



**Fermilab**

## **Closeout Presentation**

# **Director's CD-3a Review of LBNF/DUNE**

**October 27-29, 2015**

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## Executive Summary

A Director's CD-3a review of the Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment (LBNF/DUNE) was held on October 27-29, 2015 at the Sanford Underground Research Facility in Lead, South Dakota. The focus of this review was to assess whether LBNF/DUNE meets the requirements of Critical Decision CD-3A, *Approve Initial Far Site Construction* and to prepare the team for the upcoming Department of Energy/Office of Science (DOE/SC) Review for CD-3A

The committee was impressed that FNAL management, including the Laboratory Director, is fully engaged in LBNF/DUNE in a positive way. The Lab has been restructured to support project priorities. While the inclusion of international participation introduces complexity to the management of the project, a credible organizational, oversight, and project management structure was presented for executing the US-hosted world-class long-baseline neutrino program. Governance structures are in place and operating.

Overall, the subcommittees were presented with a high quality and very experienced project team and their well planned strategic project. Many of the reviewers had previous experience with this project and the progress to date is notable. The LBNF/DUNE project team has institutionalized many best practices including the use of risk and logistics workshops. The team has done a proficient job of opening communication lines across all project areas, eliminating dead ends enabling engagement of all stakeholders and participants.

### **Conventional Facilities - \*\*\*\*brief overview\*\*\*\***

### **Project Management - \*\*\*\*brief overview\*\*\*\***

Overall, after a thorough review, the project was deemed to be ready for CD-3A with only a few adjustments and suggestions for improvements.

### ***Key Recommendations:***

1. Review the attached geotechnical and design review memo and identify any needed actions
2. Clarify the issue associated with movement of existing utilities in the shaft and the installation of 50% of the new utilities.
3. Define milestones to capture and control requirements, interfaces and parameters needed to complete the final design for the CD-3a scope and integrate these milestones into the final design schedule.
4. Develop preliminary acceptance and QC/QA plans for the 3a scope that include the appropriate aspects of requirements and interfaces
5. Get CD-3A documents finalized and signed.
6. Identify specific lists of prioritized activities to respond to possible budget limitations,
7. Clarify the message on what is being approved as part of CD-3A.
8. Include a presentation on QA in the HQ-IPR Review.

## Closeout Presentation

9. A QA program lead should be appointed by the award of the CM/GC to ensure the various QA/QC requirements are implemented across the project.

10. **Proceed to CD-3a!**

## 1.0 Introduction

A Director's CD-3a review of the Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment (LBNF/DUNE) was held on October 27-29, 2015. The focus of this review was to assess whether LBNF/DUNE meets the requirements of Critical Decision CD-3A, *Approve Initial Far Site Construction*.

## 2.0 Conventional Facilities

### 2.1 Excavation

**Primary Writer: Kevin Hachmeister**

**Contributor: Fulvio Tonon**

#### Charge Questions:

- Has the scope of work proposed as part of CD-3A been clearly defined?

Yes

- Are the designs related to the initial construction activities technically sound and sufficiently mature, are technical risks understood, and are requirements and interfaces with the cryostats, cryogenic systems, detectors, and logistic plans, on track to support the planned start of initial construction activities?

Yes– upon resolution of recommendation below

- Is there an adequate plan to complete the final design in time to start these activities?

Yes

- Is there a comprehensive plan to execute the initial construction activities?

Yes

#### **Findings**

- The subcommittee found the design documents to support the planned start of initial construction activities
- The subcommittee found plans for test blasting to evaluate impacts of early construction on existing science
- The subcommittee reviewed the Arup 100% Preliminary Design Report and Drawings (Aug2015), Arup Geotechnical Interpretive Report for 100% Preliminary Design (Aug2015), Arup LBNE Phase 2 Geotechnical Site Investigation Data Report (Sep2014), and Golder In Situ Stress Measurement report for DUSEL (Jan2010).

## Comments

- Based on this review and the attached geotechnical memo, the project should consider further assessment of geologic features (foliation) as they apply to design and construction, and further evaluation of the conclusions drawn from back analysis aimed at characterizing the ground based on behavior of historic underground openings
- Ensure consistency between ground support analysis and the ground support requirements outlined in the PDR drawings
- Consider assessing the impact of cryostats, cryogenic systems, and detectors in terms of:
  - Level of reliability of the underground excavation agreed upon with stakeholders considering where interventions (repairs) may not be easily carried out during the intended 20 years operational life of the detector
  - Impact of potential rock failures on personnel, infrastructure and equipment
  - Impact of unexpected events on excavation support and stability (e.g. leakage of cryogens causing damage to ground support)
- Re-visit the in situ stress measurement data to ensure appropriate consideration of the anisotropy of the rock, which has precluded use of these measurements in the design
- The subcommittee commends the design team plans for test blasting and encourages adding evaluation of the rock mass response to the proposed smooth blast techniques (e.g. damage around excavated profile, opening of fractures along the foliation)

