

*Department of Energy  
Review Committee Report*

on the

Technical, Cost, Schedule, and  
Management Review

of the

**NEUTRINOS at the  
MAIN INJECTOR  
(NuMI) PROJECT**

May 2004

## **EXECUTIVE SUMMARY**

On May 25, 2004, a Department of Energy review committee conducted a semiannual review of the Neutrinos at the Main Injector (NuMI) construction project at Fermi National Accelerator Laboratory (Fermilab). By the request of Dr. Robin Staffin, Associate Director for the Office of High Energy Physics, the review committee was chaired by Stephen Tkaczyk of the Office of Major Systems Assessment. The Committee consisted of four DOE reviewers and two technical consultants.

The NuMI project is more than 97 percent complete. The civil construction is complete, and Fermilab has beneficial occupancy of all buildings, shafts, tunnels, and underground halls. There has been excellent progress on installation of the near detector, and all its remaining components are ready for construction. Progress on installation of the technical components has also been excellent, and construction of almost all technical systems is complete. The far detector is performing well in Soudan, Minnesota.

The project has made thorough plans for commissioning the NuMI facility and the detectors, and has made excellent progress in implementing these plans, which include physical commissioning, as well as administrative approvals (shielding assessment, safety assessment document, and readiness reviews). The plan providently covers both Critical Decision 4, Start Operations, and initial operation for physics.

Fermilab has effectively addressed the Environmental, Safety and Health recommendations from the November 2003 DOE review. The project is ahead of schedule and is manageable within the current cost baseline.

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# 1. NuMI TECHNICAL COMPONENTS (WBS 1.1)

## 1.1 Findings

The work in WBS 1.1, NuMI Technical Components, is now largely devoted to installation activities. Excellent progress has occurred in the last six months with the completion of almost all technical systems and significant installation progress. No schedule slippage occurred in the last six months. Technical changes have been limited. Listed below are some of the key technical achievements of the last six months:

- Magnetic shielding was installed on two NuMI dipoles and successfully tested during a power-on access. (WBS 1.1.1)
- The first UT-Austin profile monitor was delivered to Fermilab. (WBS 1.1.1)
- Installation of the lower shielding in the target pile was completed. (WBS 1.1.2)
- Both horns were attached to their respective modules, and both modules were rigged into the target chase. (WBS 1.1.2)
- The horn power supply was moved underground and electrical connections made. (WBS 1.1.3)
- Refurbishment of all power supplies has been completed. (WBS 1.1.3)
- Installation of the hadron absorber has begun. (WBS 1.1.4)
- The hadron monitor has been assembled. (WBS 1.1.5)
- The Target Hall alignment network is completed. (WBS 1.1.6)
- The decay pipe was pumped down to 1.4 Torr. (WBS 1.1.7)
- All water and vacuum skids have been moved underground. (WBS 1.1.7)
- The fiber-optic controls link was established in all NuMI areas. (WBS 1.1.8)

There were no recommendations from the November 2003 DOE review.

It was decided to resolve the quadrupole magnet cooling issue by ramping the power supplies and adding cooling plates to the magnets.

Some diagnostics are not complete but are expected shortly and will have no schedule impact.

The current estimate at completion for WBS 1.1 is \$28.6 million. The budgeted cost of work performed through March 2004 is \$24.6 million, leaving an estimate to complete of \$4.0 million. Of this amount, 30 percent is for purchases, 30 percent is for Fermilab labor, and 40 percent is for Davis Bacon labor. A total of \$5.7 million was spent in the last six months. Change requests of \$1.9 million were approved in the last six months, largely for installation cost overruns. There is an additional \$1 million in contingency usage projected for the remainder of the project. The remaining work, almost all installation activities, is scheduled to be completed in the next six months.

## **1.2 Comments**

The Committee commends the NuMI team for their excellent work and progress towards commissioning. Installation activities are proceeding well, and the upcoming August shutdown should be sufficient to install the remaining Main Injector components. The other installation activities are on track to be completed by December 2004.

The laboratory has made sufficient resources available to the NuMI project, including overtime where required.

The commissioning plans presented are well thought out and detailed. Necessary safety documentation and review is on track for completion on schedule.

Fermilab management has plans for the transition of NuMI to operations in conjunction with existing experiments. Plans for operation beyond Critical Decision 4, Start Operations, have been presented.

## **1.3 Recommendations**

None.

## **2. MINOS DETECTORS (WBS 2.0)**

### **2.1 Findings**

The far detector is routinely taking cosmic ray data and performing well. There has been good progress on the near detector (ND) since the November 2003 DOE review. The ND installation is proceeding smoothly, and suitable checks are being performed on the planes as they are installed. The installation of the spectrometer section is nearly complete, and installation of the calorimeter section is scheduled to begin June 14, 2004. All components and preassemblies are ready for the remaining installation.

Data taking for the installed planes is presently being controlled from the detector site for purposes of detector checkout. The project team plans to test remote operation of installed planes soon. Plans for commissioning the ND for taking and analyzing neutrino data are well underway, and the schedule provides adequate time for accomplishing this.

### **2.2 Comments**

Installation of the remaining ND planes is presently anticipated to be complete by August 15, before the August shutdown begins. The Committee supports a high priority for accomplishing this, since it would allow them to proceed most efficiently with preparations for turning on the NuMI beam.

### **2.3 Recommendations**

None.

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### **3. ENVIRONMENT, SAFETY and HEALTH**

#### **3.1 Findings**

Progress since the November 2003 DOE review has been impressive. All of the prior recommendations have been effectively addressed.

#### **3.2 Comments**

Planning for the required documentation and Accelerator Readiness Reviews is excellent, and will support NuMI commissioning and operation. Integration with DOE has been timely and thorough, and will significantly reduce the uncertainty associated with the approval process.

#### **3.3 Recommendations**

None.

