LBNE Conventional Facilities Design Updates Since CD-1

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Near Site Conventional Facilities

The conventional facilities (CF) for the LBNE beamline, is fully described in the Conceptual Design Report prepared for the October 2012 DOE CD-1 review [1]. Design work has continued to advance since then, including a number of design studies aimed at improving the performance of the neutrino beam flux spectrum and lowering the cost. These include:

- The absorber design has been advanced allowing for the absorber hall to be reconfigured which is in process. This is expected to lower the cost of the absorber hall while maintaining full functionality.
- Decay pipe options are under study to reduce cost or improve the beam intensity and spectrum, which could result in changes to the conventional facilities design. These include:
    - Filling the decay pipe with helium vs. air
    - Cooling the decay pipe with air vs. water
    - Varying the decay pipe length from 175 m to 250 m (CD-1 design is 200 m) and the diameter from 2 m to 6 m (CD-1 design is 4 m)

The current scope of CF for the beamline is shown in plan view and in cross section in Figures 1 and 2.

Progress has also been made since the October 2012 DOE CD-1 review to prepare for the start of preliminary design. Progress includes the following advances.

- An architect/engineer (A/E) firm has been selected and is under contract to complete geotechnical investigations, preliminary and final designs. This firm will also provide services during construction.
- A geotechnical investigation has been completed for the NS and early results of the investigation are available [2]. Laboratory testing of soil and rock samples, processing and analysis of field and laboratory test data, will continue throughout summer and fall of 2013.

The conventional facilities design for the near neutrino detector (NND) is fully described in the Conceptual Design Report prepared for the March 2012 Director's Review [3]. Although a near detector is not part of the CD-1 reference design, the goal still is to include it in the first phase of LBNE through international partnership, and the March 2012 NND reference design has been advanced to accommodate the proposed near detector by requiring that the width of the hall must be increased by 5 ft. The current design of the near detector underground and surface facilities are shown in Figure 3.

Figure 1: Plan view of the LBNE beamline conventional facilities.

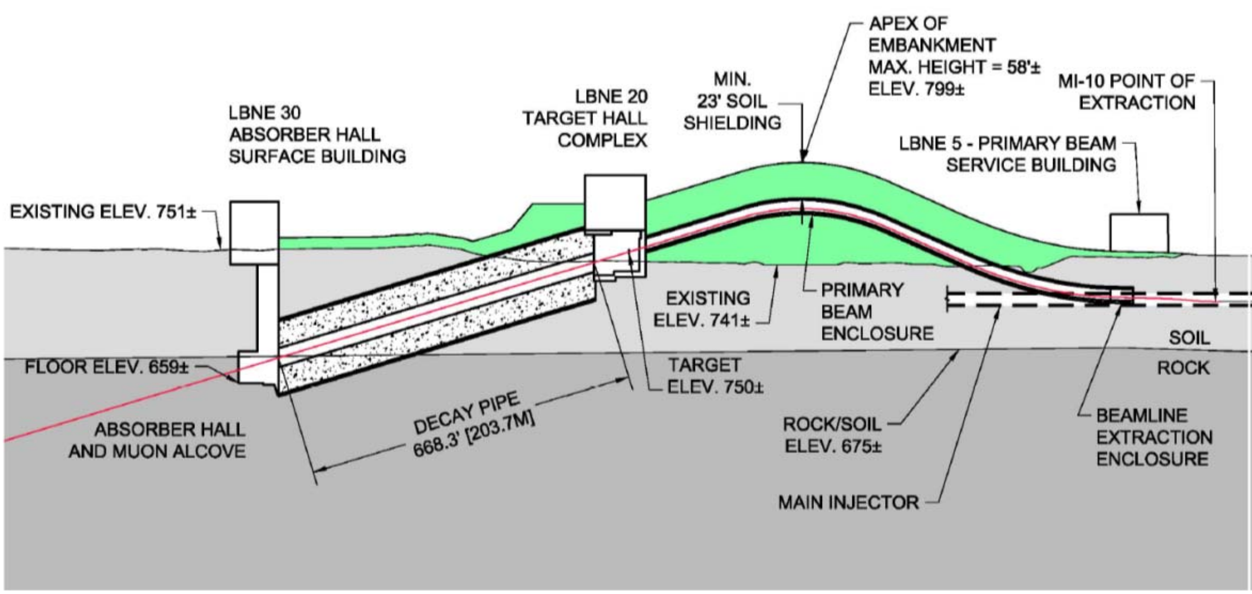


Figure 2: Current Near Site Conventional Facilities Cross Section. Note No Near Neutrino Detector.

