Close-Out Report

on the

Department of Energy
Review Committee Report

on the

Mini-Review

of the

D-Zero Detector Upgrade

November 4, 1999

Department of Energy Review
of the
CDF/D-Zero Detector Upgrade Projects

REVIEW COMMITTEE MEMBERS

Department of Energy

Mr. Daniel Lehman, SC-81, Chairman	301-903-4840	daniel.lehman@science.doe.gov
Mr. Steve Tkaczyk, SC-81	301-903-3288	steve.tkaczyk@science.doe.gov
Dr. Jack Ritchie, SC-223	301-903-4801	jack.ritchie@science.doe.gov
Mr. Paul Philp, Fermi Group	630-840-4481	paul.philp@ch.doe.gov

Consultants

Professor Tony Barker, Colorado	303-492-6074	tonyb@colohe.colorado.edu
Mr. Bill Edwards, LBNL	510-486-7271	wredwards@lbl.gov
Professor David MacFarlane, UC San Diego	619-822-1452	dbmacfarlane@ucsd.edu
Professor Harry Nelson, UC Santa Barbara	805-893-8612	hnn@charm.physics.ucsb.edu

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(8-89)
EFG (07-90)

United States Government **Department of Energy**

memorandum

DATE: October 5, 1999

REPLY TO ATTN OF: Office of Science

SUBJECT: Review of the CDF and D-Zero Upgrades for Run II

TO: Dan Lehman, Director, Construction Management Support Division, SC-81

I am requesting that you carry out, consistent with the Action Items from the review you conducted June 15-18, 1999, a follow-up review of the CDF and D-Zero Upgrades for Run II at Fermilab. The June review indicated that the schedules for both detectors were optimistic, particularly so for D-Zero. Subsequently, both detectors have revised their construction and installation schedules, and the Laboratory has developed a new running schedule that is consistent with the new detector schedules.

The review should focus on management, cost, schedule, and technical issues to the extent they affect schedule. Within this framework, make assessments of:

- the current status of the Upgrade projects;
- the likelihood the new schedules will be maintained;
- the appropriateness of steps being taken by the CDF and D-Zero project managers to assure they are maintained; and
- the appropriateness of the Laboratory's oversight of these projects.

In addition, assess the impact upon the schedules from construction activities that are not part of the baselines for these detectors.

Dates for the review of November 3-4, 1999, have been established in consultation with the Laboratory. I would appreciate receiving a formal report of your review by December 23, 1999. Jack Ritchie, the Fermilab program officer, will assist you and will act as the representative of the Division of High Energy Physics.

We appreciate your help in this matter. These reviews are an essential management element in the Department of Energy's oversight of the CDF and D-Zero upgrades.

Robert Woods

for John R. O'Fallon
Director
Division of High Energy Physics

cc: S. P. Rosen, SC-20
Mike Witherell, Fermi
Ken Stanfield, Fermi
Robert Wunderlich, Fermi Group

Department of Energy Review
of the
CDF/D-Zero Detector Upgrade Projects

REPORT OUTLINE WRITING ASSIGNMENTS

CDF Detector Upgrade

Summary ..... Philp*/Tkaczyk

1. Technical Systems Overview
   - 1.1 Silicon Detector System ..... Nelson*/Barker
   - 1.2 Central Tracker ..... MacFarlane*
2. Cost ..... Tkaczyk*
3. Schedule—Installation and Commissioning ..... *Edwards*

D-Zero Detector Upgrade

Summary ..... *Philp*/Tkaczyk*

1. Technical Systems Overview
   - 1.1 Silicon Detector System ..... Nelson*/Barker
   - 1.2 Fiber Tracker ..... MacFarlane*
2. Cost ..... Tkaczyk*
3. Schedule—Installation and Commissioning ..... Edwards

*Lead for writing assignment.

Tony Barker / Harry Nelson
11/4/99 15:30 CDT

1.1 Silicon Detector System

Findings

- Sensor deliveries from Micron have, since June, accelerated significantly. The problems with F-wedge sensors have largely been resolved, and a second F-wedge vendor (Eurisys) is in production. The delivery of DSDM 90° sensors remains slow.

- Production of 3-chip and 9-chip ladders, and H-half wedges, all to be used in the final SMT is well underway. Approximately 20% of all modules have been assembled. Extensive facilities and procedures have been developed for the remaining assembly tasks.