## Recommendations

1. Prior to DOE CD-3a IPR, review the attached geotechnical and design review memo (Fulvio Tonon independent geotechnical review Oct 2015) and identify any needed actions
2. Proceed to DOE CD-3a IPR

## 2.2 Building and Site Infrastructure

**Primary Writer: Bill Miller**

**Contributors: Shane Wells**

### Charge Questions:

- Has the scope of work proposed as part of CD-3A been clearly defined? **Yes**
- Are the designs related to the initial construction activities technically sound and sufficiently mature, are technical risks understood, and are requirements and interfaces with the cryostats, cryogenic systems, detectors, and logistic plans, on track to support the planned start of initial construction activities? **Yes**
- Is there an adequate plan to complete the final design in time to start these activities? **Yes**
- Is there a comprehensive plan to execute the initial construction activities? **Yes**

### **Findings**

- The preliminary design of the Conventional Facilities that was presented showed detailed integration with all the shareholders associated with LBNF/DUNE and SURF. A Logistics workshop was recently held with all shareholders it was critical in getting to this point.

### **Comments**

- Logistics between the Detector and Cryogenic systems and the Conventional Facilities is critical as each of the final design stages are completed. Use of 3D modeling insures that stay-out zones for all the systems are defined to minimize conflicts. The initial model shows adequate room for all utilities overhead in the utility drift between the utility cavern and the detector cavern, but this needs to be monitored closely as this is the only viable path for utility connections between caverns. There are also potential conflict areas in access drifts between the Ross and Yates shafts to insure the required passage of materials.
- There is little redundancy in some of the HVAC systems underground in case of failure or schedule maintenance. Some of these can be remedied using mine ventilation and should be quantified as part the design criteria to allow the redirection of air flow.
- Traffic management during peak construction periods should be looked at more closely. Although much of the traffic issue has been addressed in the logistic meeting and it will be the ultimate responsibly of the CMGC. It would be beneficial to take a more detailed look at the possible trucking routes for spoils, concrete materials, LAr, etc. Outreach, as suggested in the risk registry, may identify potential political issues within the local communities that will need to be addressed. This would allow the ability to give better direction to the CMGC

- Because of the limited surface laydown/storage area at the Ross Shaft, just in time delivery will have to be carefully controlled. This gets considerably more difficult when detector installation begins and civil construction is still ongoing. Off-site staging will be required to help alleviate congestion. Limited staging underground will also require continual monitoring.
- While space was shown as available, there are currently no plans to include bathrooms or a break room in this facility. The team mentions that there is a location that can be used as a breakroom and SURF is planning to add a bathroom in the vicinity, tracking this and adding to final design as appropriate.
- Consider constructing an electrical/mechanical room as appropriate in the cryo compressor building to minimize exposure of maintenance personnel to the noise of the compressors.
- Finalize approach and location of racks for the DAQ system as soon as possible, but no later than the RFP for the final design, as this will have a significant impact on the CF design on heat rejection and power loads, both surface and underground.
- Consider moving the installation of ½ the utilities in the shaft into the schedule for the Site Prep and Waste Rock Handling phase as shown in the LBNF Far Site Schedule Summary Overview. Moving to this stage of the construction could increase shaft availability at the end of CD3a. This item should also be tracked in the risk registry.

## Recommendations

3. Prior to CD-3a, clarify the issue associated with movement of existing utilities in the shaft and the installation of 50% of the new utilities.
4. Proceed to DOE CD-3a IPR

## 2.3 Detector and Cryogenic Interfaces

**Primary Writer: Gil Gilchriese**

**Contributors: Joel Fuerst, Tom Nicol**

### Charge Questions:

- Has the scope of work proposed as part of CD-3A been clearly defined? YES
- Are the designs related to the initial construction activities technically sound and sufficiently mature, are technical risks understood, and are requirements and interfaces with the cryostats, cryogenic systems, detectors, and logistic plans, on track to support the planned start of initial construction activities?

YES

- Is there an adequate plan to complete the final design in time to start these activities?

YES – upon resolution of the recommendations below

- Is there a comprehensive plan to execute the initial construction activities?

YES – upon resolution of the recommendations below

### **Findings**

- The Project has established a process to capture and document requirements.
- The requirements relevant for the CD-3a scope have been defined and are under change control management
- Interface control documents (ICDs) are in place for all aspects of the design relevant for the CD-3a scope
- There is a plan to complete a comprehensive CAD 3D model that includes the relevant detector and conventional facilities elements to identify interferences and serve as a reference for future work
- There is a preliminary ODH analysis for the underground facilities based on current estimates of pipe sizes, numbers of flanges, numbers of valves, etc.
- A logistics plan is in place which confirms that the Ross shaft will support installation activity. The Yates shaft will provide capacity when the piping is being installed in the Ross shaft.
- References to “half the cryogenic piping” in the schedule mean that half the length of each vertical run in the Ross shaft will be installed as part of CD-3a. The rationale for only half is schedule. There isn’t time between completion of Ross shaft rehabilitation/preparation and the start of excavation to complete the vertical runs.