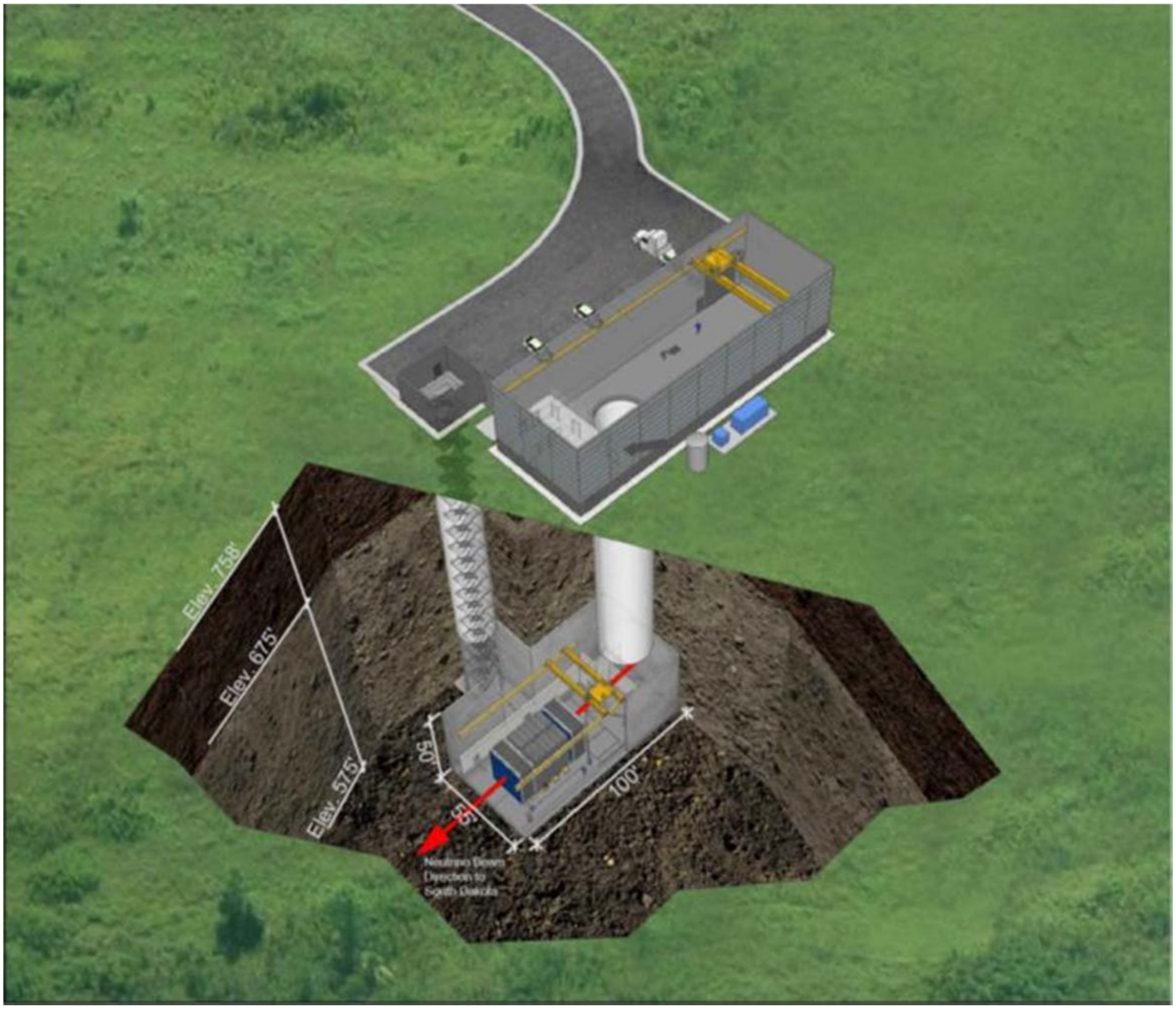


Figure 3: CF Design for the Near Neutrino Detector

Far Site Conventional Facilities

At the time of the March 2012 Directors Readiness Review the Far Site (FS) CF scope was based on the conceptual design of a 34kT detector located at the 4850L of Sanford Laboratory (Sanford). The two detector modules of the 34kTdetector were placed end-to-end. The Oro Hondo shaft required refurbishment from the surface to the 3650L and a new ventilation borehole was required to be excavated between the 3650L and 4850L. Argon was conveyed from the surface as a liquid therefore pressure reducing stations were required in the Oro Hondo shaft at 800-ft intervals. The March 2012 design also included LBNE contributing to the cost of rehabilitating the Ross Shaft. The CF scope is described in greater detail in the Conceptual Design Report prepared for the March 2012 review [3].

