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To: Members of the LBNE Re-Configuration Steering Committee

I am confident that my colleagues in the LBNE Collaboration join with me in thanking you, the members of the Costing Committee, the Project Office staff and appropriate members of the LBNE Collaboration for extensive efforts in the LBNE Re-Configuration process. Much effective and innovative work has been accomplished under extreme time pressure in re-designing the LBNE Experiment.

Despite this substantial effort, I am writing to express significant reservations about the so-called "preferred option," namely a 10 kT Liquid Argon (LAr) Detector on the surface at Homestake with a new beam but no Near Detector (ND).

My particular concerns are in three areas:

• *Locating the LBNE Far Detector on the surface in a beam with no Near Detector (ND) likely compromises the ability of the experiment to do significant physics.* The preference for a surface location with no ND sacrifices Phase 1 physics for Phase 2 potential. The surface location eliminates all non-beam Phase 1 physics. Even for beam physics, the enormous cosmic ray backgrounds and the long LAr signal integration time will at best complicate the oscillation analysis and at worst increase systematic uncertainties to the point where the data is largely uninteresting. A new beam with no ND will also increase systematic uncertainties. Talks at Neutrino 2012 Conference were instructive in this regard. Only experiments in the NuMI and T2K beams, which have NDs, reported quantitative results. Experiments in the ND-less CERN-Gran Sasso beam only displayed pictures of interesting, but individual, events. In contrast to a surface detector in a new, ND-less Homestake beam, the well-understood NuMI beam offers a deep underground location at Soudan, a choice of several NDs and a coincident off-axis NOvA Far Detector. The opportunities for minimizing NuMI beam systematic uncertainties abound.

In my opinion, while Phase 2 potential is a factor, it should not dominate the decision. My understanding is that Fermilab plans to follow Phase 1 LBNE with Phase 1 Project X followed by Phase 2 LBNE. At best, Phase 2 LBNE results thus occur in the ~2030 timeframe. Neutrino 2012 was a showcase for recent progress in neutrino physics outside the United States, particularly in Asia. It is not clear that whatever LBNE Phase 2 might measure around 2030 will be relevant or interesting at that time.

• *Mass hierarchy is likely an important topic for the next decade, not for the 2020's.* The Steering Committee's focus on a long baseline to achieve optimal sensitivity to mass hierarchy likely misreads the competitive world neutrino experiment context. Talks at Neutrino 2012 indicated that a number of experiments (for example, NOvA, INO, Pingu, Daya Bay II, RENO II and Hyper K atmospheric neutrino) will have the ability to determine mass hierarchy. Some of these projects will likely yield data in the next ~10 years. When LBNE reports data around 2025, the mass hierarchy may well be known and the key question in neutrino physics will be the value of delta CP. With a known mass hierarchy, baseline length becomes less important and the

larger masses of the NuMI beam detector options provide a more competitive capability for delta CP measurement.

• *The LBNE Re-Configuration process has chosen to compare non-optimal configurations for the NuMI beam detector options.* Clearly, a more expensive detector likely produces better results. Thus, LBNE options should be compared for equal cost projects. That has not been done. Appendix E lists the following costs: Homestake Surface 10 kT $789 M, Ash River Surface 30 kT $684 M, Soudan Underground 15 kT $675 M. The marginal cost for all options is ~$15 M per kT. Thus, if the LBNE cost cap has the Homestake value of $789 M, the comparable Ash River configuration is 37 kT and the Soudan configuration is 23 kT. If the $44 M allocated in Appendix E for NuMI Beam maintenance were moved off-project, these masses become 40 kT at Ash River and 26 kT underground at Soudan. The table below summarizes the appropriate comparisons for several cost caps. Although not an official option, I have been told an extra $150 M would be required to move the 10 kT Homestake Detector underground. The last column shows detector sizes for Soudan and Ash River, if such additional funds were available.

Table 1. Masses for LBNE Detector options for four possible cost caps. Masses in parentheses are possible if NuMI Beam maintenance were moved off-project.

Cost Cap	$609 M	$684 M	$789 M	$ 940 M
Homestake (no ND)	0 kT	3 kT surface	10 kT surface	10 kT underground
Soudan (existing NDs)	10 (13) kT underground	15 (18) kT underground	23 (26) kT underground	33 (36) kT underground
Ash River (existing NDs)	25 (28) kT surface	30 (33) kT surface	37 (40) kT surface	47 (50) kT surface

The physics graphs and discussion in your report should be re-studied with a comparison of physics capabilities for equal cost options.

If done correctly, LBNE will be an important experiment for many years. We have an obligation to both the future of neutrino physics and ourselves to make an optimal scenario choice.

Best regards,

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