Comments from a Review of Shielding of Target Hall Area
July 27, 2001

Responses by Bruce Baller
May 7, 2004

Radiation protection requirement/calculation update
Presenter: N. Grossman

1. (Reviewer: M. Gerardi) Was there any mention of how water leakage into the target hall area on the floor, that could be activated, is either contained or routed?

There are no significant water leaks in the target hall. Water from minor ceiling drips evaporates.

2. (Reviewer: N. Grossman) It seems NuMI may need re-do the air and prompt rates in the Target Hall based on the present design, or write a document that justifies why it is not necessary. It may be easier to simply get the numbers from already existing MARS runs.

The most current results based on the present design are documented in the Shielding Assessment.

3. (Reviewer: N. Grossman) NuMI needs a MARS run with the baffle just upstream of the target in as presently it is envisioned to look at backsplash and beam and residual dose rates. Perhaps we can have Igor Tropin do this next.

The baffle is inside the target chase and should intercept less than a few percent of the beam. The dose rate due to the baffle is insignificant compared to the target.

4. (Reviewer: N. Grossman) What does NuMI envision the contamination issues to be in changing out a hot component? Will activated rust particles and dust etc. get dispersed in the Target Hall during a change-out? Clearly the possibility of the spread of contamination during change out needs to be minimized and I am not sure that this has been addressed at all. Perhaps it came up in the hot horn handling review.

Radiation Work Procedures will be developed to control contamination during maintenance. These procedures will be reviewed and monitored by AD ES&H to ensure that contamination controls are in place.

5. (Reviewer: N. Grossman) I thought I heard that the chase air-cooling was based on MARS results and a 10% safety factor. Is there a good basis for the 10%? My concern is that perhaps that is not enough of a safety factor.

Air-cooling calculations should be considered rough estimates. The 10% "safety factor" may be too optimistic, however the cost of increasing the cooling capacity is not warranted based on the level of uncertainty in the modeling.

6. (Reviewer: T. Leveling) Consideration of the shielding design for prompt and residual ionizing radiation appears to be comprehensive. The MARS calculations developed to understand residual dose rates in the NUMI target hall appear to work well for times greater than about an hour. Since it is improbable that target vault components can be removed within an hour of beam going off, the calculations should also be sufficient for purposes of this review. A waiting period of at least one hour should be imposed when the target hall be comes operational to preclude personnel access when dose rates are very high and not well understood.

The appropriate cool-down time will be determined after operations begin.

7. (Reviewer: T. Leveling) The shielding calculation process is reasonably well understood and is fairly reliable at predicting actual conditions. However, a comprehensive measurement plan should be developed to check and confirm calculations when target hall operation begins.

This is planned.

8. (Reviewer: T. Leveling) Groundwater calculations and groundwater protection has been considered extensively. The RAW systems associated with the target hall will be a significant source of activated water. It would be more complete to include, at least peripherally, some mention of engineering controls to be used to preclude RAW system water from entering groundwater.

These issues are discussed in the Shielding Assessment.

9. (Reviewer: T. Leveling) The Access portion of Grossman slides, includes the statement "RAW Room may have a locked door." The RAW Room appears in the list of NUMI spaces where beam on access is permitted. This is a little surprising. Even though the NUMI RAW room does not contain a beam dump cooling system, it seems probable that dose rates due to activated horn water would prohibit personnel access. Perhaps this room should be listed under "NO ACCESS" and should have a delay time after beam goes off before personnel access should be permitted. In addition, a remote monitoring system (e.g., chipmunk on MUX) should be used to determine radiation dose rates before permitting personnel access.

RAW room access will be controlled by the RSO.

10. (Reviewer: T. Leveling) The shielding of the RAW room is not addressed in the target hall shielding presentation except for mention of a penetration. If not already done, the RAW room shielding needs to be addressed somewhere.

This is addressed in the Shielding Assessment.