- HDI production is complete, but there have been significant quality-control problems in chip-mounting and wirebonding at Promex

more Findings

- Problems with low mass cable procurement have been solved, and production of the final versions of the low mass cables has begun

- Major changes in the scope of the Interface Card have caused substantial delays and cost increases. Two additional prototype cycles are planned before production can begin

- The silicon management does not believe that adequate technical manpower is in place.

- The SMT assembly and installation schedules have been reevaluated and new milestones have been established.

- In the response to the June review, silicon management indicated that a decision would be needed by around Jan. 1, 2000 regarding whether to descope SMT.

Comments

- The DØ silicon group has done a good job of monitoring sensor production at Micron. Current delivery rates are adequate to meet the proposed schedule.
- We commend the SMT team for their excellent progress on assembling production ladders and wedges. The ~200 modules already built and now being tested represent major progress toward a completed detector.
- Quality control of HDI population at Promex has been poor. We endorse the group's efforts to identify an alternate vendor.
- The status of the Interface Card should be carefully monitored. Additional design changes should be avoided.
- The 10% test is a good approach to understanding the remaining assembly and commissioning issues.

more Comments

- Additional efforts should be made to utilize the substantial experience in production already gained in order to better understand the detailed schedule and resource requirements for remaining tasks.
- The Jan 1, 2000 decision date for descoping the SMT is early, relative to the planned SMT completion date.
- The overall schedule is achievable, but optimistic.

Recommendations

- Improve communication between the DØ silicon group, DØ project management, and SiDet management. Ensure that DØ is aware of the status of their requests for equipment and personnel.

- The DØ silicon group should be provided with adequate technical manpower, particularly for post-production testing and rework.

- Re-evaluate the Jan. 1, 2000 decision date for descoping the SMT, in view of the overall laboratory schedule.

- By May 1, 2000 the collaboration should submit a detailed SMT installation plan to laboratory management. The plan should specify any descoping that is necessary to meet the laboratory schedule.

- Develop time contingency in the silicon schedule to allow for unforeseen delays

D.MacFarlane
Version 1.0

1.2 Fiber Tracker

Findings

- Mounting of ribbons on the first production cylinder (3B) completed in early September
- Problems discovered at that time:
  - Connector dimensional change causes interference
  - *Alignment of axial layers does not meet specification*
- Consequences
  - Delay in further ribbon mounting, interrupting main production line
  - Time required investigating, devising alternative for connector, and arranging machining of new parts
- VLPC production not started yet
  - Delays due to vendor problems with manufacture of flexible cables
  - All other components available, production steps devised, tooling available, and personnel trained
- Most carbon fiber cylinders completed; ribbon production nearly 50% complete, tooling for trial nesting assembly of cylinders 7 and 8 available by December 1
- New procedure for trial installation and alignment of H-disk and barrel CF mounting cylinder inside the fiber tracker, reduces installation coupling between the systems
- Completion of mechanical assembly delayed from January 24 to May 4, 2000
- Completion of VLPC installation delayed from May 25 to September 13, 2000

Comments

- Production schedule involves tightly orchestrated and interleaved process of fiber procurement, ribbon production and mounting, and nesting of completed cylinders
- Appear to be ways to accelerate some of these steps, for example with early delivery of fiber or faster curing RTV for mounting
- Critical path will continue to be assembly of completed cylinders, which will not be easy to advance from present projected completion date
- Most technical problems have been investigated; team appears to have sufficient technical manpower and has good control of the assembly steps
  - Ready for full production following well thought-out schedule
- Some tolerances for the mechanical construction may not be achievable
  - May need to relax the requirements in order to keep production underway with out further delays
- Nesting of completed cylinders is the critical path for the mechanical assembly
  - Timely physicist assessment of CMM data will be essential to maintaining tight schedule
  - Completion of trial assembly of test parts in December very important for early exposure of unexpected problems and completion of required tooling
- Appears to be adequate float in the scheduled installation of the Fiber Tracker to accommodate delays in delivery of the mechanical system without compromising March 1, 2001 date for Run II