## Comments

- The development of requirements is advanced with input from all stakeholders. There is good communication among the Project Management, the DUNE collaboration and the conventional facilities design team.
- The framework and process to continue to develop and refine requirements is in place to complete the final design but the schedule for final design for the 3a scope is aggressive. Completion of the final design on the planned schedule depends on finalizing requirements by all stakeholders, and completing relevant change control actions in time to meet the final design schedule.
- The development of ICDs is advanced with good input from all stakeholders. There is good communication among the Project Management, the DUNE collaboration and the conventional facilities design team.
- The framework and process to continue to develop and refine ICDs is in place to complete the final design but the schedule for final design for the 3a scope is aggressive. Completion of the final design on the planned schedule depends on finalizing ICDs by all stakeholders.
- Although requirements are under change control, key parameters that define the conventional facilities scope proposed for CD-3a are not yet under change control but there is a plan to implement change control as required by the schedule for final design.
- Acceptance planning (including QC/QA) criteria, processes and documentation that include requirements and interfaces needs to be developed for the 3a scope. A draft plan should be in place before the CD-3a IPR.
- The ODH analysis is considered a work in progress and should continue to follow the design of the cryogenic infrastructure as it develops.
- Develop an agreement that engineering notes/documentation for systems designed at Fermilab, CERN or elsewhere are acceptable for operation at SURF.

## Recommendations

5. Define milestones to capture and control requirements, interfaces and parameters needed to complete the final design for the CD-3a scope and integrate these milestones into the final design schedule before the CD-3a IPR.
6. Develop preliminary acceptance and QC/QA plans for the 3a scope that include the appropriate aspects of requirements and interfaces before the CD-3a IPR.
7. Proceed to DOE CD-3a IPR

## 3.0 Project Management

### 3.1 Cost and Schedule

**Primary Writer: Rick Larson**

**Contributors: Cathleen Lavelle**

#### Charge Questions:

- Are the cost and schedule estimates for the initial construction activities credible, with adequate contingencies? **Yes**
- Does the project have a plan to measure and report status of initial construction activities following a CD-3a decision? **Yes**
- Are cost and schedule risks identified and managed appropriately? **Yes**

## Findings

### Cost Estimate

- The DOE Total Project Cost (TPC) point estimate presented was \$1,457M including \$344M of contingency. The proposed \$302M budget for CD-3a consists of \$219M base budget with \$83M of contingency of which 24% is Labor and 76% is M&S
- The project WBS structure is detailed and product oriented to integrate the scope cost and schedule. A WBS Dictionary has been generated for each WBS element.
- The project estimate is costed in \$FY15USD based on Preliminary Design. Escalation and labor rates were provided through the Fermi Budget Office. The construction cost escalation was based on several consultant studies.
- The construction cost estimates performed by the Architect/Engineer (ARUP) and the independent estimating firm Hatch Mott McDonald were developed throughout the preparation of the Preliminary Design. The estimates were reconciled through a series of workshops. This portion represents \$193M (88%) of the CD-3a cost estimate.
- The cost estimate is classified as a Level 3, in line with AACE International best practices and appropriate for current design maturity.

- The estimating team performed manual quantity take-offs for each specific work element or component. The estimates assume local wages with travel, multiple shifts, and overtime.
- Key estimate assumptions were documented. Conventional Facilities estimate uncertainty was categorized into three categories, with a couple of exceptions, 10% hard estimates/proposals, 20% EDIA, and 28% on all Far Site construction tasks.
- The project has identified scope contingency / options.
- An Independent Cost Review was conducted in July 2015 using the CD-1 Refresh cost basis. The review contained one recommendation to expand the upper end of the cost range. They stated that the project had a solid cost estimating process in place.
- An Independent Cost Estimate Review to assess the updated 100% preliminary design cost estimates is planned in November/December 2015.

## Schedule

- The total project resource-loaded schedule consists of 6883 activities, 1143 Tiered Milestones and 703 LOE activities with 106 control accounts, managed by 41 CAMs. The master project is made up of 10 subprojects.
- The Far Site Conventional Facilities consists of 931 activities.
- The CD-3a FSCF scope was analyzed in Acumen Fuse for the three associated control accounts which indicates 564 activities in total with 85 milestones and 116 LOE activities. There are 67 activities with missing logic.
- Schedule contingency is 40 months from Early Completion to CD-4.
- The Far Site schedule includes 195 critical path activities, approximately 45 activities for the FSCF scope starting in January, 3 2017 with FSCF Waste Rock Handling Procurement Process running through November 2025 (Detector#2 Commissioning Complete).
- The schedule includes 122 inter-project milestones.
- The FSCF Final Design for the BSI and Excavation are shown as 30%, 60%, 90% and 100% Final Design.
- The cost baseline is time-phased by activity in P6 and Cobra to derive the time-phased total cost estimate.
- Obligations are planned in the schedule to model contract awards and phased funding of procurements.
- Acumen Fuse data indicates: 317 (4%) constraints in the schedule, missing logic 834 (10%) and a large number of lags 582 (7%) and leads 173 (2%).

