

12 May 2004

To: Paul Philp
DOE Project Manager, Run IIb CDF Detector Project

From: Pat Lukens
Project Manager for the Run IIb CDF Detector Project

Subject: Run IIb CDF Detector Project March 2004 Report

Attached is the monthly report summarizing the March 2004 activities and progress for the Fermilab RunIIb CDF Detector Project. This report is available electronically at:

<http://www-cdf.fnal.gov/run2b.html>

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RunIIb CDF Detector Project
Progress Report No. 16
1 - 31 March 2004

I. PROJECT DESCRIPTION

The primary goal of the CDF Run IIb Detector Project is to enable the detector to exploit the physics opportunities available during Tevatron operation through 2008. The data from Run II will represent a set of detailed measurements that can be compared with the predictions of the Standard Model at the highest available collision energy. The increased size of the data sample will allow us to study the top quark by measuring the details of its production and decay mechanism. In addition, we plan precision electroweak and QCD measurements, continued searches for a variety of phenomena that are predicted to exist beyond the Standard Model framework, and to explore CP violation in the b quark sector. The detailed physics goals of the upgrade are described in the Technical Design Report (TDR).

The major tasks of this upgrade are:

- Upgrade the calorimeter by replacing the Central Preradiator Chamber with a device with shorter response time to allow operation in a high-luminosity environment, and adding timing information to the electromagnetic calorimeters.
- Upgrade the data acquisition and trigger systems to increase throughput needed for higher luminosity operation and efficiently trigger on the higher multiplicity events of Run IIb.

II. OVERVIEW OF PROJECT STATUS – P. Lukens

Although the schedule slip in the TDC and XFT schedules remains, there were significant developments for these projects in March 2004. TDC testing continues, and results continue to be encouraging for the device in hand. There have been no issues discovered that will require a redesign of the boards. XFT work has been directed lately towards understanding the performance of the device in an environment of declining drift chamber performance. Additional collaboration manpower is being applied to these studies.

Internal reviews of the TDC and XFT projects are being planned for May 2004.

Production has begun on the Calorimeter Preshower modules. Development of installation procedures began in March, since we had the opportunity of access to the detector. This afforded the opportunity to plan for mitigation of ES&H issues, as well as detailed design question concerning the installation itself and the fixtures needed.

Silicon related upgrade issues are deferred until the report of the CDF Silicon Longevity Committee.