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## 4. COST and SCHEDULE

### 4.1 Findings

On December 21, 2001, the Deputy Secretary approved a Level 0 baseline change that established a new Total Project Cost (TPC) of \$171.4 million for the NuMI project. At subsequent DOE reviews, the project presented changes to the baseline that required contingency utilization but left the TPC fixed. At the current review, additional contingency activity was presented, but the TPC still remains unchanged. Table 4-1 shows a summary of the TPC evolution from the December 2001 re-baseline to this current review. Additional cost details can be found in Appendix D.

**Table 4-1. Changes to Baseline Cost Estimate (in \$K)**

WBS	Description	December 2001 Baseline	November 2003 Review	Changes since Nov. 2003 Review	May 2004 Review
1.1	Technical Components	27962	26768	1856	28624
1.2	Facility Construction	60493	68047	846	68893
1.3	Project Management	4788	4330	-750	3580
	Contingency on TEC	15999	10097	-1952	8145
<b>1.0</b>	<b>Total Estimated Cost (TEC)</b>	<b>109242</b>	<b>109242</b>	<b>0</b>	<b>109242</b>
2.0	MINOS	38776	42407	-150	42257
3.0	Project Support	16109	16378	-231	16148
	Contingency on OPC	7315	3415	381	3796
	<b>Other Project Cost (OPC)</b>	<b>62200</b>	<b>62200</b>	<b>0</b>	<b>62200</b>
	<b>Total Project Cost (TPC)</b>	<b>171442</b>	<b>171442</b>	<b>0</b>	<b>171442</b>

Since the November 2003 DOE review, the contingency for the TEC was reduced by \$1,952,000. This is primarily due to labor costs for the installation of technical components and change orders to the Service Buildings and Outfitting subcontract, partially offset by a reduced budget for project management. Contingency for Other Project Costs increased by \$381,000 due primarily to closeouts and replanned detector installation costs. A list of the change requests and their descriptions is included in the Appendix D.

The project is 97 percent complete (TPC) through March 2004.

The project presented a master schedule and a list of DOE milestones with associated schedule float relative to the project's internal schedule (see Appendix E). Milestone L-1-9 (Start commissioning beam line) is projected to occur on December 27, 2004. This would be followed by the milestone L-0-3 (CD-4, Start Operations) on February 1, 2005. There would be 241 days of float remaining until the baseline CD-4 date of September 30, 2005.

Milestone L-2-17 (Complete installation of horn power supply) occurred on May 21, 2004, 93 days ahead of the baseline date.

Milestone L-2-11 (Beneficial occupancy of service buildings at Fermilab) occurred on March 10, 2004, 82 days ahead of the baseline date.

Milestone L-2-14 (Near detector complete and tested) is forecast for December 27, 2004, 94 days ahead of the baseline schedule date.

The funding profile for the project supports the internal schedule.

## **4.2 Comments**

The contingency remaining is a significant percent of the estimate to complete. However, there are remaining cost risks within the project. The project will incur additional costs if any of the 241 days of float in the schedule are required for completion. The Committee's conclusion is that the project is manageable within the boundaries of the current cost baseline.

The Committee commends the project for accomplishing DOE and Level 3 milestones since the November 2003 DOE review well ahead of the baseline schedule, and sees evidence that this trend will continue. There are no funding issues with the project.

## **4.3 Recommendations**

None.

# **APPENDIX A**

## **CHARGE MEMORANDUM**

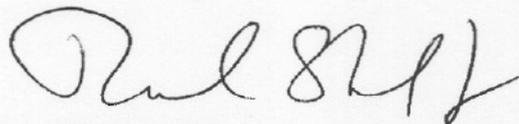
# memorandum

DATE: APR 21 2004  
REPLY TO:  
ATTN OF: SC-20  
SUBJECT: NuMI Semiannual Review  
TO: Daniel Lehman, Director of the Construction Management Support Division, SC-81

I would like to thank you for agreeing to chair the next semiannual review of the Neutrinos at the Main Injector (NuMI) project. The review is scheduled to be held on May 25, 2004, on-site at Fermilab. The purpose of the review is to examine the technical, cost, schedule, and management aspects of the project. A more detailed articulation of the questions that your review committee is to address in making these assessments is provided in the attached charge. I would appreciate it if you could provide a completed report of your review to me no later than July 9, 2004.

As you know, Phil Debenham, of this office, will serve as Executive Secretary to the review committee, consistent with his role as the program manager for this project. It is my understanding that you are working with him and members of the Fermilab staff to prepare for the review.

Again, I wish to thank you for agreeing to chair this review. I look forward to receiving your Committee's report.



Robin Staffin  
Associate Director  
Office of High Energy Physics

Attachment:  
Charge to Committee

cc:  
A. Byon-Wagner, SC-20  
P. Debenham, SC-20  
L. Dever, SC-80  
R. Lutha, CH/FERMI  
J. Monhart, CH/FERMI  
M. Procaro, SC-20  
D. Sutter, SC-20  
S. Tkaczyk, SC-81  
S. Webster, CH/FERMI

**Department of Energy  
Review of the NuMI Project  
May 25, 2004**

**CHARGE to the COMMITTEE**

This is the thirteenth Department of Energy (DOE) review of the Neutrinos at the Main Injector (NuMI) project. The review, which is being requested by the Associate Director for the Office of High Energy Physics, will consider the technical, cost, schedule, and management aspects of the project, as well as environmental, safety, and health (ES&H) issues. The last review was held in November 2003.

The project is currently more than 95 percent complete. Fermilab now has beneficial occupancy of all buildings, shafts, tunnels, and underground halls, and is installing the NuMI beam line (technical components) and the MINOS near detector in the tunnels and halls. Occupancy of the MINOS area occurred six weeks later than the laboratory had projected at the last review, resulting in a compressed installation schedule for that sector.