## Closeout Presentation

- The FSCF CD-3a contains the following higher level milestones: Tier 2 - 2 (FPD), Tier 3 - 2 (Lab Director), and Tier 4 and below (PD) - 36.

## Funding

- The cost plan has been adjusted to fit within the projected funding profile. Obligations and the cost plan are within the presumed time-phased funding profile.
- For CD-3a, no procurements are planned during the 1st three months of a new fiscal year in consideration of potential Continuing Resolutions (CRs).
- A contingency spend plan has been developed.

## EVMS

- The “Earned Value Management Implementation Plan for CD-3a Scope” identifies the existing EVMS practices already in place, identifies gaps, and outlines a plan for implementation. The preliminary baseline will be established in March 2016 with a formal baseline occurring before the end of FY2016 allowing for the staff to exercise the system
- The EVM system to be implemented for LBNF/DUNE is the Fermilab Certified in 2010 and a recent surveillance review in December 2014 found the system is consistent with the ANSI Standard 748b.
- EVM system applied to DOE scope, milestones will be used to assess progress for partners.
- The project has developed a plan to start EV performance measurement in April 2016 after the CD3a scope has been baselined.
- The CD-3a portion of the project consists of 564 activities has three control accounts, and one CAM.
- RISKS
- The FSCF estimate contains \$93M of contingency of which \$83M is budgeted for CD-3a.
- The FSCF contingency estimate is based on an evaluation of the project team assessment of the project risks over two 2-day workshops and open design items. The 1st conducted in April looked at LBNF-DUNE risks and the 2nd at the end of August focused on FSCF. The results were derived by using the 90% confidence level from the risk modeling tool (\$32.5M, CD-3a \$27M). This evaluation was combined with an evaluation of the open design items, additional construction-phase contingency and unanticipated user requirements (\$60.5M, CD-3a \$56M). Total CD-3a \$83M.
- In addition to above analysis, each CD-3a schedule activity was evaluated using standardized estimate uncertainty rules. Using 90% of the summarized value, the estimate uncertainty contingency is \$53M. This estimate coupled with the project risk modeling data (\$27M) resulted in a contingency of \$80M which compares favorably with the above analysis.

- The project has identified 4 high risks, 7 medium risks, and 10 low risks for the FSCF scope. There are 14 total high risks, 64 total medium risks and 78 total low risks for the project.
- The Risk Register has been re-evaluated on a regular basis.
- CD-3a contingency is \$83M which is 38% of the cost to go.
- Contingency is applied to the DOE scope only.
- The schedule contingency is represented in the late milestone dates using the following allocation: Tier 1 - 1 year float, Tier 2 - 6 month float, Tier 3 - 3 months, and Tier 4 - no float.

## Risks

- The FSCF estimate contains \$93M of contingency of which \$83M is budgeted for CD-3a.
- The FSCF contingency estimate is based on an evaluation of the project team assessment of the project risks over two 2-day workshops and open design items. The 1<sup>st</sup> conducted in April looked at LBNF-DUNE risks and the 2<sup>nd</sup> at the end of August focused on FSCF. The results were derived by using the 90% confidence level from the risk modeling tool (\$32.5M, CD-3a \$27M). This evaluation was combined with an evaluation of the open design items, additional construction-phase contingency and unanticipated user requirements (\$60.5M, CD-3a \$56M). Total CD-3a \$83M.
- In addition to above analysis, each CD-3a schedule activity was evaluated using standardized estimate uncertainty rules. Using 90% of the summarized value, the estimate uncertainty contingency is \$53M. This estimate coupled with the project risk modeling data (\$27M) resulted in a contingency of \$80M which compares favorably with the above analysis.
- The project has identified 4 high risks, 7 medium risks, and 10 low risks for the FSCF scope. There are 14 total high risks, 64 total medium risks and 78 total low risks for the project.
- The Risk Register has been re-evaluated on a regular basis.
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- Contingency is applied to the DOE scope only.
- The schedule contingency is represented in the late milestone dates using the following allocation: Tier 1 - 1 year float, Tier 2 - 6 month float, Tier 3 - 3 months, and Tier 4 - no float.

## Comments

### Cost Estimate

- Estimate maturity/basis is quantified and detailed. The cost book is easily reconciled to the schedule.

## Closeout Presentation

- The drill down demonstrated a well documented cost estimate with the basis of estimate documented in the cost book by activity and by resource. The cost estimate was traceable to the schedule activities in P6 for the CD-3a scope.
- Though the CD-3a budget is based on the Preliminary Design, typical CD-3 budgets are based on a 100% final design, the A/E and independent cost estimates were reconciled and used for the CD-3a budget. Both cost estimates were prepared by highly qualified firms.