11. (Reviewer: T. Leveling) Comment on crane dose rates: mentioned 10 krad/year to crane bridge. Does this include any electronics, for example radio receiver, controls circuits? Upper limit for solid state components is about 10 krad. While not a concern for structural or electrical systems, electronic stuff begins to break down at this level. If gamma only, electronic stuff may be good for a factor of 10 higher integrated dose.

The crane electronics will be removed during operation.

12. (Reviewer: T. Leveling) Operational aspects of target hall are not presented. It will be a major concern what modules will require removal and replacement and how all that is too be done. Facility design vv. ALARA and personnel exposure control needs to be addressed.

These issues were addressed in a separate review on hot horn handling.

13. (Reviewer: T. Leveling) Personnel radiation exposure resulting from operation of this facility needs to be estimated and reviewed in context of annual exposure limits, ALARA, and DOE performance criteria.

Done.

14. (Reviewer: P. Martin) The NuMI Radiation Safety Advisory Committee review of 7/99 and the Preliminary Radiation Shielding Assessment of 10/99 were both based upon the construction drawings as they went out for bid. The change to the Tunnel Boring Machine was proposed by Healy and accepted by the lab subsequent to these reviews. The NuMI project should verify that the changes from the use of the TBM do not alter the conclusions of those reviews.

Done.

Thermal Model Update
Presenter: J. Hylen

1. (Reviewer: N. Grossman) Does horn 2 module costs include allowances for movement? If so then perhaps we should remove them. If the movement allowances have already been removed, that means we do not plan to do a horn 2 flexible joint even if we end up having $ for it, correct?

Motion control for Horn 2 was eliminated.

Description of shielding block layout, tests, air handling
Presenter: Andy Stefanik

1. (Reviewer: D. Cossairt) The cracks between the Duratek steel blocks remain a concern. How these will work out when the blocks are stacked on the floor of the target enclosure remains to be seen. These cracks should perhaps not be filled. Past experience with materials used to fill cracks is not encouraging. The shielding calculations, hopefully, allow for the cracks by, perhaps, using a reduced density. This should be good enough provided the blocks are laid with good masonry practices of well-developed overlaps.

Cracks have been simulated in the MARS runs.

2. (Reviewer: D. Cossairt) Reference was made to HEPA filters. Perhaps the word "HEPA" should not be used to designate this equipment. This conjures up "nuclear facility" type air systems, which are costly, or impossible, to maintain in accordance with strict ANSI standards applicable to such systems as commonly used to directly protect personnel in other kinds of installations. If one simply calls them "high efficiency" filters without the use of the acronym, this potential compliance issue may well be averted. The other review panel members are welcome to create a better name.

OK

3. (Reviewer: D. Cossairt) The material of choice for the windows (Be or Ti) was going to be checked as an action item. Ti may be preferred.

We have decided to use Be windows.

4. (Reviewer: D. Cossairt) Be careful in deleting the top row of blocks over the target station. It appears from the drawing shown that this could leave cracks of unacceptable orientation, number, and/or size.

OK

5. (Reviewer: D. Cossairt) A final check of airflows and their directions will be needed after construction/installation. The air flow pattern is a complicated one and may not be completely predictable given other uncertainties related to cracks, etc.

Agreed. This will be done during the checkout of the air system.

6. (Reviewer: M. Gerardi) The use of titanium windows in lieu of beryllium windows is highly encouraged. The failure of a Be window involves significant down time, cost, and IH (industrial hygene)requirements.

The probability of window damage is significantly higher for titanium than beryllium. Beryllium windows are commonly used on site. We recognize the IH concern.

7. (Reviewer: M. Gerardi) I was able to view the Blue Blocks assembled at MDB and had some concerns with the arrangement that provided several aligned cracks that will surely cause operational problems. Some of the cracks may be large and require some type of fill. However, the choices are limited and many times cause more problems. It is best to minimize all cracks rather than look for cosmetic fill later.