All installation is scheduled for completion in December 2004, to be followed by commissioning and then start of operations (CD-4) in February 2005. This would leave eight months of schedule float until the September 30, 2005 baseline date for CD-4. However, delays in CD-4 beyond February 2005 would also increase the cost to complete the project and would consume contingency funds. The laboratory and the DOE project office therefore need to develop a technical, cost, and schedule "end-game" plan to complete construction and make a transition to operations.

The review committee is asked to address the following points:

1. Assess the project's response to the comments and recommendations of the last review committee.
2. Evaluate the project end-game plan to achieve CD-4 on the stated date with appropriate ES&H performance.

A written report on the review is due to the Associate Director by July 9, 2004.

# **APPENDIX B**

## **REVIEW PARTICIPANTS**

**Department of Energy Review of the  
Neutrinos at the Main Injector (NuMI) Project**

**REVIEW COMMITTEE PARTICIPANTS**

**Department of Energy**

Daniel Lehman, DOE/SC, Chair  
Philip Debenham, DOE/SC, Ex. Secretary  
Richard Imlay, DOE/SC detailee  
Stephen Tkaczyk, DOE/SC  
Stephen Webster, DOE/Fermi Group

**Consultants**

Roy Cutler, ORNL  
Frank Kornegay, ORNL

**Observers**

Jane Monhart, DOE/Fermi Group  
Ronald Lutha, DOE/Fermi Group

# **APPENDIX C**

## **REVIEW AGENDA**

**Department of Energy Review of the  
Neutrino at the Main Injector (NuMI) Project**

**AGENDA**

Monday, May 24, 2004

3:30 pm	Tour of NuMI Facility and Technical Components	

Tuesday, May 25, 2004

8:00 am	DOE Executive Session	S. Tkaczyk
8:30 am	Opening Remarks	Directorate
8:35 am	<u>Project Overview</u>	G. Bock
9:10 am	<u>Commissioning</u>	B. Baller
9:35 am	<u>ES&amp;H and SAD</u>	N. Grossman
10:00 am	Break	
10:15 am	Questions and Answers	
11:30 am	DOE Executive Session	
12:30 pm	Working Lunch	
1:30 pm	Writing	
2:30 pm	Closeout	
3:00 pm	Adjourn	

# **APPENDIX D**

## **COST TABLES**

**NuMI Project Budget in \$TY -- Nov-03 Review**

(\$000's Omitted)

WBS	Item	NuMI Project Baseline - Burdened													bligations
		Nov-98	Sep-99	Mar-00	Sep-00	Mar-01	Sep-01	Oct-01	Dec-01	Mar-02	Sep-02	Mar-03	Sep-03	Mar-04	Thru 03/04
<b>1.0</b>	<b>Total Estimated Cost</b>	<b>\$76,198</b>	<b>\$76,198</b>	<b>\$76,200</b>	<b>\$76,200</b>	<b>\$76,149</b>	<b>\$76,149</b>	<b>\$109,242</b>	<b>98,674</b>						
1.1	Technical Components	15,254	15,882	17,740	18,541	18,656	18,656	27,962	26,432	27,260	26,160	26,219	26,768	28,62	26,107
1.2	Facility Construction	45,256	45,814	51,965	51,971	54,248	54,282	60,494	63,381	62,650	66,867	67,059	68,047	68,86	69,650
1.3	Project Management	2,825	2,825	2,825	2,825	3,046	3,046	4,788	4,430	4,430	4,430	4,430	4,330	3,58	2,916
	Indirects	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Contingency	12,863	11,677	3,670	2,863	199	166	15,998	14,999	14,902	11,785	11,534	10,097	8,14	
	% Contingency	20.3%	18.1%	5.1%	3.9%	0.3%	0.2%	17.2%	15.9%	15.8%	12.1%	11.8%	10.2%	8.1	
<b>2.0</b>	<b>Minos Detector</b>	<b>\$33,530</b>	<b>\$32,664</b>	<b>\$37,089</b>	<b>\$37,401</b>	<b>\$38,638</b>	<b>\$38,776</b>	<b>\$38,776</b>	<b>\$38,044</b>	<b>\$41,159</b>	<b>\$42,583</b>	<b>\$42,195</b>	<b>\$42,407</b>	<b>\$42,25</b>	<b>41,993</b>
2.1	Magnets: Steel and Coils	8,229	7,396	7,937	7,497	7,546	7,706	7,706	7,508	7,679	7,566	7,566	7,540	7,62	7,622
2.2	Scintillator Detector Fabrication	17,489	17,201	19,343	18,665	18,674	18,652	18,576	18,576	20,153	20,153	19,561	19,540	19,52	19,525
2.3	Electronics, DAQ & Database	3,994	4,943	6,684	7,016	7,084	7,084	7,084	7,008	8,529	8,618	9,222	9,222	9,06	9,056
2.4	Far Detector Installation	4,746	4,792	4,792	5,574	6,173	6,173	6,173	6,114	5,077	5,077	5,077	5,077	4,58	4,577
2.5	Near Detector Installation	2,050	2,073	2,073	2,389	2,762	2,762	2,762	2,564	3,448	4,896	4,495	4,753	5,07	4,385
2.6	Project Management	1,532	1,532	1,532	1,532	1,670	1,670	1,670	1,546	1,546	1,546	1,546	1,546	1,65	1,630
	Indirects	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	
	UK In-Kind Contribution	(4,510)	(5,272)	(5,272)	(5,272)	(5,272)	(5,272)	(5,272)	(5,272)	(5,272)	(5,272)	(5,272)	(5,272)	(5,27	(4,802)
<b>3.0</b>	<b>Project Support</b>	<b>\$10,343</b>	<b>\$12,483</b>	<b>\$12,551</b>	<b>\$15,126</b>	<b>\$16,108</b>	<b>\$16,108</b>	<b>\$16,108</b>	<b>\$16,218</b>	<b>\$16,218</b>	<b>\$16,218</b>	<b>\$16,377</b>	<b>\$16,378</b>	<b>\$16,14</b>	<b>16,142</b>
3.1	NuMI Conceptual Design	1,835	1,869	1,869	1,869	1,934	1,934	1,934	1,933	1,933	1,933	1,933	1,934	1,93	1,928
3.2	MINOS Detector R&D	1,604	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,780	1,78	1,768
3.3	MINOS Cavem	9,153	11,043	11,111	13,686	14,416	14,416	14,416	14,527	14,527	14,527	14,527	14,527	14,52	14,527
3.4	Soudan/Minos Operating	1,509	1,550	1,550	1,550	1,737	1,737	1,737	1,737	1,737	1,737	1,896	1,896	1,67	1,677
	Indirects	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Minnesota Funds	(3,758)	(3,758)	(3,758)	(3,758)	(3,758)	(3,758)	(3,758)	(3,758)	(3,758)	(3,758)	(3,758)	(3,758)	(3,75	(3,758)
	Contingency	\$16,027	\$14,753	\$10,260	\$7,373	\$7,454	\$7,315	\$7,315	\$7,938	\$4,822	\$3,399	\$3,628	\$3,414	\$3,79	
	% Contingency	36.5%	32.7%	20.7%	14.0%	13.6%	13.3%	13.3%	14.6%	8.4%	5.8%	6.2%	5.8%	6.5	
<b>1.0</b>	<b>Total Estimated Cost</b>	<b>\$76,198</b>	<b>\$76,198</b>	<b>\$76,200</b>	<b>\$76,200</b>	<b>\$76,149</b>	<b>\$76,149</b>	<b>\$109,242</b>	<b>98,674</b>						
<b>2.0 &amp; 3.0</b>	<b>Other Project Costs</b>	<b>59,900</b>	<b>59,900</b>	<b>59,900</b>	<b>59,900</b>	<b>62,200</b>	<b>62,200</b>	<b>62,200</b>	<b>62,200</b>	<b>62,200</b>	<b>62,200</b>	<b>62,200</b>	<b>62,200</b>	<b>62,200</b>	<b>58,135</b>
	<b>Total Project Costs</b>	<b>136,098</b>	<b>136,098</b>	<b>136,100</b>	<b>136,100</b>	<b>138,349</b>	<b>138,349</b>	<b>171,442</b>	<b>156,809</b>						