III. PROJECT MILESTONE SUMMARY (as of 31 March 2004)

CDF Level 2 Schedule Milestones from the Resource Loaded schedules

WBS	Title	Baseline Comp. Date	Forecast/Actual Completion Date	Complete
1.2.1.10.1	First phototube order placed	9-May-03	1-Apr-03	Yes
1.2.2.2.7.1	Prototype Testing Complete	16-May-03	28-Mar-03	Yes
1.2.2.2.7.4	ASD->TDC Cables ready for installation	16-May-03	26-Aug-03	Yes
1.2.2.2.7.2	CEM Splitters ready for installation	19-May-03	29-Jul-03	Yes
1.2.2.2.7.3	PEM Harnesses ready for installation	2-Sep-03	28-Apr-03	Yes
1.2.2.2.7.5	All cables done and ready to install	2-Sep-03	26-Aug-03	Yes
1.2.2.2.7.8	VME Crate ready for installation	7-Oct-03	30-Apr-03	Yes
1.3.1.6.6	First Prototype TDC available for testing	19-Nov-03	10-Feb-04	Yes
1.2.2.2.7.10	Upstairs components ready to install	7-Jan-04	16-Oct-03	Yes
1.2.2.2.7.11	All EM Timing components ready to install	7-Jan-04	16-Oct-03	Yes
1.2.2.2.7.6	ASD/TB ready for installation	7-Jan-04	16-Oct-03	Yes
1.2.2.2.7.7	Downstairs components ready to install	7-Jan-04	16-Oct-03	Yes
1.2.2.2.7.9	TDC boards ready for installation	7-Jan-04	16-Oct-03	Yes
1.3.3.2.3.4	Begin fabrication of Prototype Finder 1/3 board	8-Jan-04	8-Jan-04	CR in process
1.2.1.10.3	First set of Calorimeter phototubes tested	30-Jan-04	20-Oct-03	Yes
1.3.3.8.1.9	Prototype XFT Linker Module available for testing	26-Mar-04	26-Mar-04	CR in process
1.2.1.10.2	1 st Calorimeter WLS fiber holder finished	1-Apr-04	17-Feb-04	Yes
1.3.4.4.1.4	Prototype Event Builder hardware arrives	3-Jun-04	3-Jun-04	
1.2.1.10.4	1 st CPR module finished and tested	4-Jun-04	15-Mar-04	Yes
1.2.1.10.6	1 st CCR module finished and tested	19-Jul-04	2-Mar-04	Yes
1.3.2.9	Pulsar Level 2 subproject ready for installation	4-Aug-04	4-Aug-04	
1.2.1.10.5	2 nd set of Calorimeter phototubes tested	6-Aug-04	26-Mar-04	Yes
1.3.5.2.5	Arrival of 0/10 PCs from the vendor	10-Sep-04	10-Sep-04	
1.3.2.6.3	Begin production of Level 2 Pulsar system	17-Sep-04	17-Sep-04	
1.3.4.5.3	Production Readiness Rev - Event Builder	4-Oct-04	4-Oct-04	
1.3.3.10.3.3	Preproduction XFT Stereo Assoc Modules	29-Nov-04	29-Nov-04	
1.3.6.5	SVT ready for installation	13-Dec-04	13-Dec-04	
1.3.1.12	Beginning of TDC Production	10-Jan-05	10-Jan-05	
1.2.1.10.7	50% Calorimeter CPR Detectors Tested	14-Jan-05	14-Jan-05	
1.3.4.5.4.4	Arrival of Event Builder hardware	3-Feb-05	3-Feb-05	
1.2.1.10.8	50% Calorimeter CCR Detectors tested	14-Feb-05	14-Feb-05	
1.3.5.5.5	Arrival of 70 L3 & 15 DAQ PCs from the vendor	24-Mar-05	24-Mar-05	
1.3.5.6.5	Arrival of 140/20 PCs from the vendor	24-Mar-05	24-Mar-05	
1.3.3.8.3.3	Begin Production of XFT Linker Modules	24-Mar-05	24-Mar-05	
1.3.3.2.6.9	Begin Production Finder SL7 boards	28-Mar-05	28-Mar-05	
1.3.5.8	Finish Purchase of Computers for L3/DAQ	14-Apr-05	14-Apr-05	
1.2.1.10.9	Final Calorimeter CPR Detector Tested	15-Apr-05	15-Apr-05	
1.2.1.10.10	Final Calorimeter CCR Detector Tested	15-Apr-05	15-Apr-05	
1.2.1.10.11	Final set of Calorimeter phototubes tested	6-May-05	6-May-05	
1.2.1.10.12	End of Central Preshower Project	6-May-05	6-May-05	
1.2.3.5	End of Calorimetry Project: Level 2	6-May-05	6-May-05	
1.3.4.8	Finish Event-Builder Upgrade	31-May-05	31-May-05	
1.3.1.14.16	Data Concentrator Production Completed	29-Jul-05	6-Jun-05	
1.3.3.10.4.6	XFT Production Stereo Modules complete	18-Aug-05	18-Aug-05	
1.3.3.23	XFT Ready for Installation at CDF	29-Sep-05	29-Sep-05	
1.3.1.13.10	TDC Production Board testing complete	30-Sep-05	30-Sep-05	
1.3.1.16	Run 2b TDC Ready for Installation	30-Sep-05	30-Sep-05	
1.3.8	Finish Run 2b Trigger DAQ project	30-Sep-05	30-Sep-05	

IV. PROCUREMENT – P. Lukens

Orders were placed with Argonne National Laboratory and Michigan State University for production of the Calorimeter Preshower Modules.

V. PROJECT HIGHLIGHTS

1.1 – Silicon Detector Closeout Work - Nicola Bacchetta

All hybrids have been built, tested and burned-in with excellent yield and minimum re-work (well below our goal of 10%). All modules have been finished. The totals are 30 stereo modules and 62 axials that have been built and tested. Again, quality is excellent with non-useable channels in the range of a few parts per 10^{-4} . That's one order of magnitude below all previous CDF silicon detectors. Modules are placed on stave at a rate of 2 staves per week now and we completed 11.5 out of 15 staves. Firmware has been modified successfully to readout 5 staves in parallel as needed for the full test of staves in the barrel. The 9 fully functional staves has been installed in the preproduction barrel and tested. No major problems were encountered.