Care has been taken to ensure there is no straight line of sight and that blocks are tightly stacked.

8. (Reviewer: M. Gerardi) Replacement of too many T-Blocks with Blue Blocks may cause considerable additional cracks and gaps that must be dealt with, which could in turn ultimately cost more.

OK

9. (Reviewer: M. Gerardi) The ability to monitor airflow and the desired path is important from the radiological discharge standpoint. Decay time is necessary since a significant part of the labs permit will be eaten up by NuMI operation.

Agreed.

10. (Reviewer: N. Grossman) NuMI needs to figure out how to seal around the transmission line as it goes through the target pile. Does it need to be "sealed" only at the top, and not worry about air going in one direction at the bottom of the TL and in the other direction at the top and thus some leakage? And NuMI needs to make sure that under whatever sealing conditions are determined that the TL is kept sufficiently cooled.

The design engineers are addressing these issues.

11. (Reviewer: N. Grossman) Along the same lines, is there a rough estimate as to how much will leak out of the whole target pile to ensure that a limit of 1500-cfm leakage is well above what we expect and thus air activation is not a concern?

An estimated leak rate was given to Nancy Grossman.

12. (Reviewer: N. Grossman) Is moisture in the pseudo-HEPA filters a problem? An observer suggested that it might be a problem for the filter. Do we expect

them to get damp? Where the filters are located the dose rates should be reasonable so that personnel changing them do not incur too much dose. Do we have estimates as to what these dose rates are and how often the filters will need to be accessed?

The air-cooling system includes dehumidification that should prevent this from occurring. Filter replacement methods have been discussed with the system designer to ensure dose rates are ALARA.

13. (Reviewer: T. Leveling) Target hall ventilation does not appear to be fully designed at this point. It would be prudent for NUMI to review air sample results of pbar vault air UPSTREAM of the HEPA filtered target vault exhaust. My recollection is that fairly significant airborne contamination (above and beyond PET isotopes C11, N13, etc.) exists in the vault upstream of the HEPA filter during beam operation due to activation of airborne dust, rust, etc. This source of contamination could be spread throughout the air-cooling system resulting in contamination control requirements for the air-cooling system maintenance. In addition, condensate drains in the system could become radioactive due to deposition of same materials on cooling system coils. Recent samples with beam off and beam on have been collected by the BD ES&H Department at pbar vault. If this is found to be a problem, NUMI should strongly consider the use of HEPA filters to remove particulates from the vault return air prior to cooling.

Done

14. (Reviewer: T. Leveling) Removable radioactive contamination may be more of a concern at NUMI than at previous facilities due to intended beam power. Care needs to be taken in the facility design to provide for this (e.g., handling and storage of T blocks in manner that lower surfaces of blocks don't come in contact with uncontrolled surfaces.)

OK

15. (Reviewer: P. Martin) The Alignment and Metrology Group should be consulted about the wall that is proposed just upstream of the target hall. Placing this wall during the present excavation contract or the follow-on outfitting contract will make their life more difficult. It wasn't fully clear whether this wall was just for air-containment, but if so, it can be a simple concrete masonry unit wall, erected near the end of the installation.

The wall will be hand-stacked concrete blocks and will be installed after the alignment network is completed.

16. (Reviewer: P. Martin) The target hall shielding installation schedule takes the better part of a year, working two shifts. This will require at least three task managers. Identification of these people ought to be a fairly high priority.

The major part of the target hall shielding has been completed. The task management was excellent.

17. (Reviewer: P. Martin) The air-cooling relies upon control of cracks that can short-circuit the intended path of flow. Once installed, the proposed aluminum sheets will be inaccessible. This whole problem should be given more thought. How do you verify the desired flow once the installation is complete? Are there any intermediate measurements that can be done during the installation phase, while it is still possible to correct things? Is it worth developing a prototype, as was done for seeing how the blocks would stack?

Joints in the aluminum sheets were sealed by welding. The welding was prototyped.