WBS Item	Project Estimate			DOE Assessment					Variance	Comments
	To Date	To Go	Total	To Date	To Go	Contingency		Total		
	Cost	Cost		Cost	Cost	\$	%			
<b>1.1 Technical Components</b>	\$24,910	\$3,714	\$28,624	\$24,910	\$3,714	\$0	0%	\$28,624	\$0	
1.1.1 Extraction & Primary Beam	5,188	98	5,287	5,188	98		0%	5,287	0	
1.1.2 Neutrino Beam Devices	10,030	607	10,638	10,030	607		0%	10,638	0	
1.1.3 Power Supply System	4,730	285	5,015	4,730	285		0%	5,015	0	
1.1.4 Hadron Decay and Absorber	839	596	1,434	839	596		0%	1,434	0	
1.1.5 Neutrino Beam Monitoring	418	64	481	418	64		0%	481	0	
1.1.6 Alignment Systems	199	109	308	199	109		0%	308	0	
1.1.7 Water, Vacuum & Gas Systems	1,747	788	2,535	1,747	788		0%	2,535	0	
1.1.8 Installation and Integration	1,696	1,168	2,865	1,696	1,168		0%	2,865	0	
1.1.9 Hadronic Hose	63	(1)	62	63	(1)	0	Done	62	0	
<b>1.2 Facility Construction</b>	\$69,460	(\$566)	\$68,893	\$69,460	(\$566)	\$0	0%	\$68,893	\$0	
1.2.1 Facility Physics Design	70	(0)	70	70	(0)	0	Done	70	0	
1.2.2 Facility Const Title I Design	1,437	1	1,438	1,437	1	0	Done	1,438	0	
1.2.3 Facility Const Title II Design	2,974	1	2,975	2,974	1	0	Done	2,975	0	
1.2.4 Facility Construction Phase	64,978	(568)	64,410	64,978	(568)		0%	64,410	0	
<b>1.3 Project Management</b>	\$2,916	\$664	\$3,580	\$2,916	\$664	\$0	0%	\$3,580	\$0	
1.3.1 FY 98 Project Management	141	133	275	141	133	0	Done	275	0	
1.3.2 FY 99 Project Management	661	(102)	560	661	(102)	0	Done	560	0	
1.3.3 FY 00 Project Management	663	(88)	575	663	(88)	0	Done	575	0	
1.3.4 FY 01 Project Management	423	265	688	423	265	0	Done	688	0	
1.3.5 FY 02 Project Management	324	378	703	324	378	0	Done	703	0	
1.3.6 FY 03 Project Management	421	120	541	421	120	0	Done	541	0	
1.3.7 FY 04 Project Management	283	(174)	108	283	(174)		0%	108	0	
1.3.8 FY 05 Project Management	0	130	130	0	130		0%	130	0	
Contingency	0	8,145	8,145	0	8,145			8,145	0	
<b>Total Estimated Cost</b>	\$97,286	\$11,956	\$109,242	\$97,286	\$11,956	\$0	0%	\$109,242	\$0	
<b>2.0 MINOS Detector</b>	\$46,535	\$993	\$47,528	\$46,535	\$993	\$0	0%	\$47,528	\$0	
2.1 Magnets: Steel & Coils	7,621	0	7,621	7,621	0		0%	7,621	0	
2.2 Scintillator Detector Fabrication	19,525	(0)	19,525	19,525	(0)		0%	19,525	0	
2.3 Electronics, DAQ & Database	8,937	132	9,069	8,937	132		0%	9,069	0	
2.4 Far Detector Installation	4,576	4	4,581	4,576	4		0%	4,581	0	
2.5 Near Detector Installation	4,245	829	5,074	4,245	829		0%	5,074	0	
2.6 MINOS Project Management	1,630	28	1,658	1,630	28		0%	1,658	0	

