE Project Manager

The international DUNE Project Manager (PM) acts as a direct representative of the TC in all matters related to Configuration Management activities. The TC can designate the DUNE PM to take on any of the TC responsibilities with respect to CM as outlined above.

7.4 DUNE Level 2 Managers

WBS L2 Managers are responsible for the following tasks:

- Serve on the DUNE Change Control Board.

- Identify the management level required for each change based on thresholds in Table 4-2 and the DOE PPEP [2] (for changes to DOE-funded scope).

- Determine if a proposed change has a potential impact upon LBNF, and if so, identify it as such.

- Maintain CM control over the L2 area of responsibility, including work by subcontractors and collaborators.

- Notify the DUNE TC of any need to change documentation or a system as soon as that need is identified and determined to be valid.

- Ensure that the TC is informed of as-built changes and revisions to controlled documents.

- Assess impacts of proposed changes on cost, schedule, resources, risk, technical performance, and scientific objectives.

- Submit Change Requests and implement approved changes to technical, cost and schedule baselines.

7.5 DUNE WBS Level 3 Managers

WBS L3 Managers are responsible for the following tasks:

- Compile all technical, cost and schedule data associated with Change Requests to their baseline configurations.

- Keep track of progress on work activities under the L3 area of work, including work by subcontractors and collaborators.

- Notify the L2 Project Manager of any need to change a CI as soon as that need is identified and determined to be valid.

- Ensure that people under their authority use the latest versions of documentation available.

- Submit changes made as a result of fieldwork for processing in an orderly and timely manner.

7.6 DUNE Change Control Board

The DUNE Technical Board (TB), see PMP [1], functions as the DUNE Change Control Board (DUNE CCB). The DUNE CCB makes recommendations to the DUNE Technical Coordinator regarding proposed changes that affect the Project baseline cost, schedule, and technical specifications at Change Control threshold identified in Table 4-2Table 4-1. The CCB is chaired by the DUNE TC or designee. The Board meets at regular intervals, and as necessary to process pending actions. Notices of approval or denial of all Change Requests are distributed to the relevant Managers by the Project Office. The CCB is responsible for evaluating the impact of a proposed CR on LBNF and whether the CR needs to be reviewed by higher levels of management.

7.7 DUNE Working Groups

DUNE Working Groups are the collaboration bodies where issues related to design, construction, installation, and commissioning of the different detector elements are discussed. These groups are jointly led by appointed members of the collaboration (conveners) and the L3 Managers responsible for the associated WBS elements   The DUNE Working Groups are responsible for reviewing Change Requests that impact their areas of responsibility. Recommendations on Change Requests that require higher level management approval are forwarded by the L3 Manager to the DUNE Technical Board via the responsible L2 Manager.

7.8 DUNE Document Control Managers

The DUNE Project encompasses multiple international institutions. Therefore, the DUNE Technical Coordinator or designee evaluates and establishes satellite sites for separate DUNE Configuration Items. Each site must have a Document Control Manager (DCM) whose responsibilities include transmission of the site's documentation to the LBNF/DUNE DCM.

Each site's DCM and the LBNF/DUNE DCM are responsible for ensuring that the latest versions are disseminated and available, and that they clearly replace any older versions. If outdated documentation is requested for any reason, it shall be labeled as outdated or obsolete in a clear and distinctive manner. Document Control Managers are responsible for the data management system in their organization.

7.9 DUNE Executive Committee (EC)

The DUNE EC, defined within the LBNF/DUNE Project Management Plan [1], is another collaboration body that is tasked with participating in the decision-making process for Change Requests. The EC considers CRs that affect the Project baseline cost, schedule, and technical specifications at levels above the Change Control thresholds identified in Table 4-2. Change Requests approved by the EC that have impacts on multiple funding agencies are passed to the RRB through the DUNE RC. If the EC, which is consensus-driven decision-making body, is unable to reach a consensus on a particular Change Request, decision-making authority is transferred to the Fermilab Director. The DUNE Collaboration General Assembly (CGA) and DUNE Institutional Board (IB) act as consulting bodies to the DUNE EC, at the discretion of the EC, within the LBNF/DUNE Change Control process.

8 GROUPS IN THE CHANGE CONTROL PROCESS FOR BOTH LBNF AND DUNE

8.1 LBNF/DUNE Experiment - Facility Interface Group (EFIG)

The EFIG is an oversight group defined within the LBNF/DUNE Project Management Plan that considers the broad ramifications of CRs submitted within the LBNF/DUNE Change Control process according to Figure 4-1. The EFIG is chaired by two Deputy Directors of Fermilab. If the EFIG, a consensus body, endorses the change, the CR is referred to each of the Projects for full consideration and implementation through their respective change management procedures as identified in Figure 4-1 and Figure 4-3.

8.2 DUNE Collaboration Resource Board (CRB)

The DUNE Collaboration Resource Board (CRB) is chaired by the DUNE Resource Coordinator (RC) as defined within the LBNF/DUNE Project Management Plan. The CRB vets CRs prior to their submission to the LBNF/DUNE Resource Review Board within the LBNF/DUNE Change Control process according to Figure 4-1 and Figure 4-3.