Recommendations

1. D0 Collaboration and Project Management should evaluate the impact of looser tolerances for axial ribbon alignment or inter-cylinder alignment on the L1 trigger
2. D0 Collaboration and Project Management should identify 2-3 new postdoc-level physicists to be added to the Fiber Tracker project in the very near term
3. Resume production of ribbon-mounting on production cylinders as soon as possible
4. Complete trial assembly of nested cylinders before the end of this year
5. Prepare a commissioning plan for summer and fall cosmic running, including online software and physics goals

D.MacFarlane
Version 1.0

1.3 Muon Systems

Findings

- Production of pixel trigger quadrants is underway, with 16 out of 48 completed
  - Rate of assembly appears to be close to the predicted 1.1/week
- Production of MDT planes has not started
  - Installation of MDT planes has slipped from April 26 to August 4, 2000
  - Delivery of full complement of mini-drift tubes from Dubna has been delayed from October, 1999 to January, 2000
  - Appears to be difficulty in obtaining large area honeycomb back planes which meet tight flatness specification

Comments

- Schedule for this project has eroded by more than 3 months since the June review, rather than moving forward an accelerated pace as recommended
  - Appears to be partly due to delays in identifying vendors for components meeting tight flatness specification

Recommendations

1. D0 Collaboration and Project Management should be prepared to make timely decisions of relaxing technical requirements and tolerances should these prove difficult to achieve technically while still maintaining production
2. Find ways to win back lost schedule contingency by increasing production rates of forward muon systems octant assembly

2. COST

2.1 Findings

The D-Zero project developed a new bottoms-up cost estimate for Materials and Services (M&S), as well as the Solenoid, in the October-November 1999 time frame. The total cost for M&S and the Solenoid, at $45,478 K, is a slight increase from the June 1999 review. There have been change control actions since the previous review that have resulted in utilization of contingency, as indicated in the table below. Currently, 90 percent of the total M&S and Solenoid cost has been obligated.

M&S and Solenoid Costs
(In thousands of then year dollars)

	June 1999 Review	November 1999 Review	Changes	Obligated	Estimate to Complete
M&S	38,533	40,244	1,711	35,119	5,125
Solenoid	4,936	4,975	39	4,975	0
Contingency	2,009	635	-1,374	0	635
Total	45,478	45,854	0	40,094	5,760

The major changes since the June 1999 review were in the area of the Silicon Tracker ($1.6 million). The project has not identified any potential significant changes which would further draw on the remaining $635k of contingency.

Costs for Salary, Wages and Fringes were reported as $19.1 million through FY01 in then year dollars

2.2 Comments

The contingency remaining for the M&S and Solenoid costs at $635k is 12 percent of the estimate to complete. The project indicated (and the committee concurred) that this level of contingency is uncomfortable. Further utilization of contingency will have to be carefully executed.

2.3 Recommendations

None.

3.0 Installation / Commissioning + Schedule

findings:

- Si Trkr schedule is tight – no hic-ups in production / ~~allowed~~ assembly allowed (C.P.)

- Fiber Tracker – 1 of 8 cyl. has been completed. Some decisions have been made recently to reduce alignment spec. Some loss of float has occurred recently.

- μ-system – MDT portion of Fwd μ supt. is off to slow start. Decision on flatness spec. -vs- survey/mapping will have to be made soon. Some loss of float has/will occur.

- While there's a good deal of existing "infrastructure" (cooling, gas, pwr, etc.) in DØ, much of the new detector component infrastr. hasn't yet been installed on the detector. (counting house is better)

- Pre-production versions of all the various types of boards + modules (electronics) will be available for testing in March, 2000.

- Cosmic testing/commis. of Central μ supt. has begun + Cosmic testing on all but Si Trkr system

cont

~~will~~ is planned to begin by late Sept, 2000.

- "commissioning workshops" ~~for~~ of various kinds (trg., etc.) have taken place and have provided
- a detailed resource loaded schedule showing links/dependencies exists & is being updated on occasion
- a commissioning plan exists but is not resource loaded. It may take 2-3 mo's. of beam commissioning before detector is "physics ready".
- Some thinking has transpired, within the collaboration, regarding "fallback" plans should component schedules slip significantly.

comments:

(1) The installation & integration group should consider proceeding @ a faster pace in finalizing the design and installation of the infrastructure items - gas system, water, DC pwr. cabling, interlocks/safety systems, etc.

cont

(2) urge continuation of the "commissioning workshops" for the purposes of:
- communication of plans/goals ~~problems~~
- problem solving

(3) By further refining (or beginning to load) the resource-loaded schedules ~~so~~ the project will benefit.
- identify skillset & quantity of resources
- identify ~~dates~~ need dates

(4) Some consideration should be given to displaying schedule & milestone information in a format that ~~is~~ allows Sr. Mgmt to more effectively review & understand.
- 1 page GANT chart
- highlighting Critical Path
- highlighting ammount of float in non C.P. subsystems

(5) The schedule of DØ being complete by Feb 02, 2001 is reasonable, but optimistic, unless the collaboration is willing enact a fallback plan (if necessary) &/or reduce the scope of the commissioning effort.