WBS Item	Project Estimate			JOE Assessment					Variance
	To Date	To Go	Total	To Date	To C	Contingency		Total	
	Cost	Cost		Cost	Cost	\$	%		
3.0 Project Support	\$19,900	\$6	\$19,906	\$19,900	6	\$0		\$19,906	\$0
3.1 NuMI Conceptual Design	1,928	6	1,934	1,928	6	0	Done	1,934	0
3.2 MINOS Detector R&D	1,768	0	1,768	1,768	0	0	Done	1,768	0
3.3 MINOS Cavern	14,527	(0)	14,527	14,527	)	(0)	Done	14,527	(0)
3.4 Soudan/MINOS Operating	1,677	(0)	1,677	1,677	)	(0)	Done	1,677	(0)
<b>Sub Total - All Funds</b>	<b>\$66,435</b>	<b>\$999</b>	<b>\$67,434</b>	<b>\$66,435</b>	<b>\$9</b>	<b>\$0</b>	<b>0%</b>	<b>\$67,434</b>	<b>\$0</b>
Contingency	0	3,796	3,796	0	36			3,796	0
<b>Total NuMI Other Project Costs</b>	<b>\$66,435</b>	<b>\$4,794</b>	<b>\$71,230</b>	<b>\$66,435</b>	<b>\$44</b>	<b>\$0</b>	<b>0%</b>	<b>\$71,230</b>	<b>\$0</b>
UK In-Kind Contribution	(4,802)	(470)	(5,272)	(4,802)	(1)	0	0%	(5,272)	0
Minnesota Preconstruction Funds	(758)	0	(758)	(758)	0	0	Done	(758)	0
Minnesota Construction Funds FY99	(3,000)	0	(3,000)	(3,000)	0	0	Done	(3,000)	0
<b>Total US Funds</b>	<b>\$57,876</b>	<b>\$4,324</b>	<b>\$62,200</b>	<b>\$57,876</b>	<b>\$44</b>	<b>\$0</b>	<b>0%</b>	<b>\$62,200</b>	<b>\$0</b>
<b>Total Project Cost</b>	<b>\$155,162</b>	<b>\$16,280</b>	<b>\$171,442</b>	<b>\$155,162</b>	<b>\$16,0</b>	<b>\$0</b>	<b>0%</b>	<b>\$171,442</b>	<b>\$0</b>

Variance Summary Table		(Cumulative to Date as of 3/31/04)			
WBS / Description	Budgeted Cost		Actual Cost	Variance	
	Work Scheduled	Work Performed	Work Performed	Schedule	Cost
1.1 Technical Components	23,331	24,566	24,910	1,235	(345)
1.2 Facility Construction	68,893	68,893	69,460	0	(566)
1.3 Project Management	3,395	3,395	2,916	0	479
<b>1.0 TEC Total</b>	<b>95,620</b>	<b>96,854</b>	<b>97,286</b>	<b>1,235</b>	<b>(432)</b>
2.1 Magnets: Steel & Coils	7,621	7,621	7,621	0	0
2.2 Scintillator Detector Fabrication	19,525	19,525	19,525	0	(0)
2.3 Electronics, DAQ & Database	9,019	8,993	8,937	(27)	56
2.4 Far Detector Installation	4,581	4,581	4,576	0	4
2.5 Near Detector Installation	4,168	4,156	4,245	(12)	(90)
2.6 MINOS Project Management	1,621	1,621	1,630	(0)	(9)
UK In-Kind Contribution	(4,820)	(4,802)	(4,802)	18	0
<b>2.0 MINOS Detector</b>	<b>41,716</b>	<b>41,695</b>	<b>41,734</b>	<b>(21)</b>	<b>(39)</b>
3.1 NuMI Conceptual Design	1,934	1,934	1,928	0	6
3.2 MINOS Detector R&D	1,768	1,768	1,768	(0)	0
3.3 MINOS Cavern	14,527	14,527	14,527	0	0
3.4 Soudan/MINOS Operating	1,677	1,677	1,677	0	(0)
Minnesota Preconstruction Funds	(758)	(758)	(758)	0	0
Minnesota Construction Funds FY99	(3,000)	(3,000)	(3,000)	0	0
<b>3.0 NuMI Project Support</b>	<b>16,148</b>	<b>16,148</b>	<b>16,142</b>	<b>0</b>	<b>6</b>
<b>OPC Total</b>	<b>57,864</b>	<b>57,843</b>	<b>57,876</b>	<b>(21)</b>	<b>(33)</b>
<b>TPC Total</b>	<b>153,483</b>	<b>154,697</b>	<b>155,162</b>	<b>1,214</b>	<b>(465)</b>

### WBS1.1

Schedule variance real and positive.