8.3 LBNF/DUNE Resource Review Board (RRB)

The RRB is defined within the LBNF/DUNE Project Management Plan. The RRB is a change decision-making body that considers changes affecting multiple funding agencies within the LBNF/DUNE Change Control process according to Figure 4-2. There are two subgroups of the RRB: RRB-LBNF and RRB-DUNE. Each of these groups monitors progress and considers the issues specific to LBNF and DUNE, respectively, while the whole RRB considers matters that concern the entire enterprise (LBNF and DUNE).

9 TOOLS

Elements of LBNF/DUNE Configuration Management include many hardcopy and software tools, including a document control system that supports versioning and document signoff to approve a version; tools also include engineering data management systems and software control with a versioning and release system based on a software repository. For LBNF and DUNE to maintain proper Configuration Management, it is imperative that their personnel be trained in these tools and disciplined in their use, and that they act in a coordinated manner.

9.1 Data Management Systems

The items included in this Configuration Management Plan do not naturally lend themselves to a single data management solution. In addition, different tools are used at different sites to manage their Configuration Items for the LBNF and DUNE Projects. Compatible data management solutions amongst the various domestic and international DCMs and with the Fermilab DCM are highly desirable.

Management documents and reports that are under Configuration Management control are managed using LBNF/DUNE's Document Database (DocDB). The DUNE DocDB is found at the URL https://docs.dunescience.org/. General information about DocDB can be found at http://docdb.fnal.gov/doc/. LBNF/DUNE implements the electronic approvals feature of DocDB for tracking approvals of controlled documents. The LBNF/DUNE Projects use Microsoft SharePoint to house certain documentation in a controlled environment while it is under development; the completed documentation is uploaded to the DocDB, along with the native/editable file format, and made available, as appropriate. The LBNF/DUNE DCM allows for SharePoint accessibility by satellite sites, thus allowing sites to maintain controlled documentation inside this central repository.

Configuration Management for all LBNF and DUNE engineering documentation (including CAD models, drawings, technical notes, and specifications) created by all participating organizations use the TeamCenter engineering data management system. This database offers controlled access with versioning and workflow capabilities. Through TeamCenter, LBNF/DUNE sites are able to engineer their Configuration Item(s) within their native CAD and engineering documentation systems and upload the controlled data at regular intervals and at milestones (TBD), as needed.

Further information for interfacing with LBNF/DUNE scientists, engineers, designers and management are located at: https://web.fnal.gov/project/LBNF/SitePages/Home.aspx .

Configuration Management for all LBNF and DUNE hardware and structures is achieved through the life of the Project through use of fundamental engineering documentation principles that are the basis for the use of TeamCenter, such as:

- Requirements change control

- CAD model, drawing and specification change control and revision control

- Manufacture records

- Quality Assurance inspection and qualification testing documentation

- Manufacture and construction change control

- As-built configuration documentation

The configuration management of detector software and firmware is to be determined prior to CD-2. A version-control system that can record and control the history of source files, as well as documents, is required.

The LBNF/DUNE Project Master Schedule information (resources, schedule, and cost) is documented in the Primavera P6 scheduling and Cobra cost processing software tools. Prior to the Projects' baseline the Master Schedule is "unlocked" (i.e., not under Configuration Management) while Project planning continues. At baseline, the Master Schedule is "locked" (i.e., placed under Configuration Management) to allow for its use as the tool for the Earned-Value Management System (EVMS) for DOE purposes. Thereafter, any change to the Master Schedule requires the approvals in accordance with the processes described in Section 3, *Change Control*. Any significant Project change may require a re-baseline of the Master Schedule.

Risk management is documented using the Fermilab Risk Register tool, implemented in SharePoint. This tool creates the risk registry. Its access is restricted to selected individuals in the Project Offices and managed by the LBNF and DUNE Risk Managers.

Requirements management is initially achieved using controlled revision to Excel workbooks as a precursor before transitioning to Fermilab's TeamCenter engineering data management software. These workbooks capture requirements and assumptions at tiered levels corresponding to the WBS structure; the highest level of which identifies the scientific objectives of LBNF/DUNE. Each level (corresponding to each WBS element) specifies the requirements that it must satisfy in order to provide the functionality required by the WBS item of which it is a part. The Project requirements baseline is established prior to all other Project baselines, following CD-1. The full set of requirements therefore becomes the first CI for which Change Control is instituted. Changes are then tracked within the workbooks (prior to TeamCenter implementation) and revisions will only occur in accordance with the Change Control process.

9.2 Change Control Database

To track and manage changes to the baseline during the life of the Project, a central Change Control database is being developed for LBNF/DUNE. This will be utilized for submitting changes, tracking change approvals, and reporting change status. At the time of CD-3a, an interim Sharepoint tool is used for LBNF/DUNE change control.

10 REFERENCES

[1] LBNF/DUNE Project, "LBNF/DUNE Project Management Plan (dune-doc-117)," May 2015. [Online].

[2] Department of Energy, "Preliminary Project Execution Plan for LBNF (dune-doc-118)," 2015.