Comments from the Hadron Absorber Review
June 12, 2001
Chaired by J. Misek

Responses by Bruce Baller
May 6, 2004

Radiation Analysis
Presenter: N. Grossman

1. The MARS model needs to be run with the current design geometry. This geometry needs to address the issue of cracks and must be thought out carefully with consideration given to block tolerances, block lifting voids, and areas such as the roller track, containment pan, and module base.

Done

2. Resources should be provided to address the outstanding issues as stated in N. Grossman's report. This work needs to be completed in a timely manner and any changes generated incorporated as early as possible into the absorber design. RAW tritium production calculations need to be made for factoring into operational considerations. It is not clear from the limited time allotted for review that all the pertinent dose rate calculations for the labyrinth and penetrations take into account the current design. It is also not clear whether there has been concurrence by the ES&H Section with regards to groundwater protection and the 10' tunnel flow. With respect to airborne activation, it should be stated on how many air exchanges per hour can be achieved.

Done

3. The "one hour" accident condition needs to be reevaluated in the light of the current target and baffle arrangement as well as from the operational likelihood potential. The presented accident condition appears to be extremely conservative. This directly impacts many design issues in the absorber and other portions of the overall NUMI project. An accident scenario should be developed that is reasonable and which can be justified.

Done

Thermal Analyses
Presenter: B. Wands

1. Both transient and steady-state thermal analyses were performed on the Hadron Absorber. The results appear consistent (within ~25%) and credible. The maximum absorber temperature (#4 module receives the maximum energy

deposition) is 368 degrees C ~steady state after 1800 pulses. The thermal analyses (B. Wands) assume a 50 gpm flow rate through each water circuit (2 circuits/module), which is not consistent with the RAW skid capability (70-80 gpm). This inconsistency needs to be resolved. The mechanical stress due to the significant energy absorbed over the 10 micro second beam pulse was also investigated, with the resulting stresses determined to be acceptable.

The RAW skid has a flow rate of 500 gpm into 16 cooling circuits = 30 gpm/circuit. The decreased flow rate (compared to 50 gpm) increases the absorber temperature by only 3 degrees C (See B. Wands thermal analysis) with negligible effect on the stresses.

2. The possibility of cooling a module with conduction, convection, or radiation to an adjacent module or to the base plate in the event of a total loss of water cooling to a given module should be considered. The "one hour" accident heating model was used which, as stated previously, is not based upon any plausible scenario. With a revised accident scenario, the possibility of adequate cooling during the accident may be handled by air flow alone. Remote valving of each module circuit at the manifolds is endorsed.

The 1 hour accident scenario is no longer valid since the RAW system status is sensed by the NuMI beam permit system.

<u>Core Design & Repair/Replacement</u>
<u>Presenter: E. Villegas</u>

1. With the high radiation levels present in the absorber, the current design does not allow for module replacement. A specific procedure for replacing a module was not presented. ALARA principles, which would be part of this module replacement, were therefore not included in this discussion. Secondary containment in the absorber was only briefly discussed. No discussion explained what happens with the contained fluid or how one might retrieve the fluid for proper radiological disposal. Long term reliability was not defined other than stating that it would be a minimum 10 years.

The small absorber cavern size and lack of a crane precludes replacement of a core module. The design features were changed to improve reliability (e.g. eliminating potential leak points, redundant cooling circuits) for the expected 10-year lifetime. A secondary containment pan prevents loss of cooling water into the sump water in the event of a catastrophic failure.

2. The critical welding of the module cooling tubes needs to be modeled for quality control. The space constraint puts heavy responsibility on the individual welder's skills. Automatic welding may be a possible option for the tight space welds. The QC requirements of the welds need to be defined, be it x-ray, ultrasonic, die penetrant, hydrostatic testing, etc. Also to avoid stressing of welds from relative displacements (modules, manifolds, supports), thermal effects, pump and

manifold vibrations, module water lines must be supported in a compliant way with some expansion-displacement capability at the manifold connections (e.g., braid covered metal bellows hose connections or expansion loops).

Done.

3. On a more global note, the reduced scope of the project resulted in changes to the Absorber Cavern geometry that will have an impact on the design and operation of the experimental apparatus. These impacts need to be fully understood and incorporated into the equipment design. For instance, the loss of the overhead crane and the radiation worker exposure regulations have, in effect, combined to remove the possibility of module replacement during the planned life of the experiment. A less complex design of the core modules, cooling connections, and support systems may present an opportunity for cost savings and an increase in reliability. Examples might include elimination of the Tube Guides, elimination of the Core Assembly/Removal Stand, higher reliability for cooling water connections due to better access for the welder, less costly quality assurance checks for finished cooling water welds, etc.

Accepted.

<u>Installation Plan</u>
<u>Presenter: B. Baller</u>

1. The installation plan relies on specialized equipment modified to deal with the absorber's unique layout within the enclosure. Given this need, availability on renting and modifying this equipment at a specific time may be problematical or costly. Investigation into rental with the option to buy may be a possibility. The extent of modification may make purchasing of the units a more cost effective option. As presented, the twin lift used to move the shielding blocks within the enclosure is diesel powered. The cost of additional enclosure ventilation required by the use of diesel power was not presented. With this in mind, the availability of battery powered equipment should be investigated. If owned by Fermilab, the twin lift might be able to be converted to battery, electric or hydraulic power.

We have purchased an electric fork truck.

Cost Estimate
Presenter: A. Wehmann

1. Careful coordination of rigging crews will be necessary. The multiple 3 man crew teams overall output will be driven by the slowest crew. This makes for the possibility of significant dead time for this rigging activity. The possibility of cost creep with such a large installation window will make accurate cost estimation of rigging work difficult.

The estimate has been refined and reviewed several times by engineers and task managers.

2. The engineering time estimate for the absorber does not include oversight for the assembly and installation of the various mechanical components. Depending on the extent of changes on the design, the engineering and drafting estimates may need to be increased.

OK