Table of Recommendations

for the Director's Preliminary Review of the Super NuMI Plan
November 14 – 16, 2006

#	Recommendation	Assigned To	Status/ Action	Date
	2.1.1 Booster Upgrades	**Eric**		
1.	Consider the potential benefit of a dual-harmonic RF system in the Booster.			
	2.1.2 Recycler Upgrades	**Paul**		
2.	Concerning the kicker modules, their impedance and the danger of electron cloud, the committee recommends reconsidering the inside coating of the ceramics in terms of resistivity and SEY (Ti, TiN, …).			
3.	There seems to be a trade-off between the number of bunches "notched" out in the booster and the stringent requirements on rise- and fall-time of the injection and gap clearing kickers – the specified 38 ns are based on 2 missing bunches. The committee recommends evaluating this trade-off and to prepare for a different number of "notched" bunches as a fall-back solution.			
4.	In view of SNuMI phase II, the committee recommends to consider purchasing material also for a spare cavity, bringing the total number to 5.			
5.	Since slip-stacking to full intensity cannot be tested early in the RR, the committee recommends continuation of tests in the MI.			

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6.	Due to the envisaged completely new type of operation of the RR without the possibility of relevant tests before the end of the Tevatron run, the committee recommends to consider at least fully simulating this new operation, including longitudinal and transverse beam dynamics.			
7.	Concerning the change of BPM cables, the committee recommends: Assign a coordinator now who will manage the 2009 shutdown activities. Develop the installation plan, and examine what activities could be done in earlier shutdowns to ease conflicts due to multiple personnel working in the same areas and tunnel blockages. (Cables pulls and LCW pipe relocation are two obvious candidates for doing early.)		Paul, please contact me as we should talk about this soon.	
	2.1.3 Main Injector Upgrades	**Ioanis**		

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8.	We recommend that emittance growth at transition as a function of beam brightness be re-examined in light of the Phase II requirements. If machine studies can be done with relevant bunch parameters then they should be given high priority.		Extensive simulations of transition crossing in MI were performed for bunch intensities of 1.0E11 (Phase I), 1.8E11 (Phase II) and different longitudinal emittances (Ref…I have a talk but I will write a more detailed note) a) Without a gamma-t jump and intensities of 1.0E11 per bunch the maximum longitudinal emittance that can be accelerated through transition is 0.4 eV-sec. b) For intensities of 1.8E11 the maximum longitudinal emittance that can accelerated trough transition is limited to 0.3 eV-sec. c) By using a gamma-t jump we can accelerate trough transition longitudinal emittances up to 0.6 eV-sec with minimal emittance growth. d) The use of a longitudinal quad damper can greatly reduce the emittance growth during the transition crossing.	
9.	It is unlikely that the losses of un-captured beam in the MI will be significantly reduced when 12 Booster batches are slipped stacked in the Recycler compared to now when 11 batches are slip stacked in the MI. The collimation system for MI must be demonstrated to be effective for Phase I to be a viable design for producing 700 kW.		The collimator design has been finalized and we will stsrt ordering parts at the end of January of 07. We expect to have the primary collimator and the four secondary ones ready for installation in MI during the shutdown of summer 07.	

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10.	The work on the upgraded power amplifier for the MI should begin a soon as possible.		We plan to finalize the low power tests of an upgraded cavity with two power amplifiers by April 07.	
	2.1.4 NuMI Upgrades	**Mike**		
11.	It is commendable that these particular items have already been examined and to reference these to the worst case, condition of a pulse, or pulses of an uninteracted proton beam reaching these components (e.g., the target is missing or the beam is missing the target).			
12.	The plans outlined in the CDR to add an input to the beam permit system to check for "beam present without muons downstream of the hadron absorber" (indicative of the presence of untargeted beam) is a worthwhile addition given the anticipated increased beam power.			
13.	It would be prudent to plan any Phase I work in a manner that does not necessitate undoing and/or repeating it for Phase II. This is particularly true for RAW (Radioactive Water) systems.			
14.	The temperature distribution of the fin structure should be carefully analyzed due to the longer distance between the beam impact and the water cooling.			
15.	Conceptual and final designs need to be developed for the Phase II NuMI upgrade.			
16.	The conceptual plans to procure a new off-the-shelf remote manipulator with special tools designed for this application and considerable associated efforts are good ones.			
17.	It would be advisable to not acquire "used" manipulators that might become available from other facilities due to the potential for contamination, not readily removable.			