## Schedule

- The integration of the project scope, cost, and schedule is evident. The critical path was well developed and the initial construction schedule provides sufficient detail to provide validity to the schedule.
- Obligations planned in the schedule is a good practice and supports a more accurate assessment of work planned against funding constraints.
- The 40 months of schedule contingency (29%) from early completion to CD-4 is reasonable for the duration of the project.
- An Acumen Fuse analysis resulted in a score of 68 for the full project schedule. A score of 85 is considered a good score. The primary drivers for this lower number are missing logic 834 (10%) and a large number of lags 582 (7%) and leads 173 (2%). At a minimum, the missing logic should be reviewed and corrected, if necessary.
- The milestones were logical and well-spaced. Generally, Tier 2 milestones (FPD) represent the completion of major milestones and are set 6 months after the early date, Tier 3 milestones (Lab Director) are set 3 months after the early date, and Tier 4 milestones (PD) reflects the early dates.
- To provide more detailed planning and statusing of the FSCF Final Design 30%, 60%, 90% and 100% effort, consider adding some activities to each segment.
- The project benefitted by having both ARUP and Hatch Mott McDonald (HMM) estimating firms providing construction schedules for evaluation.

## EVMS

- Though the \$219M CD-3a scope will be managed by three Control Accounts and one CAM, 79% of scope will be executed under a large fixed fee lump sum CM/GC contract.
- With the planned implementation of the EVM system in March 2016, the Project plans to begin reporting on all FSCF scope in April 2016. This will enable the Project to continue to train and practice using the system, as well as produce EV data. It should be noted at the CD-3a baseline starts January 2017.

- The Project Controls staff is knowledgeable, experienced and professional. The current staffing levels may need to be increased once the project is fully baselined and measuring performance.

### **Risks**

- The use of the 2-day workshop show a high level of commitment of the project team. The team should be commended for using outside experts to assist with the evaluation of specific issues.
- Consider preparing a contingency analysis report to summarize development, results, and allocation of the contingency estimate.

### **Recommendations**

8. Proceed to DOE CD-3a IPR.

## 3.2 ESH

**Primary Writer: Craig Ferguson**

### Charge Questions:

- Are the environmental, safety, and health aspects related to the initial construction activities being addressed appropriately?

YES

### **Findings**

- An experienced ESH Manager is in place, dotted line to L-2 PM
- An ESH Coordinator is planned to be hired and in place 3 months prior to construction.
- CD-3a Required ESH documents are in place
  - NEPA documentation is complete, FONSI has been issued
  - The Hazard Analysis has been prepared
  - Integrated Safety Management Plan
  - Hazard Analysis Report
  - Security Vulnerability Assessment Report
  - Construction Environmental, Safety, and Health Plan
- Conventional Facilities construction at both Fermilab and SURF will be accomplished through a Construction Manager/General Contractor (CM/GC) contracting methodology in which the CM/GC holds the trade subcontracts.
  - 10CFR851 requirements will be flowed to CM/GC and lower tier subs, and SDSTA
- Ross Shaft rehabilitation, Ross headframe repair, Oro Hondo fan replacement, Ross skip replacements, 4850L ground support, and Ross skip and cage replacements must be completed before major excavation can begin at SURF
- Refuge Chamber capacity will need to be increased from 72 people to 200 people before major construction peak
- Test blast program is scheduled for December
- Life Safety systems are in place underground to allow for excavation

## Comments

- A very experienced and qualified ESH Manager is assigned to the project
- A well established FNAL and SDSTA ESH program is being implemented on the project
- The ESH and QA lead should report to the PM. The org reporting relationship should match between talks (See Mike Headley's org chart and Mike Andrew's org chart)
- A QA Plan and Configuration Management Plan have been developed. However the project should now establish how QA is organized and how items relied on for safety are designed, installed, tested, accepted and under configuration control. Examples include:
  - Fire detection and suppression, electrical equipment, cryogenic pressure systems containment (e.g. piping, dewars), ventilation and other mitigations and assumptions in the HAR, ODH analysis, FHA.
- SURF ESH Director should present how SURF ESH covers SDSTA performed CD-3a scope performed by SDSTA
- CM/GC ESH related selection criteria should include visiting bidders' active work sites to evaluate implementation of their ESH program
- Suggest that you require that CM/GC have CPR certified person underground when major construction and population underground
- The test blast program is a good opportunity to exercise ESH monitoring and protections and obtain feedback for continuous improvement
- The LBNF/DUNE pressure systems program should be mapped to 10CFR851 requirements and flowed to CM/GC and SDSTA
- The ESH presentations should clarify assurance and oversight roles of SD Office of Risk Management Oversight, DOE oversight, City of Lead AHJ, FNAL ESH oversight and SURF ESH oversight in breakout presentation
- Ensure the EA commitments are in the project schedule. Examples:

## Traffic

- Construction traffic impacts would be reduced through SEPMS, including preparing and implementing traffic control plan.
- To further address potential transportation impacts during construction, SURF intends to implement a future study to evaluate the transportation of excavated material to one of two sites discussed in the EA: the Homestake Open Cut located immediately adjacent to the City of Lead, SD, or the Gilt Edge Mine site located approximately 7 miles from the SURF property.

