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# **WBS 1.0.3.3/ 2.0.3.3**

# **NuMI Target Hall Infrastructure**

June 5, 2007

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CD-2/3a Director's Review Breakout



# NuMI Infrastructure Overview

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NuMI Target Hall Infrastructure covers:

- Shielding of the target hall from radiation
  - Includes planning & design for Horn 2 move to ME which will require significant shielding reconfiguration, also included is stripline extension to ME
- Thermal analysis of the chase region (FEA) and cooling upgrades to existing systems
  - Cooling of the target pile and support systems (which includes the Horn 1 chase stripline and block assembly)
  - Alignment concerns due to increased beam power



# NuMI TH Infrastructure WBS Tasks

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- Target Hall Operations Space Planning
- Horn 2 Relocation to Medium Energy
  - Stripline Extension
  - Shielding Reconfiguration
- Target Chase
  - Target Chase Air Cooling
  - Horn 1 Stripline Block
  - Radiant Heat Loads
- NuMI Target Hall Infrastructure Reviews



# Task Highlights

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- Target Hall Operations Space Planning (see Breakout talk in NOVA-doc-2049)
  - This is an important task. Limited space available for Target Hall activities (Horn 2 move, Target & Horn change outs & repairs, Radioactive Component Repair/Removal, Work Cell activities, etc.) so need to start planning in advance
  - ❖ This task should help better plan & co-ordinate the various Target Hall activities & will also address some of the logistic problems issue brought up during the SNuMI DR. Also includes the design & installation of new equipment.
- Horn 2 Relocation to Medium Energy (see Breakout talks in NOVA-doc-2049)
  - Stripline Extension: based on existing design (D. Tinsley)
  - Shielding Reconfiguration: this includes planning for Horn 2 move, engineering & re-design of target pile shielding, blue block removal & storage, use of a “dummy” module + new set of T-Blocks to act as ‘*shielding plug*’
- Target Chase
  - Air Cooling: Includes MARs Simulations for energy deposition & FEM 3D thermal analysis, and the analyzing of chase shielding items for temperature limits (dry heat resistance of all paints & primers). Also includes design & installation of new chiller coils and a new water chiller surface unit plus instrumentation. (see Breakout talk in NOVA-doc-2049)



# Task Highlights contd.

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- Target Chase contd.
  - Horn 1 Stripline Block: Includes analyzing Horn 1 chase stripline (from module to horn) for higher heat loads (FEA). Also included is R&D work to quantify convection coefficients & the design and assembly of a forced air cooling system for the chase stripline (see NOVA-doc-1787)
  - Radiant Heat Loads: Includes analyzing predicted block temperature effects on chase components (using 3D FEM). Also includes the design & installation of additional chase temperature monitoring equipment (such as on the modules, chase shielding blocks, etc.)
- NuMI Target Hall Infrastructure Reviews
  - Conceptual reviews before beginning design work
  - Final design reviews before procurement
  - Safety review of remote Blue-block/T-block lifting fixture is included



# Cost Overview NuMI Infrastructure

(Fully Burdened FY07 \$)

ANU NuMI Target Hall Infrastructure Cost Estimate \$K (FY07\$)								
WBS	Name	Estimated Cost (w/Indirects)			Contingency %			Total Project Cost
		M&S	Labor	Total	M&S Cont %	Labor Cont %	Total Cont %	
	<b>NuMI Target Hall Infrastructure</b>	<b>\$1,109</b>	<b>\$2,064</b>	<b>\$3,173</b>	<b>44%</b>	<b>62%</b>	<b>56%</b>	<b>\$4,938</b>
<b>1.0.3.3</b>	<b>NuMI Target Hall Infrastructure Planning, Engineering &amp; Design</b>	<b>\$21</b>	<b>\$1,321</b>	<b>\$1,342</b>	<b>67%</b>	<b>62%</b>	<b>62%</b>	<b>\$2,170</b>
1.0.3.3.1	Target Hall Operations Space Planning	\$0	\$234	\$234		100%	100%	\$468
1.0.3.3.2	Horn 2 Re-location to Medium Energy	\$3	\$526	\$529	103%	52%	52%	\$804
1.0.3.3.3	Target Chase Cooling Upgrades	\$18	\$518	\$536	61%	60%	58%	\$846
1.0.3.3.4	NuMI Target Hall Infrastructure Reviews	\$0	\$43	\$43		21%	21%	\$52
<b>2.0.3.3</b>	<b>NuMI Target Hall Infrastructure Construction</b>	<b>\$1,088</b>	<b>\$743</b>	<b>\$1,831</b>	<b>44%</b>	<b>62%</b>	<b>51%</b>	<b>\$2,768</b>
2.0.3.3.1	Target Hall Operations Space Planning	\$66	\$56	\$122	100%	100%	100%	\$245
2.0.3.3.2	Horn 2 Re-location to Medium Energy	\$838	\$424	\$1,262	39%	61%	46%	\$1,849
2.0.3.3.3	Target Chase Cooling Upgrades	\$184	\$263	\$447	44%	56%	51%	\$675



# NuMI Upgrades Risk Management

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- Risk Registry for all risks is in WelcomRisk®
  - 12 Risks entered with mitigations for this WBS
    - 2 high, 3 moderate, 7 low
- 2 high risks for NuMI is insufficient manpower (NOvA-DocDB-1446)
  - Same people involved in both NOvA ANU and NuMI Operations
  - Shortage of Mechanical Engineers in particular
  - Risk
    - Delay to Schedule
    - Reduced Operational Reliability
  - Mitigations
    - When possible, contract out engineering work
    - Reasonable contingency and schedule float
- 3 moderate risks relate to Target Hall Infrastructure and NuMI Cooling Issues being at the conceptual design level
  - Tasks taking longer than planned or costing more than planned
  - Reasonable contingency and schedule float
- Installation tasks take longer than planned (NOvA-DocDB-1964)
  - Will have detailed planning/tasks in project schedule; contingency to cover
  - Use earlier shutdowns for planning and any work possible