Negative cost variance includes spares (~230K, removed in FY05)

### WBS 1.2

Dominated by claim accrual

### WBS 1.3

Positive cost variance

WBS Item	Sep-03 Estimate	Mar-04 Estimate	Contingency Use	Description
<b>1.1 Technical Components</b>	<b>\$26,768</b>	<b>\$28,624</b>	<b>(\$1,856)</b>	
1.1.1 Extraction & Primary Beam	4,887	5,287	(400)	shutdown T&M overruns, instrumentations
1.1.2 Neutrino Beam Devices	10,012	10,638	(625)	chiller, target pile installation labor
1.1.3 Power Supply System	4,738	5,015	(277)	cooling upgrade and accumulated labor variances
1.1.4 Hadron Decay and Absorber	1,332	1,434	(102)	variances during design
1.1.5 Neutrino Beam Monitoring	481	481	(0)	
1.1.6 Alignment Systems	308	308	(0)	
1.1.7 Water, Vacuum & Gas Systems	2,185	2,535	(350)	primary beam gas system, LCW and RAW installation
1.1.8 Installation and Integration	2,764	2,865	(101)	shield door
1.1.9 Hadronic Hose	62	62	0	
<b>1.2 Facility Construction</b>	<b>\$68,047</b>	<b>\$68,893</b>	<b>(\$846)</b>	changes during SBO
<b>1.3 Project Management</b>	<b>\$4,330</b>	<b>\$3,580</b>	<b>\$750</b>	remove excess budget
Contingency	10,097	8,145	1,952	
<b>Total Estimated Cost</b>	<b>\$109,242</b>	<b>\$109,242</b>	<b>\$0</b>	
<b>2.0 MINOS Detector</b>	<b>\$47,679</b>	<b>\$47,528</b>	<b>\$150</b>	closeout and installation replan
2.1 Magnets: Steel & Coils	7,540	7,621	(81)	
2.2 Scintillator Detector Fabrication	19,540	19,525	15	
2.3 Electronics, DAQ & Database	9,222	9,069	154	
2.4 Far Detector Installation	5,077	4,581	496	
2.5 Near Detector Installation	4,753	5,074	(321)	
2.6 MINOS Project Management	1,546	1,658	(112)	
<b>3.0 Project Support</b>	<b>\$20,136</b>	<b>\$19,906</b>	<b>\$231</b>	
Contingency + MINOS Scope Reserve	3,414	3,796	(381)	
<b>Total US Funds</b>	<b>\$62,200</b>	<b>\$62,200</b>	<b>(\$0)</b>	
<b>Total Project Cost</b>	<b>\$171,442</b>	<b>\$171,442</b>	<b>(\$0)</b>	

## NuMI Project Change Requests

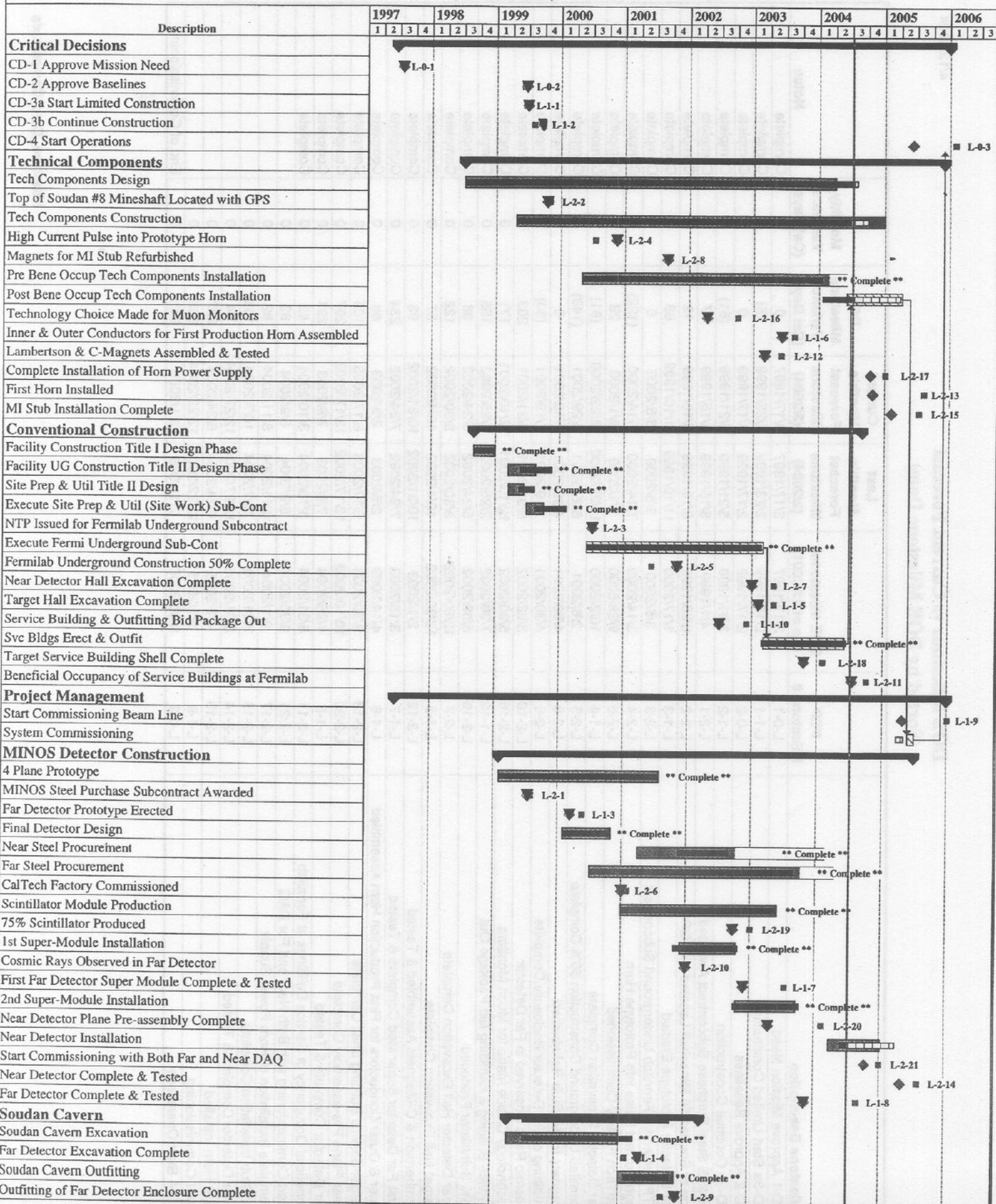
CR #	L2 WBS	Description	Amount	Reported
246	2.3 / 2.5	Milestone Revisions: WBS 2.3 and 2.5	0.00	Jan-04
247	2.1	Adjust WBS 2.1 Estimates to Final Cost	81,017.73	Nov-03
248	2.2	Retire WBS 2.2 Cost Variances	(15,317.00)	Dec-03
249	2.3	Retire WBS 2.3.2 Cost Variances	12,463.48	Jan-04
250	2.4	Retire WBS 2.4 Cost Variances	(496,000.39)	Jan-04
251	2.5	Replan WBS 2.5	(28,750.86)	Feb-04
252	1.1	Correct Oversight from CR #242	96,573.76	Oct-03
253	2.6	Project Mgmt Budget Adjustment	112,463.78	Nov-03
254	2.5	Revise Level 3 Milesones	0.00	Oct-03
255	1.1	Scope Changes to WBS 1.1.7	349,373.52	Nov-03
256	1.1	Installation Re-estimate	400,000.85	Nov-03
257	1.3	Return Budget to Contingency	(199,979.24)	Nov-03
258	1.1	Adjust Account Budgets	0.00	Dec-03
259	1.1	Multi Wire Cost Increase	168,508.60	Jan-04
260	3.2	Retire WBS 3.2 Cost Variances	(11,700.89)	Jan-04
261	3.4	Retire WBS 3.4 Cost Variances	(219,071.60)	Jan-04
262	2.3	Retire WBS 2.3.5 Cost Variances	(38,302.23)	Jan-04
263	2.3	Retire WBS 2.3.9 Cost Variances	(5,845.66)	Jan-04
264		Withdrawn	0.00	
266		Withdrawn	0.00	
268		Withdrawn	0.00	
269	2.3	Retire WBS 2.3 Cost Variances	(121,998.15)	Jan-04
270	1.1	Milestone Revisions: UID's 73484, 73497, 73498	0.00	Jan-04
271	1.1	Revise WBS 1.1.7 - Split Decay Pipe RAW into US/DS Tasks	(0.00)	Jan-04
272	1.1	Air Block Installation & Air System Components	270,000.07	Jan-04
273	1.1	Cable Installation & Kicker Power PS Construction	274,984.72	Jan-04
274	1.3	Return WBS 1.3 Budget to Contingency	(299,968.86)	Jan-04
275	1.2	Adjust RBI Budget	846,207.12	Jan-04
276	2.5	Adjust RBI Budget	349,836.47	Jan-04
277	1.1	WBS 1.1. Replan	17,763.75	Feb-04
278	1.1	Add Magnet Cooling Fin Budget	28,599.56	Mar-04
279	1.1 / 1.3	Adjust WBS 1.1.2 Installation Budget	(0.22)	Mar-04
		Total CR's Approved since Sep-03	1,570,858.33	