1.2 – Calorimeter

1.2.1 Central Preshower and Crack Detector – Steve Kuhlmann

The Central Preshower/Crack Upgrade continued to ramp up to full production in March. Two Preshower modules were assembled and tested at ANL using fiber pigtailed produced at MSU. Parts for two more modules are in hand. The 3rd and final production order of phototubes arrived on time and testing began. Fiber preparation continues at FNAL Lab 7, with 5 modules worth to be shipped in early April. The 2nd shipment of production Dubna scintillator tiles, 5 modules worth, arrived at FNAL to be prepared at Lab 8.

Production orders for Crack detector scintillator and Crack detector mechanical parts were placed, with delivery expected in early May.

The assembly of 8 production PMT boxes began at MSU. During the March 15th access, the final location of these boxes, along with HV boxes and optical fiber routing, was determined. A prototype of the mounting bracket for the Preshower detector was tested.

1.2.2 Electromagnetic Timing – Dave Toback

All EM Timing work has been completed and the components are being installed. All of the installation problems for the EMT were understood and addressed during the last shutdown. The modified transition boards went in without problems and the remaining (unmodified) boards will be addressed soon. During the entire data-taking run with this system, we have not lost a single ASD channel in the CEM or PEM. All of the channels that were installed last year are now fully functional and are operating with excellent resolution, turn-on curves, and negligible noise.

1.3 – Data Acquisition and Trigger

1.3.1 TDC (Time to Digital Converter) – Henry Frisch, Ting Miao

The firmware bug on edge detection in the TDC chips was fixed. Internal pulsing test with CDF trigger and clock protocol provided from TestClock card showed the chips are working as designed. Two more boards were sent out for assembly at end of March and testing is underway. At the same time, a test stand was setup at FNAL for testing the input and output functions of the new TDC. Input pulses were generated using the COT ASDQ calibration setup. And, trigger bit output is to be captured using current with the XFT finder board. Hardware setups for the test stand were finished and the software effort is underway. Extensive tests of TDC time linearity and offset under different operational conditions, such as temperature change and crate power supply variation, are planned for April.

1.3.2 Level 2 – Ted Liu, Peter Wittich

The CDF Level 2 Trigger system continues to make progress on the following fronts:

- Pulsar hardware, firmware and VME software,
- PCI and CPU performance studies, and
- S-LINK data format definition for all data paths.

Production has begun on pulsar motherboards. We have ordered the S-Link LDC/LSC cards, some of them have already arrived at Fermilab, and they have tested satisfactorily. All S-Link fibers have arrived and are ready to be installed in the coming months. The firmware implementation and testing for various data paths is in progress and will continue for some time. The main activity this month has been to split the fibers for different data paths to prepare to run in parasitic mode with beam over the summer. The fiber splitting is over 50% complete and one test pass has already been tested with the split system. Pulsar multiboard readout has been tested satisfactorily with the rest of the DAQ system.

1.3.3 XFT (eXtremely Fast Tracker) II – Richard Hughes, Brian Winer

Work continues on the simulation of the upgraded XFT. Recent developments with respect to the degraded performance of the COT have focused the simulation work on understanding how an upgraded device will perform with both an increase in instantaneous luminosity and a reduction of single hit efficiency due to an aged COT. The Linker upgrade work at Ohio State University has been focused on implementing the improved tracking linking algorithm in the latest Altera Stratix devices. Purdue has been provided all the mechanical and layout drawings for the former Linker board and will be working on pulling together a Linker board. The main focus now is on the development of the Finder board.

1.3.4 Event Builder – Bruce Knuteson

Prototype VMIC 7805 boards that will replace the Scanner CPUs in the current system are being tested. Some but not all of the CDF 6U to 9U adapter cards work with these boards. This is currently under investigation.

Software to read out the VRBs and send event fragments through the new Cisco 6509 switch is being written. Software for coordinating transmission to Level 3 and interfacing to the Trigger Supervisor is being designed.

An auxiliary Cisco 3750 switch, for software prototyping after the final system is in place, has arrived at Fermilab and is in the process of being installed.

1.3.6 SVT (Silicon Vertex Tracker) – Luciano Ristori

We are not planning to begin work on the Silicon Vertex Tracker trackfitter and merger boards until later in calendar year 2004.

1.3.7 Silicon Detector DAQ Upgrades – Gino Bolla

Work continues toward the goal of getting more results from trigger simulations. We are trying to understand how much faster the silicon can be read out by implementing a "pre-digitize" scheme. A faster readout of the silicon system has implications on the maximum Level 1 trigger rate acceptable by CDF. The "pre-digitize" scheme can be implemented either within the present hardware configuration or by using the already developed PULSAR board with an additional interface card instead of the old SRC. We are still waiting for results on the simulation work and CDF data analysis. We still expect to be able to review those results at the end of April.