At the time that the CDR for the March 2012 Director's Review was being completed, a modification to the cryogenics system was in process of being developed, which was completed during the reconfiguration process later in the spring of 2012 [4]. This change resulted in a significant simplification of the system for delivering the liquid to the underground detector and modification to the refrigeration system design [5]. These changes, in turn, allow significant simplification of and consequent cost reduction to the conventional facilities. Contrary to the March 2012 design, in the new design, the argon is delivered to depth as a gas, which allows the pressure reducing stations to be deleted. In addition, the argon delivery in the new design is via a dedicated compartment in the Ross shaft, resulting in omission of the ventilation borehole between the 3650L and 4850L and omission of renovation of the Oro Hondo shaft. This configuration has been reviewed with the LBNE ES&H Manager. The compressors for the refrigeration system are moved to the surface, which reduces the amount of power delivered to detector hall and reduces amount of heat rejected to air underground. Redundant systems for cyber and electrical power infrastructure were also omitted – the small amount of power for these systems will instead be connected to uninterruptable power supplies.

The design presented for CD-1 is for a detector at the surface, but the goal is to start with an underground detector, enabled by additional international and domestic partnerships. The design of the underground facilities for a 34kt detector is as shown in Figure 4. Contracting for the geotechnical investigation for a cavern to house a 34 kt detector at the 4850L has been initiated. The geotechnical investigation for the 34kt detector would explore the same rock mass as would be explored for smaller detectors because all would be located on the same longitudinal axis. If a geotechnical investigation was to be conducted for a larger, up to 70kt detector, the investigation would explore the rock mass adjacent to the 34kt detector due to detector hall length constraints as shown in the conceptual layout of geotechnical investigations for 34kt and 70kt detectors in Figure 5. Since the procurement and equipment acquisition process for the geotechnical investigation takes some time, it is believed that as much as 6 to 9 months could elapse before needing to commit to a scope.

Progress has also been made since the October 2012 DOE CD-1 Review to prepare for the start of preliminary design. Progress includes the following advances.

- An architect/engineer (A/E) firm has been selected and is under contract to complete geotechnical investigations, preliminary and final designs. This firm will also provide services during construction.
- A geotechnical investigation for a 34kt detector at the 4850L is being developed for the FS. Initial tasks have been authorized and drillers are being procured to conduct the investigation.