## Closeout Presentation

### **Air Quality**

- The Proposed Action would require an air quality construction permit for the Ross Crusher and associated rock transfer points.
- A preliminary ODH analysis has been performed and will evolve with design progression
- Make sure bidders know ESH (emergency response drills, training etc.) requirements and time

### **Recommendations**

9. A QA program lead should be appointed by the time of the award of the CM/GC to ensure the various QA/QC requirements are implemented across the project.
10. Proceed to DOE CD-3a IPR

### 3.3 Management

**Primary Writer: Bob Wunderlich**

**Contributors: Karen Hellman, Troy Lark**

#### Charge Questions:

- Is the project being effectively managed, and is it properly organized and staffed to successfully execute the project plan as it relates to the initial construction activities?

Yes

- Is there a comprehensive plan to execute the initial construction activities?

Yes, however a single short document/presentation needs to be prepared that succinctly spells the CD-3A activities; information similar to what would be included in a PEP.

- Has the project responded appropriately to recommendations from past reviews, specifically in relation to the initial construction activities?

Yes, for those items that impact the CD-3A decision, they have been closed or adequate steps (in progress means vacancy interviews are planned or procurement packages reflect needs, or risk assessment modified, or blast impact tests are planned, or some other action) are in place to resolve the issue.

- Is the project ready to proceed to the DOE CD-3A review?

Yes

#### **Findings**

##### **Project Organization and Staffing**

- LBNF/DUNE and PIP-II are the highest priorities at Fermilab. The Lab has been restructured to support these priorities including the hiring of a LBNF Project Director. A new LBNF/DUNE Procurement Manager (October 2015) has been selected. The Conventional Facilities Deputy has been selected. Two additional procurement specialists will be hired as well as plans in place for additional QA support. Next week, the Project is preparing to conduct a survey of critical skills needed on the project.
- The South Dakota Science and Technology Authority (SDSTA) is a major LBNF/DUNE participant for work at the Homestake Mine which includes upgrading the facilities (i.e. hoists, fans) at the mine.

## Closeout Presentation

- A LBNF/DUNE Project Organization and Project Team in place. ARUP, the underground A/E, is internationally recognized. A CM/GC RFP is in process with award by this spring. CM/GC will be a participant in the final design.
- CERN has formally expressed interest in supporting and financially contributing to the LBNF/DUNE through the DOE-CERN-NSF Agreement.
- A formal DUNE Collaboration has been established. Collaboration Co-Spokesperson have been assigned. The DUNE Collaboration membership includes 792 members in 26 countries and 145 institutions (half international). Two formal collaboration meetings have been held this year which resulted in a defined structure and executive committee. Formal agreements will follow the approval of CD-3A (serves as a trigger for the international involvement beyond CERN).
- The composition and roles of the main financial and advisory bodies for LBNF and DUNE have been established, including the International Advisory Council (IAC), the Resources Review Boards (RRB), the DUNE Finance Board and the Long-Baseline Neutrino Committee. The membership of the RRBs and the DUNE Finance Board has been assigned. All of these organizations are functioning.
- The communication process that was outlined during the presentations is extensive involving daily, weekly, monthly meetings at all levels of the Project including the diverse stakeholders.

## Project Management Systems

- Fermilab has a formal risk management system in place. For the LBNF/DUNE Project, Fermilab conducted two risk workshops that included external participants. The Project successfully completed the Project Management Risk Committee Review at HQ. Actions to manage risks (i.e. use of contingency) can involve the CCB Process. Plans are in place for continued maturity of the risk management system. The risk identification process includes input from the users which address construction issues that can carry over to operations.
- DOE project management systems (e.g. EVMS) are applied to DOE work but agreed to project management systems (e.g. Core Accounting, milestone control) applied to partner work. EVMS training is being performed, the Project will begin to report against a preliminary baseline in April 2016.
- A Far Site Interface Matrix and corresponding Interface Control Documents are available and under formal configuration management.
- The Far Site Conventional Facilities reported that design is 40-50% complete where the preliminary design is typically 30%. Both internal and external reviews were performed to confirm the design readiness. The major concern is the possibility of a change in external requirements. Reconciliation of cost estimates has been completed.
- External independent reviews are being conducted (cryogenics and cryostat designs, cost and schedule). A LBNF/DUNE QA Plan is available.

- A Logistics workshop was held in August 2015 to plan a 15 year time horizon. This resulted in a comprehensive logistics plan to use both the Ross and Yates shafts. CM/GC will take lead for logistics once the contract is awarded. Some additional analysis is needed
- Cryostat System Requirements were presented by a CERN representative which shows direct CERN involvement. Cryostat maintenance is included in the requirements to ensure that CF space can accommodate the cryostats.
- Fermilab includes the LBNF/DUNE Project in the Monthly POG meetings to discuss status, issues, and actions.

