Comments for Review of NuMI Primary Beamline
System Design and Installation

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1. Overall Remarks: There appears to be two major areas of the project where significant effort needs to be spent in the near future:

- Significant design and planning still needs to be done on the support and installation aspects of the various beamline sections (see detailed comments below).

- An integrated installation plan/schedule for each section of the beamline should be developed soon which includes the estimated time required for installation, manpower needs, dependency on Main Injector shutdown, etc. This information is important in determining if some work can be done during short shutdowns or if a very long shutdown will be required (and if so, when and of what duration).

2. Itemized suggestions, questions and concerns: The following comments are organized
by section of the beamline:

(1) Numi Stub Region

- Hoist Capacity - The use of 7.5-ton capacity hoists seems marginal. The B-2's weigh up to 26,000 lb., which is 13,000 lb. per hoist. This seems to be too close to the capacity of the hoist, especially with the unusual rigging/loading (steep angles) that is required in this area. From past experience, when doing unusual rigging maneuvers, it is better to design in extra capacity for the unexpected (lifting fixtures, etc).

- Manual Hoists - I would also question the use of manual hoists to lift and transport a 26,000 lb. B-2 magnet. The force required to lift and move this magnet may be unattainable. The safety of this work should also be considered.

- Horizontal Translation - It wasn't clear from the presentation how the magnets will be translated horizontally from the hoist to the support stands. This needs to be thought about. If the magnets are brought in inclined (to match the beamline slope), translating them becomes even more complicated. Anytime you are moving large magnets, even small distances, is not a simple task.

• Hoist Alternative - Another possibility may be to transport the magnets on custom built dollies onto a “bridge” at the next drop-off level. Then using hydraulics or a hoist, crib them down to the lower level. The same procedure could be used to mount them on their stands. Although this is a tedious procedure, it has been used extensively at the Lab for magnets in special locations. A rough time estimate is that it would take 1-2 days to install each magnet with this method (this may not be unreasonable because of the small number of magnets in this beamline).

• Support Stands – The design of the support stands (adjusters) for this beamline is not a trivial task. The Main Injector-type supports are not suitable (as designed) for this beamline. The incline of these magnets produces a fairly significant side load (≈ 1000 lb.) at the interface between the magnet (ball foot) and the stand. The Main Injector stands are not designed for any type of side-load. Some of the possible problems this side load may cause are inadequate capture of the spherical cup in the ACME stud, uneven loading on the thrust bearing, etc. These problems could result in parts binding up, being unstable, or even failing. Because of the incline of these magnets, the Main Injector stands can not be blindly used for these magnets.

(2) Pre-Target Tunnel

• Support Stands – The same issues apply to this beamline regarding the stands as for the Numi Stub region (see comments above). The use of non-corrosive materials was discussed because of the damp environment these stands will be used in. The Main Injector stands use bronze ACME nuts and spherical cups. The majority of the other components are carbon steel with a zinc electroplating finish applied to prevent corrosion. We did find that Zinc plating the ACME stud caused friction problems between the stud and nut under heavy load. As a result, this coating was removed from the design.

• Magnet Handling – The issue of transporting magnets up a sloped surface and installing them is not trivial. It is difficult to design a method to move extremely heavy devices up hill, then translate them horizontally and lift them while providing a safe work environment for the riggers. One option may be to use some sort of chain driven dolly that has a ratcheting mechanism to prevent it from rolling back if something should fail. To translate the magnets horizontally to their stand locations, a portable hydraulic device could be designed. A similar device was used to lift the Main Injector dipole magnets off of their transport dollies located in the tunnel aisle, transfer them over their stands, and then lower them onto the stands. This device cost approximately $25K and was used to install all of the 344 MI dipoles. The design of a similar device for the Pretarget Tunnel provides some additional engineering challenges because of the sloped floor and magnets.