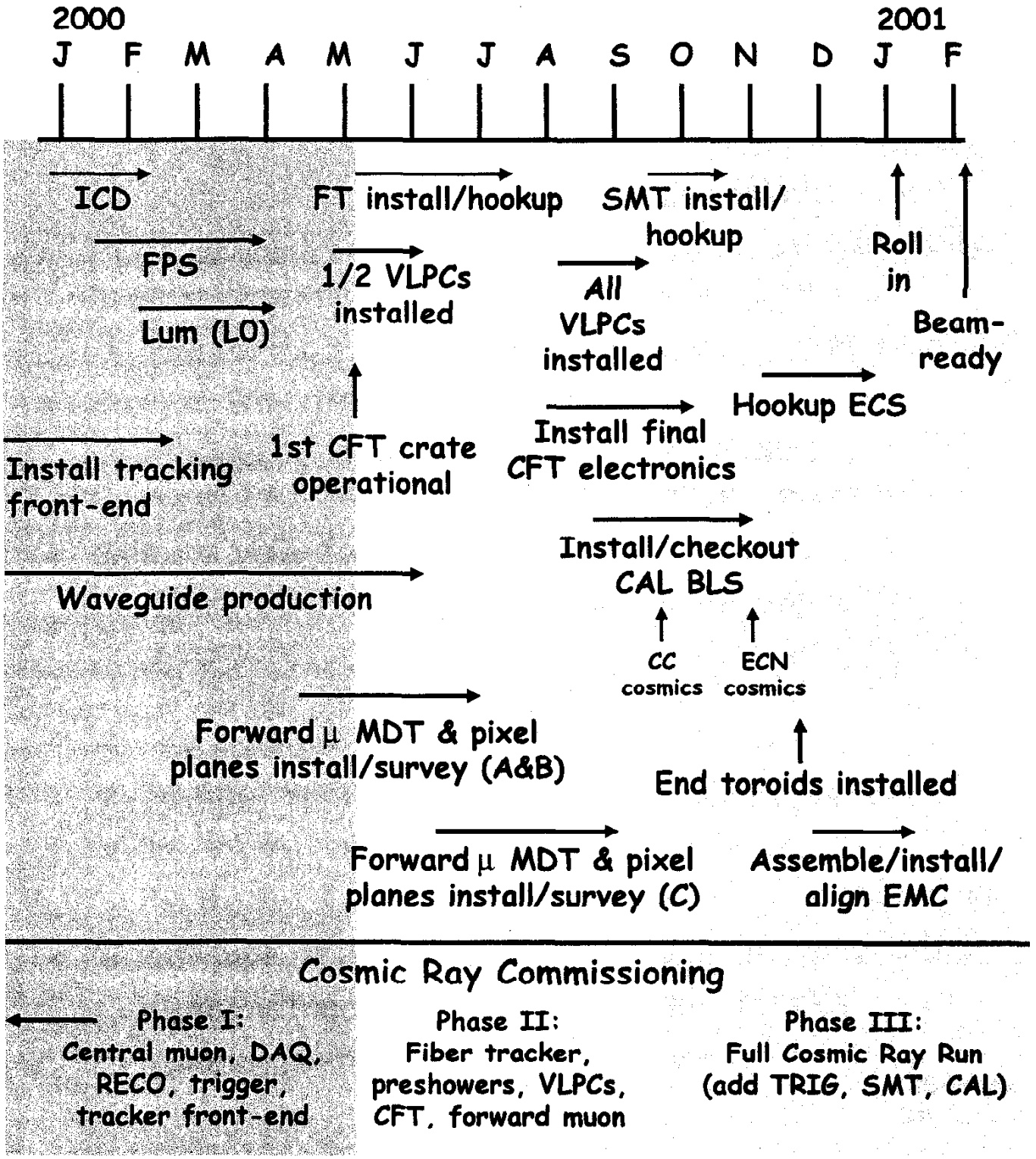
Con't

Recommendations :

1. Develop a fallback plan that will assure DØ will meet the ready for beam milestone (stated as Feb 02, '01) by Jan. 30, 2000.