VI. FINANCIAL STATUS (as of 31 March 2004)

The baseline cost of the Project is \$10,375K, and consists of the costs for the scope of the Run IIb Project (\$8,702K) plus the closeout costs of the silicon detector upgrade (\$1,673K), which will no longer be constructed.

The following financial tables are attached:

CDF Project Cost Performance Report (CPR) – This report is generated from COBRA and provides a complete financial snapshot of the Project down to Level 3 of the Work Breakdown Structure. Input data originates with the status (% Complete) of the Project schedules as reported by the Level 2 managers and actual costs extracted from the Fermilab accounting system. Financial summaries are shown for this reporting period (columns 2-6) as well as the project to date (columns 7-11). Column 12 contains our current value of BAC, and will only be changed after the formal implementation of the Change Control process.

CDF RunIIb Obligations Report - This report provides a summary, at Level 2, of the outstanding requisitions and purchase orders where money has been committed but for which the Project has not been invoiced. This does not include requisitions in the system that have not had a Fermilab Purchase Order number assigned as of the date of the report.

A number of specialized financial terms and abbreviations used in the reports are defined here for convenience:

ACWP – Actual Cost of Work Performed. This is the actual cost of tasks that have been completed.

BAC – Budget at Completion. The BAC is the estimated total cost of the project when completed. It is equivalent to the BCWS at completion. The baseline value of the BCWS is contained in column 12 of the Cost Performance Report.

BCWP – Budgeted Cost of Work Performed. This is the scheduled cost profile of tasks that have been completed.

BCWS – Budgeted Cost of Work Scheduled. This is the sum of the budgets for all planned work to be accomplished within a given time period.

CV – Cost Variance. $CV = BCWP - ACWP$

EAC – Estimate At Completion. This is the ACWP to date, plus the BCWS (current scheduled estimate) of remaining tasks. $EAC = (BAC (current) - BCWP) + ACWP$

ETC – Estimate to Completion. $ETC = EAC - ACWP + Contingency$

Percent Complete - $\%Com = \frac{BCWP}{BAC}$

SV – Schedule Variance. $SV = BCWP - BCWS$

**CDF Project
Cost Performance Report
at WBS Level 3**

Cost Performance Report - Work Breakdown Structure													
Contractor: Location:						Contract Type/No:			Project Name/No: CDF RIIB Mstr Equ - D		Report Period: 2/29/2004 3/31/2004		
Quantity	Negotiated Cost		Est. Cost Authorized Unpriced Work		Tgt. Profit/ Fee %	Tgt. Price	Est Price	Share Ratio	Contract Ceiling	Estimated Contract Ceiling			
1	8,702,000		0		0	8,702,000	0		0	0			
Funding Type-CA WBS[2] WBS[3]	Current Period					Cumulative to Date					At Completion		
Item	Budgeted Cost		Actual Cost	Variance		Budgeted Cost		Actual Cost	Variance		Baseline BAC	Latest Revised BAC	BAC Delta
	Work Scheduled	Work Performed	Work Performed	Schedule	Cost	Work Scheduled	Work Performed	Work Performed	Schedule	Cost			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
EQU Equipment													
1.2 Calorimeter Upgrades													
1.2.1 Central Preshower and Crack Detectors	16,768	68,662	31,808	51,894	36,854	258,785	177,063	87,813	-81,722	89,250	359,754	356,111	(3,643)
1.2.2 Electromagnetic timing	0	0	0	0	0	35,630	35,630	23,403	0	12,227	35,630	35,630	0
WBS[2]Totals:	16,768	68,662	31,808	51,894	36,854	294,415	212,693	111,216	-81,722	101,477	395,384	391,741	(3,643)
1.3 Run 2b DAQ and Trigger Project													
1.3.1 Run 2b TDC Project	0	0	65,488	0	-65,488	110,649	94,854	108,067	-15,795	-13,214	1,105,744	1,110,624	4,880
1.3.2 Run 2b Level 2 Project	37,680	11,955	8,956	-25,726	2,998	167,733	253,817	63,296	86,084	190,521	366,655	364,286	(2,369)
1.3.3 Run 2b XFTH Project	5,973	0	0	-5,973	0	162,525	1,309	0	-161,216	1,309	1,146,971	1,124,325	(22,646)
1.3.4 Event-Builder Upgrade	25,891	16,784	11,048	-9,107	5,735	145,583	80,976	55,952	-64,608	25,023	517,361	518,867	1,507
1.3.5 Computer for Level3 PC Farm / DAQ	0	0	0	0	0	0	0	0	0	0	478,908	478,410	(498)
1.3.6 SVT upgrade	0	0	0	0	0	0	0	0	0	0	174,441	174,441	0
1.3.7 Silicon Detector DAQ Upgrades	4,226	0	0	-4,226	0	139,358	42,907	0	-96,450	42,907	854,289	849,568	(4,721)
WBS[2]Totals:	73,770	28,738	85,492	-45,032	-56,754	725,847	473,862	227,316	-251,985	246,546	4,644,369	4,620,522	(23,847)
1.4 Administration													
1.4.3 Construction Phase	25,710	25,998	14,342	287	11,655	353,099	353,105	290,651	6	62,454	958,867	1,025,590	66,723
WBS[2]Totals:	25,710	25,998	14,342	287	11,655	353,099	353,105	290,651	6	62,454	958,867	1,025,590	66,723
Funding Type-CATotals:	116,248	123,398	131,643	7,149	-8,245	1,373,361	1,039,661	629,184	-333,701	410,477	5,998,620	6,037,853	39,233
Gen. and Admin.	0	0	0	0	0	0	0	0	0	0	0	0	0
Undist. Budget											0	0	0
Sub Total	116,248	123,398	131,643	7,149	-8,245	1,373,361	1,039,661	629,184	-333,701	410,477	5,998,620	6,037,853	39,233
Management Resrv.											2,703,380	2,664,147	(39,233)
Total	116,248	123,398	131,643	7,149	-8,245	1,373,361	1,039,661	629,184	-333,701	410,477	8,702,000	8,702,000	0