# **APPENDIX E**

## **SCHEDULE CHARTS**

# NuMI Project (Fiscal Years)

4/13/04



Project: NuMI\_Master\_Sched  
Date: 4/13/04

Baseline Task Critical Task	 	Summary Task DOE Baseline Milestone	  	FNAL Current Projection Milestone Complete	FNAL Forecast Task Status
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**DOE Milestone vs Current Forecast  
(Sorted by DOE Milestone Date)**

4/12/2004

Milestone Description	PEP Milestone #	DOE Milestones (As of 12/2001)	Last Month's Forecast Milestone (2/2004)	Current Month's Forecast Milestone (3/2004)	DOE Milestone Variance (Cal Days)	Monthly Variance (Cal Days)	Notes
CD-1 Approve Mission Need	L-0-1	3/17/1997	3/17/1997	3/17/1997	0	0	Complete
CD-3a Start Limited Construction	L-1-1	2/15/1999	2/23/1999	2/23/1999	(8)	0	Complete
CD-2 Approve Baselines	L-0-2	2/17/1999	2/17/1999	2/17/1999	0	0	Complete
CD-3b Continue Construction	L-1-2	3/31/1999	5/21/1999	5/21/1999	(51)	0	Complete
MINOS Steel Purchase Subcontract Awarded	L-2-1	4/1/1999	3/15/1999	3/15/1999	17	0	Complete
Top of Soudan #8 Mineshaft Located with GPS	L-2-2	6/28/1999	6/16/1999	6/16/1999	12	0	Complete
Far Detector Prototype Erected	L-1-3	1/17/2000	11/10/1999	11/10/1999	68	0	Complete
NTP Issued for Fermilab Underground Subcontract	L-2-3	3/6/2000	3/6/2000	3/6/2000	0	0	Complete
High Current Pulse into Prototype Horn	L-2-4	3/14/2000	7/14/2000	7/14/2000	(122)	0	Complete
CalTech Factory Commissioned	L-2-6	9/29/2000	9/1/2000	9/1/2000	28	0	Complete
Far Detector Excavation Complete	L-1-4	10/2/2000	12/22/2000	12/22/2000	(81)	0	Complete
Fermilab Underground Construction 50% Complete	L-2-5	2/6/2001	6/29/2001	6/29/2001	(143)	0	Complete
Magnets for MI Stub Refurbished	L-2-8	4/30/2001	4/30/2001	4/30/2001	0	0	Complete
Outfitting of Far Detector Enclosure Complete	L-2-9	4/30/2001	7/19/2001	7/19/2001	(80)	0	Complete
Cosmic Rays Observed in Far Detector	L-2-10	3/22/2002	8/31/2001	8/31/2001	203	0	Complete
Technology Choice Made for Muon Monitors	L-2-16	5/30/2002	12/10/2001	12/10/2001	171	0	Complete
Service Building & Outfitting Bid Package Out	L-1-10	7/30/2002	2/25/2002	2/25/2002	155	0	Complete
75% Scintillator Produced	L-2-19	8/30/2002	5/24/2002	5/24/2002	98	0	Complete
Near Detector Hall Excavation Complete	L-2-7	12/30/2002	8/30/2002	8/30/2002	122	0	Complete
Target Hall Excavation Complete	L-1-5	12/30/2002	10/4/2002	10/4/2002	87	0	Complete
Lambertson & C-Magnets Assembled & Tested	L-2-12	2/1/2003	10/31/2002	10/31/2002	93	0	Complete
First Far Detector Super Mod Complete & Tested	L-1-7	3/15/2003	7/24/2002	7/24/2002	234	0	Complete
Inner & Outer Conductors for First Production Horn Assembled	L-1-6	4/14/2003	2/5/2003	2/5/2003	68	0	Complete
Target Service Building Shell Complete	L-2-18	9/30/2003	6/17/2003	6/17/2003	105	0	Complete
Near Plane Pre-assembly Complete	L-2-20	10/10/2003	12/17/2002	12/17/2002	297	0	Complete
Far Detector Complete & Tested	L-1-8	4/25/2004	7/9/2003	7/9/2003	291	0	Complete
Beneficial Occupancy of Service Buildings at Fermilab	L-2-11	5/31/2004	3/10/2004	3/10/2004	82	0	Complete
Start Commissioning with Both Near and Far DAQ	L-2-21	8/30/2004	6/9/2004	6/9/2004	82	0	
Complete Installation of Horn Power Supply	L-2-17	9/1/2004	6/11/2004	6/11/2004	82	0	
MI Stub Installation Complete	L-2-15	3/11/2005	10/7/2004	10/7/2004	155	0	
Near Detector Complete & Tested	L-2-14	3/31/2005	12/27/2004	12/27/2004	94	0	
First Horn Installed	L-2-13	4/7/2005	6/24/2004	6/24/2004	287	0	
Start Commissioning	L-1-9	9/1/2005	12/22/2004	12/22/2004	253	0	
CD-4 Start Operations	L-0-3	9/30/2005	2/1/2005	2/1/2005	241	0	End of Commissioning