2. Further develop a detailed commissioning plan & goals, including resources, by Jan 30, 2000.

DO Timeline


2000
2001
J F M A M J J A S O N D J F
ICD
FT install/hookup
SMT install/ hookup
FPS
1/2 VLPCs installed
All VLPCs installed
Roll in
Lum (L0)
Beam-ready
Hookup ECS
Install final CFT electronics
1st CFT crate operational
Install tracking front-end
Install/checkout CAL BLS
Waveguide production
CC cosmics
ECN cosmics
Forward μ MDT & pixel planes install/survey (A&B)
End toroids installed
Forward μ MDT & pixel planes install/survey (C)
Assemble/install/ align EMC
Cosmic Ray Commissioning
Phase I: Central muon, DAQ, RECO, trigger, tracker front-end
Phase II: Fiber tracker, preshowers, VLPCs, CFT, forward muon
Phase III: Full Cosmic Ray Run (add TRIG, SMT, CAL)

Project	Milestone	Cur. Date	% Complete	Baseline	Variance
Calor Electronics 98	SCA Testing Complete	12/15/99	0%	12/15/99	0 w
Calor Electronics 98	M2-Calorimeter Preamp System Test Complete	4/4/00	0%	3/31/00	0.4 w
Calor Electronics 98	M3-Calorimeter CC,ECN Preamp Installation Complete	4/4/00	0%	3/31/00	0.4 w
Calor Electronics 98	Shaper Hybrid 50% Complete	5/9/00	0%	5/9/00	0 w
Calor Electronics 98	Daughterboard Vendor Production Complete	6/16/00	0%	6/16/00	0 w
Calor Electronics 98	BLS Motherboard Assembly Complete	8/7/00	0%	8/7/00	0 w
Calor Electronics 98	Timing System Installed	8/18/00	0%	8/18/00	0 w
Calor Electronics 98	M2-Calorimeter BLS Assembly Complete	9/26/00	0%	9/26/00	0 w
Central Preshower 98	M2-Central Preshower Module Fabrication Complete	12/16/97	100%	12/16/97	0 w
Fiber Electronics 98	Multichip Modules Received	3/8/00	0%	2/23/00	2 w
Fiber Electronics 98	10 Digitial Boards Available	4/19/00	0%	3/22/00	4 w
Fiber Electronics 98	10 Analog Boards Available	5/3/00	0%	4/19/00	2 w
Fiber Electronics 98	Mixer Boards Ready	6/21/00	0%	6/22/00	-0.2 w
Fiber Tracker 98	M2 - Assembly Design Complete	3/5/99	100%	3/5/99	0 w
Fiber Tracker 98	M2-First Cylinder Complete	9/2/99	100%	9/2/99	0 w
Fiber Tracker 98	M3-Fiber Tracker Ribbon Fabrication 50% Complete	11/12/99	0%	11/12/99	0 w
Fiber Tracker 98	M2-Fiber Tracker Assembly Begun	1/4/00	0%	12/6/99	2.2 w
Fiber Tracker 98	M3-Fiber Tracker Cylinders 8, 7, 6, and 5 Complete	2/11/00	0%	1/28/00	2.2 w