## Procurement

- A new LBNF/DUNE Procurement Manager presented the contracting strategy that spells out the roles of contract participants (CM/GC, SDSTA). The LBNF/DUNE Procurement Plan was recently updated.
- Formal Acquisition Plans are needed for acquisitions greater than \$10M. The Acquisition Plan for the CM/GC (essentially a CM at risk) was approved in early October 2015. The DOE-HQ Procurement Business Review has been waived.

## Critical Decision Strategy

- Key CD-3A documents such as the Preliminary Project Execution Plan, Hazards Analysis Report, EVM Implementation Plan, QA Plan, EA and FONSI are available but some need to be finalized and signed.
- The ESAAB for CD-3A is expected in the February 2016 timeframe.
- SDSTA, a key participant for the LBNF work, is funded by Fermilab and the State Of South Dakota while State funds are expended by the end of CY 2015. LBNF Project will fund the work needed by LBNF beyond that period.
- There has been some evolution in the Critical Decision Strategy since the CD-1R to determine what activities were critical (couldn't/shouldn't be delayed, reduced conflicts with other work) to be completed prior to CD-2.

## Comments

### Project Organization and Staffing

- Considerable progress continues to be made on the LBNF/DUNE Project.
- The management structure is in place and key positions have been filled with highly qualified personnel.

## Closeout Presentation

- While the inclusion of international participation introduces complexity to the management of the LBNF/DUNE Project a credible organizational, oversight, and project management structure was presented for executing the US-hosted world-class long-baseline neutrino program. Governance structures are in place and operating.
- Many of the presenters were certified PMPs or certified in their appropriate roles at the Project which added to their credibility.
- The level of coordination/teamwork between SURF and Fermilab has been very positive and is tightly integrated.

## Project Management Systems

- Consistent with CD-3A, the suite of required LBNF/DUNE Project Management Systems are in place and being used.
- The project has established a well-developed risk management process which directly supports the contingency analysis. The risk analysis includes impacts of schedule delays and the level of contingency needed, Never-the-less, the project is encouraged to support their ongoing value engineering and other cost saving approaches.
- Project-wide transition including potential maintenance issues were discussed but a project-wide strategy may not exist. (post CD-3A)
- The QA Program did not demonstrate that they were at a level consistent with other management systems. Some continued analysis is also needed to support the QA requirements for future component procurements (post CD-3A).

## Procurement

- The CM/GC award schedule is tight (award is late April 2016) and needs to be tracked closely.
- Continue to work closely with DOE to minimize schedule impacts for the award of large procurements requiring DOE approval.
- As the procurement process proceeds, begin to develop a list of critical (i.e. long lead, necessary for sustained operation) spares that need to be purchased. Determine which items need to be included in the cost estimate. (post CD-3A)

## Critical Decision Strategy

- The presentations were well organized and professionally presented. The inclusion of the background slide of the presenters was very helpful and supported the credibility of the presenters.

- A compelling argument for an early CD-3A is a message to the international community that the US is serious about hosting the LBNF/DUNE Project. This is important as it will take quite a while to get formal international agreements in place.
- The specific discussion on what was included in the CD-3A was found in several presentations. It would be valuable to prepare a single presentation that summarized the CD-3A scope, cost, and schedule.
- The present approach to developing the underground chambers; two chambers early with a single phase detector in one allows early science work to proceed while the remaining 2 chambers are constructed. This approach also allows additional work to select 2, 3, and 4<sup>th</sup> LArTPC detector modules to proceed possibly resulting in more sophisticated detectors. Care must be taken in the selection of detectors as there are size and other interface constraints.
- As the future DOE OHEP budgets are undefined at this point, it would be valuable to develop a plan to respond to possible reduced budgets for FY-17 listing prioritized activities that could be performed at different budget levels.

## Recommendations

11. Prior to CD-3A, LBNF/DUNE needs to get CD-3A documents finalized and signed.
12. Prior to CD-3A, LBNF/DUNE needs to identify specific lists of prioritized activities to respond to possible budget limitations,
13. Prior to CD-3A, LBNF/DUNE needs to clarify the message on what is being approved as part of CD-3A.
14. Prior to CD-3A include a presentation on QA in the HQ-IPR Review.
15. Proceed to CD-3A

Closeout Presentation

## **4.0 Appendices**

- A. Charge
- B. Agenda
- C. Review Committee Contact List and Writing Assignments

Appendix A  
**Charge**

Director's CD-3a Review of LBNF/DUNE  
October 27-29, 2015

29-Sep-2015

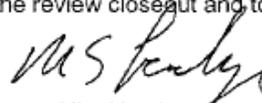
**To:** Mike Lindgren, Chief Project Officer  
**From:** Nigel Lockyer, Director  
**Subject:** Director's Review of LBNF/DUNE

I request that your Office organize and conduct a Director's Review of the Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment (LBNF/DUNE) project from October 27-29, 2015 at the Sanford Underground Research Facility (SURF) in Lead, South Dakota. This Director's Review will be in preparation for the DOE Office of Science CD-3A review scheduled for December 2-4, 2015.