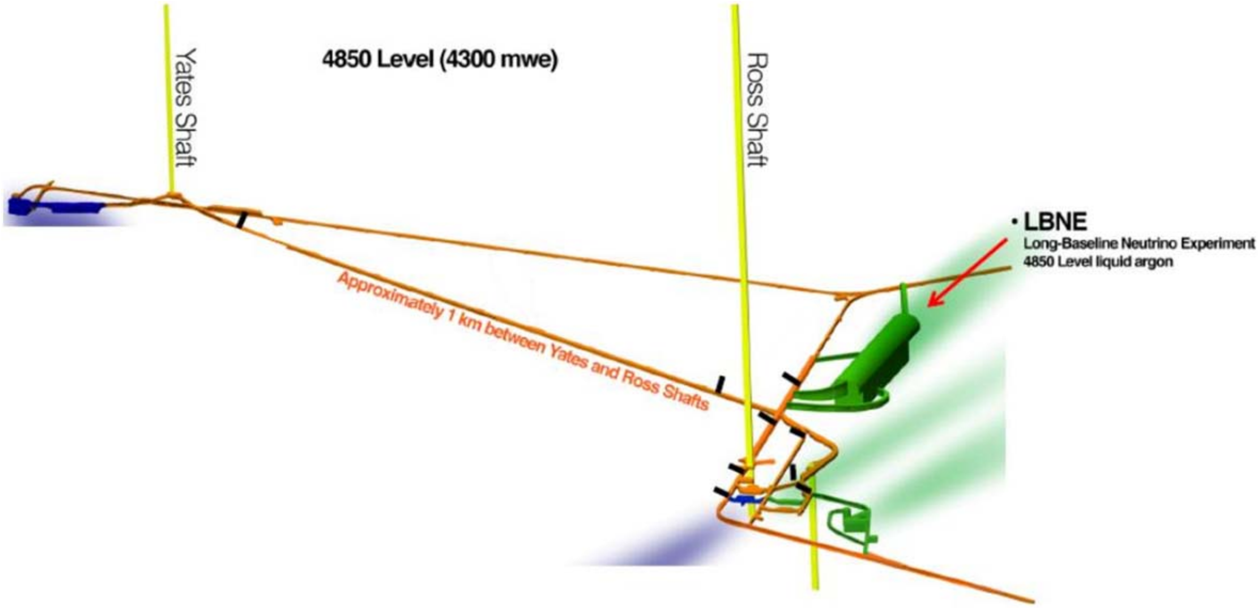
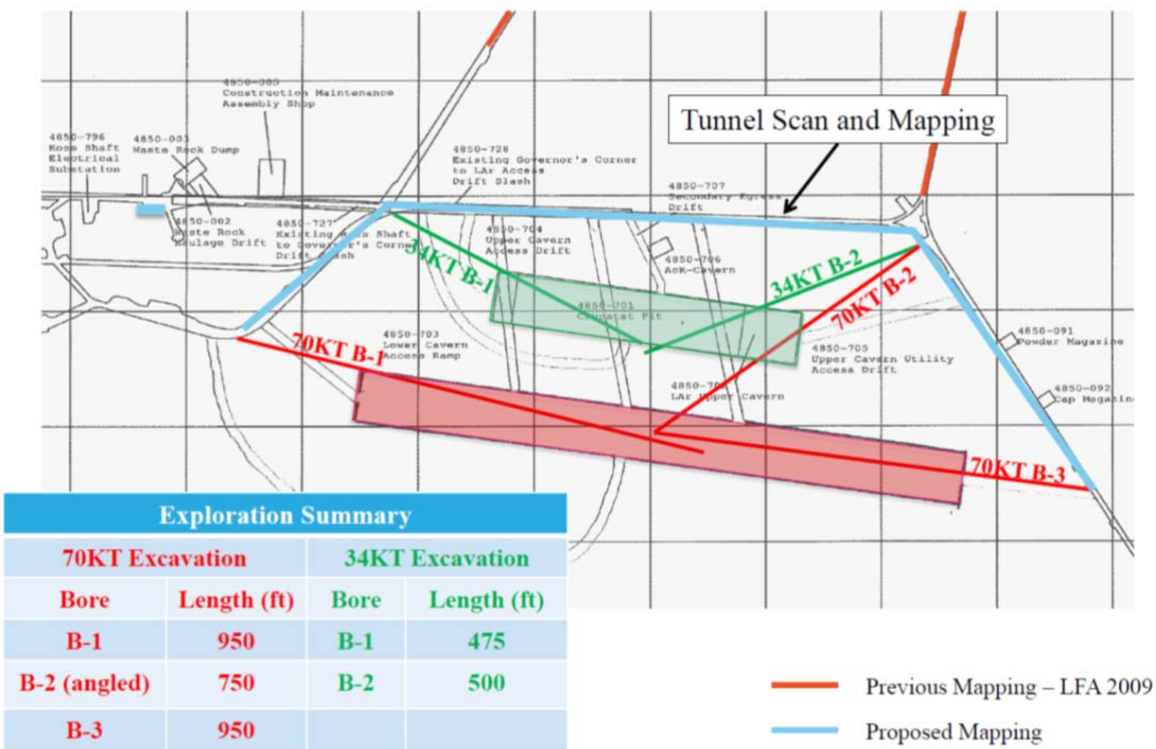


Figure 4: CF Layout of a 34kt Detector Hall.



Exploration Summary			
70KT Excavation		34KT Excavation	
Bore	Length (ft)	Bore	Length (ft)
B-1	950	B-1	475
B-2 (angled)	750	B-2	500
B-3	950		

Figure 5: Conceptual Layouts of Geotechnical Investigations for 34kt and 70kt Detectors at the 4850L

References

[1] LBNE Conceptual Design Report, October 2012, http://lbne2-docdb.fnal.gov/cgi-bin/ShowDocument?docid=7525.

[2] T. Lundin, Early Results from the LBNE Near Site Geotechnical Investigation, July 2013, LBNE-doc-7491, http://lbne2-docdb.fnal.gov:8080/cgi-bin/RetrieveFile?docid=7491;filename=NS%20Beamline%20Presentation%20-%20Early%20Results%20from%20the%20NS%20geotechnical%20investigation%20July%202013.pdf.

[3] LBNE Conceptual Design Report, March 2012, http://lbne2-docdb.fnal.gov/cgi-bin/ShowDocument?docid=7527.

[4] LBNE Reconfiguration Engineering/Cost Working Group Report, 7 August 2012, http://www.fnal.gov/directorate/lbne_reconfiguration/index.shtml.

[5] B. Norris, R. Rucinski, M. Adamowski, LBNE Conceptual Design Document of the Cryogenic System that serves the LAr-FD 34 kton detector at 4850', July 2013, LBNE-doc-7523, http://lbne2-docdb.fnal.gov/cgi-bin/ShowDocument?docid=7523.