# Doe Milestones FY2002-2005

G. Bock  
DOE Office of Science  
Review  
May 2004  
Page 28

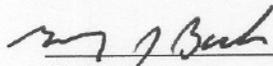
Milestone Description	PEP Milestone #	DOE Milestones	March Forecast	Float	Notes
Cosmic Rays Observed in Far Detector	L-2-10	3/22/2002	8/31/2001	203	Complete
Technology Choice Made for Muon Monitors	L-2-16	5/30/2002	12/10/2001	171	Complete
Service Building & Outfitting Bid Package Out	L-1-10	7/30/2002	2/25/2002	155	Complete
75% Scintillator Produced	L-2-19	8/30/2002	5/24/2002	98	Complete
Near Detector Hall Excavation Complete	L-2-7	12/30/2002	8/30/2002	122	Complete
Target Hall Excavation Complete	L-1-5	12/30/2002	10/4/2002	87	Complete
Lambertson & C-Magnets Assembled & Tested	L-2-12	2/1/2003	10/31/2002	93	Complete
First Far Detector Super Mod Complete & Tested	L-1-7	3/15/2003	7/24/2002	234	Complete
Inner & Outer Conductors for First Production Horn Assembled	L-1-6	4/14/2003	2/5/2003	68	Complete
Target Service Building Shell Complete	L-2-18	9/30/2003	6/17/2003	105	Complete
Near Plane Pre-assembly Complete	L-2-20	10/10/2003	12/17/2002	297	Complete
Far Detector Complete & Tested	L-1-8	4/25/2004	7/9/2003	291	Complete
Beneficial Occupancy of Service Buildings at Fermilab	L-2-11	5/31/2004	3/10/2004	82	<b>COMPLETED MAR 10</b>
Start Commissioning with Both Near and Far DAQ	L-2-21	8/30/2004	6/9/2004	82	
Complete Installation of Horn Power Supply	L-2-17	9/1/2004	6/11/2004	82	<b>COMPLETED MAY 21</b>
MI Stub Installation Complete	L-2-15	3/11/2005	10/7/2004	155	
Near Detector Complete & Tested	L-2-14	3/31/2005	12/27/2004	94	
First Horn Installed	L-2-13	4/7/2005	6/24/2004	287	
Start Commissioning	L-1-9	9/1/2005	12/22/2004	253	
CD-4 Start Operations	L-0-3	9/30/2005	2/1/2005	241	End of Commissioning

Start commissioning with protons in December 2004

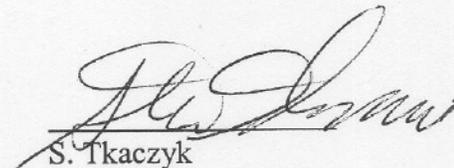
# **APPENDIX F**

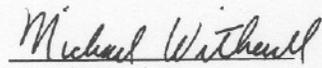
## **ACTION ITEMS**

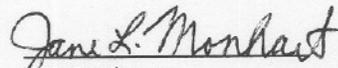
<u>Action</u>	<u>Responsibility</u>	<u>Due Date</u>
Jointly determine the timing and scope of the next review.	DOE/Fermilab	September 15, 2004

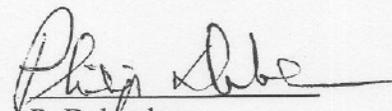
  
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NuMI Project Manager  
Fermilab

  
S. Webster  
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Fermi Area Office

  
S. Tkaczyk  
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Director  
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J. Monhart  
Manager  
Fermi Area Office

  
P. Debenham  
NuMI Program Manager  
Office of Science