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18.	Measures to address this problem should be continued. As needed, elements of this may be implemented prior to the 2009 down time.			
19.	Plans for actions to be taken in event of "crane failure" should be made in advance.			
20.	The radiation safety analysis will need to be refined as the design proceeds.			
21.	More detailed calculations will be needed to better understand the beam losses in advance of the full development of the Phase II design.			
22.	The project should consider a study of the possible use of collimation and local shielding inside the Accumulator beam enclosure to better control the prompt radiation hazard passively. A complication may be presented by the fact that the debuncher ring is likely to be retained for a potential physics experiment.			
	2.2 Civil Construction	**Dixon**		
23.	Allocate funds in a timely manner to allow installation of the penetration and building footings during the summer 2007 shutdown. Approval by December 1, 2006, is needed.			
24.	Specify the location of penetrations both inside the service buildings and to the tunnel.			
25.	Evaluate the MI cooling pond performance, and determine the incremental pond area required to both support the expected increase in heat load and to provide additional operating margin. Design and construct new pond area accordingly.			
26.	Assign additional contingency based on recent bid experience.			

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27.	Identify the area(s) to be demolished, so that the associated costs can be better validated.			
	2.3.1 Cost	**Nancy, Elaine**		
28.	Maintain the level of effort that was committed to preparing for this review to continue to refine the scope of Phase I and the cost estimate.			
29.	Complete the Basis of Estimate (BOE) documentation to support the resources assigned in the Phase I Schedule and store the information in a controlled repository.			
30.	Continue to refine the bottom-up risk assessment and the top-down risk assessment and assure that the contingency assigned is appropriate for the identified risks.			
31.	Increase the contingency on the Civil Construction work to reflect the cost increases experienced on recent Request for Proposals (RFPs).			
	2.3.2 Schedule	**Nancy, Elaine**		
32.	The SNuMI Team needs to continue to scrub the schedule by addressing the items noted in the above comments. This is needed to achieve a baseline schedule.			
	2.3.3 Management	**Nancy, Elaine**		
33.	Start regular PMG meetings as described in the PMP.			
34.	Work with the laboratory to get the FY07 funding guidance soon, along with a funding profile for the outyears for planning the rest of the project.			
35.	Assure that the SNuMI labor needs are part of AD's, and other organizations', integrated manpower planning.			

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36.	Keep up the impressive rate of progress that you have been achieving recently.			
	3.1 Technical	**Ioanis**		
37.	Estimate the beam loss instability thresholds during the beam stacking processes, in particular during debunching and rebunching of the high intensity beam in the Accumulator and the Recycler, with simulations and/or beam studies.		The impedance threshold required for self-bunching in the Accumulator was studied. See "Self-Bunching of a Coasting Beam in the Accumulator" by D. McGinnis ProtonPlan-doc-198. Currently we can routinely achieve Accumulator intensities of 1E12 and 15 eV-sec with no sign of instabilities. For PHASE II most of the Accumulator impedance sources will be removed (stochastic cooling arrays, 2.5MHz and 1.2MHz cavities) and the 53MHz impedance will be reduced by a factor of 20 with rf feedback. The debunching in the Recycler can be avoided.	
38.	Study alternative stacking schemes that are less sensitive to beam instabilities and have better efficiency.		Unfortunately we do not know of any stacking scheme that is both less sensitive to instabilities and has better stacking efficiency. The possibility of using slip-stacking to stack 18 Booster batches in the Recycler was investigated. See "Using Slip Stacking for SNuMI" by I. Kourbanis ProtonPlan-doc-272. We also doing experimenting with fast barrier bucket stacking in MI.	
39.	Test a spare 53 MHz cavity with two power tubes as soon as possible.		See response on number 10.	

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40.	Design a Linac chopper to put a notch in the Linac beam for the Booster extraction kickers.		There is currently an R@D program underway to test whether a notch created at 750 keV can be accelerated to 400 MeV by the linac without significant degradation. However, this would be incompatible with our current beam cogging system, which places the notch based on the cumulative phase error early in the Booster acceleration cycle. It is possible that our Linac low level RF upgrade will stabilize the linac energy to the point where this large correction will no longer be necessary, at which point the linac notch would become practical.	
	3.2 Civil Construction	**Dixon**		
41.	Assign beam physics manpower with the responsibility to design the AP-4 and AP-5 beamlines.			
42.	Minimize Phase 2 civil construction design effort until the beamline lattices have been finalized.			
	3.3 Project Management (Cost Schedule and Management)	**Nancy, Elaine**		
43.	Work with lab management to pursue '1.2MW' that does not jeopardize the work on SNuMI I.			