NuSAG Suggestions/Questions for the Long-baseline Working Group
June 27, 2006

1. Noting the existence of discrepant sensitivity calculations even for the same detector, it would be most useful to have any such calculations performed with consistent assumptions and methodologies.

a) Fixed, common, stated values of the mixing parameters not explicitly under study.

b) Common, stated and plotted, cross sections vs. E_ν. Common, stated nuclear models.

c) Stated assumptions about energy resolution, background rejection.

d) If appropriate, common total p.o.t. If sensible, use a common proton energy and anti-nu running fraction. If not, state the optima chosen.

e) What methods are used to extract the oscillation parameters from the final event sample (counting? fitting the spectrum?)

f) Standardized, stated method for defining sensitivity.

2. Give sufficient detail in tables and/or plots to allow a reader to understand how the numbers for rates or sensitivities are obtained. We would expect that many of the results would be easily accessible to a physicist with a calculator. Here are some useful inputs that come to mind (meant as a guide only):

a) Specify the signal channel(s). (We will assume here that it is quasi-elastic.)

b) What simple cuts (energy, etc.), if any, do you apply?

c) The number of INTRINSIC nu_e events reconstructed as signal, and their reconstructed energy spectrum (in reconstructed Enu(QE) or Evis, or Ee, or whatever you'll use.)

d) What is the purity of the QE selection, that is, for true nu_e events, what fraction of those selected as QE are actually QE (as a function of E)?

e) The total number of NC pi0 events, and spectra vs. true Enu and pi0 momentum.

f) The number of NC pi0 events reconstructed as signal, and their reconstructed energy spectrum. What is the true Enu spectrum for the NC pi0 events reconstructed as signal?

g) The NC pi0 rejection assumed, as a function of... (pi0 momentum?,…)

h) The assumed systematic errors on each of the backgrounds, with any relevant dependence on energy. How are these estimates arrived at?

i) The assumed signal efficiency as a function of energy. How are these estimates arrived at?

j) Provide tables and spectra (vs. true and reconstructed E_ν) giving the initial population of events, before cuts, by process (QE, CCpi+, DIS,...), how these numbers diminish as the cuts are applied, and in the final sample at the various oscillation parameter test points. An entry at the 3-σ sensitivity limit would be informative. Scatterplots of reconstructed vs. true E_ν for individual signal and background channels may be informative.

3. Specify the level of simulation that goes into your currently-generated sensitivity estimates. For example:

a) How is energy resolution treated? Give a plot of the assumed energy resolution (electron energy and neutrino energy) vs. energy.

b) How is the selection of QE events treated?

c) How is the rejection of pi0's modeled?

4. What near detector location/size/technology/performance/cost is assumed/needed to achieve the assumed systematic errors?

5. If possible, for comparison purposes, use the same methodologies to make parallel sensitivity estimates for NoVA (single detector) and T2K. What sensitivity for NoVA do you calculate for the same number of p.o.t. assumed in question 1?

6. All sensitivity calculations for off-axis configurations must include events from neutrinos in the high-energy peak from kaon decay.

7. What detector technologies are still worth pursuing for a 2nd off-axis detector -- Liquid scintillator? Water Cerenkov? Liquid Argon? Other?

8. There were several references to the possibility of a detector at ~250 km in the NuMI beam. Is this being pursued by the Working Group? What are the general properties of this approach?

9. Provide cost and schedule estimates for the same fiducial mass and PMT coverage/channel count used for sensitivity estimates. (We realize that fiducial/total mass ratios may be hard to estimate, but the assumptions should be stated.)

10. For the modular water Cerenkov approach, are you defining 3 modules as your baseline detector?

11. For the water Cerenkov counters, we will be eager to hear of progress in algorithms for rejecting pi0's (and the testing of them). What is the increase in pi0 rejection over that achieved by Super-K (as a function of pi0 energy) assumed in your current calculations? What have you reached with your own simulations/algorithms? Describe briefly the algorithmic improvements. Does this rejection depend more on total photocathode coverage, or on granularity?

12. Though the worldwide community of proponents of large water Cerenkov detectors seems to cooperate in simulations, algorithms, etc., we do not see evidence that there is any global planning (site-independent design studies or physics programs, etc.) underway for such a detector. Please comment.

For Liquid Argon:

13. NuSAG recommends that the Liquid Argon group reweight its emphasis from sensitivity/reconstruction/pattern recognition to hardware issues and cost estimates. We realize that a full switch cannot occur if the LAr group is a big part of the more generic off-axis calculations in the Working Group, but, for example, LAr-specific reconstruction and particle ID algorithms seem less pressing than technical feasibility.

14. What has actually been measured on purity of the Ar in a tank made with industrial technology? If not yet tried, when will the first tests be?

15. When do you expect to have tried 3-m drifts and long wires in the US? What effect will the capacitance of very long wires have on electronic noise?

16. What are the R&D milestones, with an estimated schedule, that would lead to a first realistic cost estimate for a detector of the 2nd-off-axis or wide-band class?