Fiber Tracker 98	Waveguide Production 50% Complete	2/28/00	0%	1/29/00	4.16 w
Fiber Tracker 98	M3-Fiber Tracker Ribbon Fabrication Complete	3/6/00	0%	3/6/00	0 w
Fiber Tracker 98	M3-Fiber Tracker Ribbon Mounting Complete	4/20/00	0%	4/20/00	0 w
Fiber Tracker 98	M2-Fiber Tracker Assembly Complete	5/4/00	0%	5/4/00	0 w
Fiber Tracker 98	M3-Waveguide Production Complete	7/6/00	0%	6/5/00	4.6 w
Forward Preshower 98	M2-Forward Preshower Module Fabrication Begun	11/4/98	100%	11/4/98	0 w
Forward Preshower 98	Module Fabrication Complete	1/21/00	0%	12/10/99	4 w
Forward Preshower 98	M3-1st Forward Preshower Detector Complete	1/25/00	0%	1/12/00	1.8 w
Forward Preshower 98	M3-2nd Forward Preshower Detector Complete	2/22/00	0%	3/8/00	-2.2 w
ICD 98	Drawers Ready	1/4/00	0%	12/14/99	1 w
ICD 98	M3-ICD Tile Modules Ready	1/11/00	0%	1/18/00	-1 w
ICD 98	M2-ICD Modules Arrive at Fermilab	1/18/00	0%	1/25/00	-1 w
Master Upgrade Schedule	M1-Solenoid Delivered to Fermilab	5/12/97	100%	5/12/97	0 w
Master Upgrade Schedule	M2-Central Preshower Installed on Solenoid	5/21/98	100%	5/21/98	0 w
Master Upgrade Schedule	M3-InterCryostat Detectors Installed	1/25/00	0%	2/1/00	-1 w
Master Upgrade Schedule	M3-Level Ø-South Installed	2/22/00	0%	2/9/00	1.8 w
Master Upgrade Schedule	M1-Central Silicon Complete	9/18/00	0%	9/18/00	0.2 w
Master Upgrade Schedule	M2-Silicon Tracker Installed in Solenoid/Fiber Tracker	9/25/00	0%	9/25/00	0.2 w
Master Upgrade Schedule	M2-Muon End Toroids Installed on Platform	11/15/00	0%	11/15/00	0.2 w
Master Upgrade Schedule	M1-Begin Shield Wall Removal/Ready to Roll-in	11/22/00	0%	11/22/00	0 w
Master Upgrade Schedule	M1-Detector Rolled-in and Hooked Up	2/2/01	0%	2/2/01	-0.1 w
Muon Cent Detector 98	PDT Commissioning Complete	6/16/00	0%	6/9/00	1 w
Muon Cent Detector 98	CFA Commissioning Complete	7/10/00	0%	7/10/00	0 w
Muon Electronics 98	MDT ADB Fabrication Complete	12/2/99	0%	12/2/99	0 w
Muon Electronics 98	MDC Fabrication Complete	12/13/99	0%	12/13/99	0 w
Muon Electronics 98	M2-Muon Electronics Preproduction Installation Complete	12/13/99	0%	12/13/99	0 w
Muon Electronics 98	FEB, CB Production Complete	1/3/00	0%	1/3/00	0 w
Muon Electronics 98	SFE,SRC Fabrication Complete	2/3/00	0%	2/3/00	0 w