# Relevant Recommendations from SNuMI Review (11/2006)

<b>2.1.4 NuMI Upgrades</b>	
<p>It is commendable that the Decay Pipe Water Cooling System, Decay Pipe Vacuum Window, and Hadron Absorber Water Cooling System have already been examined and referenced 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).</p>	<p><b>Status: Complete</b> Beamline and component survival during accident scenarios will continue to be an important</p>
<p>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.</p>	<p><b>Status: Need to add a “Beam Permit Upgrade” to the WBS.</b> We will add a task in the WBS for an upgrade the beam permit system. Incorporating the hadron monitors or muon monitors will be considered as part of this upgrade.</p>
<p>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.</p>	<p><b>Status: Complete</b> We will make estimates of the demands on the water systems for upgrades beyond the first phase of the upgrade. This will be considered during the scheduled design reviews of the water systems.</p>
<p>The temperature distribution of the fin structure for the medium energy target should be carefully analyzed due to the longer distance between the beam impact and the water cooling.</p>	<p><b>Status: IHEP work needs to be reviewed by Fermilab Engineering.</b> A thorough analysis of the medium energy target was completed by IHEP. The conclusions of their report suggest the fin design is adequate for the NuMI upgrades. The report needs to be reviewed by Fermilab engineers.</p>
<p>Several serious logistic problems have already been identified both at NuMI and at the Target Storage Building (TSB). Measures to address this problem should be continued. As needed, elements of this may be implemented prior to the 2009 down time.</p>	<p><b>Status: Complete</b> Tasks for the Target Hall Operations Space Planning are already in the WBS structure. Where possible, these tasks will be integrated with existing NuMI operations.</p>
<p>The radiation safety analysis will need to be refined as the design proceeds.</p>	<p><b>Status: Need to add a “Prepare Shielding Assessment Document” to the WBS.</b> Much of the radiation safety analysis is a part of the work cell upgrade and the radioactive component removal plan. The organization chart includes a Radiation Safety Coordinator (RSC) as a level 2 manager for the NuMI upgrades.</p>



# WBS 1.0.3 Milestones

Activity ID	Activity Desc.	Date	Milestone Tier	FY06					FY07					FY08					FY09					FY10				
				Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
<b>L.2 -- WBS L2 Manager's Milestone</b>																												
1.0.3.3.5.11	NuMI FEM 3-D Thermal Analysis Complete	20Sep07	L.2																									
1.0.3.3.5.1	NuMI Analyze Predicted Block Temperatures Effect on Chase Components Complete	01Nov07	L.2																									
1.0.3.1.5.2	NuMI Profile Monitor Conceptual Design Review Complete	03Mar08	L.2																									
1.0.3.1.5.3	NuMI Profile Monitor Technical Design Review Complete	24Jul08	L.2																									
1.0.3.2.5.1	NuMI Target, Baffle & Carrier Initial Design Review Complete	21Oct08	L.2																									
1.0.3.2.5.9	NuMI Hadron Monitor Initial Re-design Complete	04Nov08	L.2																									
1.0.3.2.5.3	NuMI Final Design of Target Carrier Complete	19Mar09	L.2																									
1.0.3.3.5.3	NuMI Target Chase Cooling Design Complete	06Jul09	L.2																									
1.0.3.1.5.1	NuMI Charging PS Upgrade Design Complete	28Oct09	L.2																									
1.0.3.3.5.2	NuMI Shielding Assessment Complete	05Mar10	L.2																									



# WBS 2.0.3 Milestones

Activity ID	Activity Desc.	Date	Milestone Tier	FY06	FY07	FY08	FY09	FY10	FY11	FY12
<b>L.2 -- WBS L2 Manager's Milestone</b>										
2.0.3.2.3.7	NuMI IHEP ME Target Accord Signed	09Jan09	L.2				▲			
2.0.3.2.3.1	NuMI Begin Baffle Procurement	13Aug09	L.2				▲			
2.0.3.2.3.2	NuMI Baffle Delivered	18Jun10	L.2					▲		
2.0.3.4.4.2	NuMI RAW Systems Mods Complete	01Nov10	L.2						▲	
2.0.3.4.4.3	NuMI Cooling Water (Non-RAW) Mods Complete	01Dec10	L.2						▲	
2.0.3.3.4.2	NuMI Installation of Target Chase Cooling Complete	02Dec10	L.2						▲	
2.0.3.1.5.1	NuMI Charging PS Upgrades Testing Complete	29Dec10	L.2						▲	
2.0.3.2.3.4	NuMI Target Carrier Delivered	16Mar11	L.2						▲	
2.0.3.2.3.8	Replacement Hadron Monitor Delivered	26May11	L.2						▲	
<b>T.3 -- Fermilab Director or NOVA Management Milestone</b>										
2.0.3.3.4.1	NuMI Shielding Blocks, Dummy Module & Carriage Complete	09Jul10	T.3					▲		
2.0.3.3.4.3	NuMI Stripline Assembly Complete	30Aug10	T.3					▲		
2.0.3.1.5.2	NuMI Primary Beamline Ready for Faster Cycle Time	21Feb11	T.3						▲	
2.0.3.2.3.3	NuMI ME Target/Carrier/Baffle Assembly Complete	26Sep11	T.3							▲



# Summary

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- Technical
  - See **NOVA-doc-2049** for more detailed breakout talks on these tasks
- NuMI Infrastructure Cost:
  - \$3,173K (fully burdened FY07\$, no contingency)
  - 56% (contingency)