The focus of this review is design, cost, schedule, management, ES&H, and other identified concerns relating to scope proposed as part of the CD-3A, which includes initial conventional facilities construction activities at SURF, the project's far site. Designs for these conventional facilities are at a preliminary level. The review committee should respond to the following questions:

1. Has the scope of work proposed as part of CD-3A been clearly defined? Are the designs related to the initial construction activities technically sound and sufficiently mature, are technical risks understood, and are requirements and interfaces with the cryostats, cryogenic systems, detectors, and logistic plans on track to support the planned start of initial construction activities? Is there an adequate plan to complete the final design in time to start these activities?
2. Is there a comprehensive plan to execute the initial construction activities?
3. Is the project being effectively managed, and is it properly organized and staffed to successfully execute the project plan as it relates to the initial construction activities?
4. Are the cost and schedule estimates for the initial construction activities credible, with adequate contingencies? Does the project have a plan to measure and report status of initial construction activities following a CD-3A decision? Are cost and schedule risks identified and managed appropriately?
5. Are the environmental, safety, and health aspects related to the initial construction activities being addressed appropriately?
6. Has the project responded appropriately to recommendations from past reviews, specifically in relation to the initial construction activities?
7. Is the project ready to proceed to the DOE CD-3A review?

The committee is asked to present a draft of their report at the review closeout and to issue the final report within one week of the review's conclusion.



Nigel Lockyer  
Director  
Fermi National Accelerator Laboratory

cc:  
G. Bock  
E. Gottschalk  
E. James  
J. Lykken

Appendix B

**Agenda**

Director's CD-3a Review of LBNF/DUNE  
October 27-29, 2015

**Tuesday, October 27**

**EXECUTIVE SESSION – E&O Conference Room**

8:00 – 9:00 AM 60 Executive Session

**PLENARY SESSION – E&O Conference Room**

9:00 – 9:10	AM	10	Welcome and the Fermilab Context	Nigel Lockyer
9:10 – 9:40	AM	30	LBNF/DUNE Projects Overview	Chris Mossey
9:40 – 10:10	AM	30	DUNE	Mark Thomson
10:10 - 10:35	AM	25	Far Site Facilities, Interfaces & Logistics	Mike Headley

**10:35 – 10:50 AM 15 BREAK – E&O Building**

10:50 – 11:15	AM	25	FSCF Design, Cost & Schedule	Josh Willhite
11:15 – 11:35	AM	20	ES&H	Mike Andrews
11:35 – 11:55	AM	20	FD Requirements on FSCF	Jim Stewart

**11:55 – 12:55 PM 60 LUNCH – E&O Building**

12:55 – 1:10	PM	15	Cryo System Requirements on FSCF	David Montanari
1:10 – 1:25	PM	20	Cryostat Requirements on FSCF	Marzio Nessi
1:25 – 1:50	PM	25	Final Design and Construction Plan	Tracy Lundin

**1:50 – 2:00 PM BREAK – Move to Parallel Sessions**

**PARALLEL BREAKOUT SESSIONS**

2:00 – 5:10 PM 190

- B01: Excavation – 1<sup>st</sup> Floor Vault (Admin Bldg)
- B02: Building & Site Infrastructure – 2<sup>nd</sup> Floor Vault (Admin Bldg)
- B03: ES&H – Exec Conference Room (Admin Bldg)
- B04: Management – E&O Conference Room
- B05: Cost & Schedule – E&O Classroom

5:10 – 5:55	PM	45	Subcommittee Executive Sessions – in Breakout Rooms
5:55 – 6:55	PM	60	Executive Session – E&O Conference Room
6:55	PM		Adjourn

**Wednesday, October 28**

**PARALLEL BREAKOUT SESSIONS – continued in same rooms**

8:00 – 9:30 AM 90

**9:30 – 10:30 AM 60 BREAK**

**PARALLEL BREAKOUT SESSIONS – continued in same rooms**

10:30 – 11:30 AM 60 Answers to Questions

11:30 – 1:30 PM 120 Subcommittee Executive Session (and Working Lunch)

1:30 – 3:30 PM 120 Full Committee Executive Session/Report Writing – E&O Conference Room

3:30 PM Adjourn

**Thursday, October 29**

9:00 – 10:00 AM 60 Executive Committee Report Writing – E&O Conference Room

10:00 – 11:00 AM 60 Full Committee Executive Session Dry Run

11:00 – 12:00 PM 60 Summary and Closeout – E&O Conference Room

12:00 PM Adjourn

Appendix C  
**Review Committee Contact List and Writing Assignments**

Director's CD-3a Review of LBNF/DUNE

October 27-29, 2015

**Chairperson**

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\*Lead

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