Project	Milestone	Cur. Date	% Complete	Baseline	Variance
Muon Electronics 98	MRC, MFC Production Complete	3/27/00	0%	3/27/00	0 w
Muon Fwd Tracker 98	M2-Muon Forward Tracker MDT Assembly 10% Complete	1/29/99	100%	1/29/99	0 w
Muon Fwd Tracker 98	Arrival Of C-Layer MDT Modules At FNAL	11/12/99	0%	10/22/99	3.08 w
Muon Fwd Tracker 98	M2-All Muon Forward Tracker MDT Modules At Fermilab	3/10/00	0%	3/10/00	0 w
Muon Fwd Tracker 98	B-Layer Octants Assembled	4/18/00	0%	4/18/00	0 w
Muon Fwd Tracker 98	Muon Forward Tracker B-Layer Planes Installed	6/9/00	0%	6/15/00	-0.8 w
Muon Fwd Tracker 98	All MDT Octants Assembled	7/14/00	0%	7/14/00	0 w
Muon Fwd Tracker 98	All MDT Planes Installed	8/4/00	0%	8/4/00	0 w
Muon Fwd Trig Detector 9	M2-Muon Forward Trigger Counter Assembly 10% Complete	10/12/98	100%	10/12/98	0 w
Muon Fwd Trig Detector 9	All Pixel Octants Assembled	4/4/00	0%	4/4/00	0 w
Muon Fwd Trig Detector 9	All Muon Forward Trigger Detector Planes Installed	8/25/00	0%	8/25/00	0 w
Muon Level 1 98	Preproduction MTCxx, MTFB, and MTCM Complete	1/24/00	0%	1/24/00	0 w
Muon Level 1 98	M3-Muon Level 1 Trigger Preproduction Testing Complete	4/18/00	0%	4/18/00	0 w
Muon Level 1 98	Production MTCxx, MTFB, and MTCM Complete	6/27/00	0%	6/27/00	0 w
Online 98	Steady DAQ Running	4/7/00	0%	3/31/00	0.9 w
Silicon Vertex 98	H Half-Wedge Fabrication 20% Complete	10/15/99	100%	10/15/99	0 w
Silicon Vertex 98	3 Chip Ladder Fabrication 80% Complete	10/26/99	100%	10/20/99	0.6 w
Silicon Vertex 98	9 Chip Ladder Fabrication 20% Complete	11/3/99	0%	11/3/99	0 w
Silicon Vertex 98	6 Chip Ladder Fabrication 20% Complete	1/10/00	0%	1/3/00	1 w
Silicon Vertex 98	F Wedge Assemblies 20% Complete	1/19/00	0%	1/19/00	0 w
Silicon Vertex 98	M2-First Silicon Tracker Barrel/Disk Module Complete	2/2/00	0%	1/24/00	1.4 w
Silicon Vertex 98	H Half-Wedge Fabrication 80% Complete	2/23/00	0%	2/23/00	0 w
Silicon Vertex 98	6 Chip Ladder Fabrication 80% Complete	3/21/00	0%	3/14/00	1 w
Silicon Vertex 98	9 Chip Ladder Fabrication 80% Complete	3/27/00	0%	3/27/00	0 w
Silicon Vertex 98	F Wedge Assemblies 80% Complete	4/26/00	0%	4/26/00	0 w
Silicon Vertex 98	H-disks Ready	7/3/00	0%	7/3/00	0 w
Silicon Vertex 98	M3-All Silicon Tracker Barrels/Disks Complete	8/25/00	0%	8/25/00	0.2 w
Silicon Vertex 98	Central Silicon Complete & Ready To Move To DAB	9/18/00	0%	9/18/00	0.2 w
Solenoid Installation 98	M1-Solenoid Installed and Tested	9/30/98	100%	9/30/98	0 w
Tracking Electronics 98	First Readout Crate Installed & Working	12/2/99	0%	12/2/99	0 w
Trigger 98	SLICs Received	11/10/99	0%	11/10/99	0 w
Trigger 98	M3-Establish Single Crate Internal Data Movement	1/6/00	0%	1/6/00	0 w
Trigger 98	M3-Complete Cal Readout to L2	2/9/00	0%	2/11/00	-0.4 w
Trigger 98	MBTs Received	3/16/00	0%	3/16/00	0 w
Trigger 98	Alpha Cards Received	5/15/00	0%	5/15/00	0 w
Trigger 98	M3-L3 Operational	6/1/00	0%	6/1/00	0 w
Trigger 98	Global Installation Complete	7/12/00	0%	7/12/00	0 w
Trigger 98	L2 Muon Installation Complete	7/26/00	0%	7/26/00	0 w
Trigger 98	L2 CTT Installation Complete	8/9/00	0%	8/9/00	0 w
Trigger 98	L2 Cal Installation Complete	8/21/00	0%	8/21/00	0 w
Trigger 98	M3-Trigger Level 2 Commissioned	9/21/00	0%	9/21/00	0 w
VLPC Cassettes 98	M2-VLPC Production 50% Complete	8/31/97	100%	8/31/97	0 w
VLPC Cassettes 98	M3-VLPC Cassette Assembly 50% Complete	4/12/00	0%	4/12/00	0 w
VLPC Cassettes 98	M3-VLPC Cryo System Operational	6/12/00	0%	6/12/00	0 w
VLPC Cassettes 98	M3-VLPC Cassette Assembly Complete	8/22/00	0%	8/22/00	0 w

Action Items

Resulting from the DOE Review of the
DZero Upgrade Project
November 4, 1999

	Action Item	Responsible Party	Due Date
1.	Conduct the next Review	DOE/DZero	5/2000

The above Action Items were agreed upon by:

K. Stanfield Fermilab Deputy Director	R. Wunderlich, Acting Fermi Group Manager, DOE	D. Lehman, DOE Review Chairperson
M. Tuts Project Co-Manager	P. Philp, Fermi Group DOE	J. Ritchie, HEP Division DOE
H. Weerts Project Co-Manager		