CDF Project Obligations Report Through 31 March 2004

CDF RI1b EQU - MAR FY04 IN \$K							
Expenditure Category		Current Mth Total Cost	Current Mth Obligation	YTD Total Cost	YTD Obligations w/Indirect	Current PO Open Comm	Prior Yr Total Cost
M&S		6.2	123.9	195.1	271.5	820.7	221.0
SWF		35.8	35.8	213.0	213.0	0.0	346.1
OH		13.1	0.0	82.3	82.3	0.0	140.2
Total 1.1		55.1	159.7	490.4	566.8	820.7	707.2
M&S		15.6	192.3	40.4	228.2	187.8	0.0
SWF		11.0	11.0	29.5	29.5	0.0	20.6
OH		5.1	0.0	14.7	14.7	0.0	6.3
Total 1.2		31.8	203.3	84.6	272.4	187.8	26.9
M&S		57.7	0.3	168.0	212.8	179.2	2.9
SWF		19.3	19.3	34.8	34.8	0.0	0.0
OH		8.5	0.0	21.1	21.1	0.0	0.5
Total 1.3		85.5	19.7	223.9	268.8	179.2	3.4
M&S		0.0	0.0	9.1	9.1	0.0	13.3
SWF		11.0	11.0	77.1	77.1	0.0	126.7
OH		3.3	0.0	24.4	24.4	0.0	40.1
Total 1.4		14.3	11.0	110.5	110.5	0.0	180.1
Total Project	M&S	79.6	316.5	412.6	721.6	1187.7	237.2
	SWF	77.1	77.1	354.5	354.5	0.0	493.5
	OH	30.1	0.0	142.5	142.5	0.0	187.0
Grand Total		186.8	393.6	909.5	1218.5	1187.7	917.6

TOTAL PROJECT COST (INCEPTION TO DATE): 1827.2

VII. VARIANCE ANALYSIS – P. Lukens

The most significant variance the Project has from the baseline schedule is in the TDC and XFT development. This will be best remedied by additional manpower from the collaboration, and we are currently trying to secure this effort. We anticipate formalizing a new schedule for these projects in conjunction with the May review.

VIII. BASELINE CHANGES

No Change Control action documents were approved during March 2004. A reassessment of likely Administrative needs resulted in a reduction to our Administration cost estimate of \$47K. This baseline change was executed on 10 May 2004 and is contained in our Change Request #11. The cost performance report shows an artificial variance because of this change, which will be corrected in subsequent reports.

IX. FUNDING PROFILES

The funding profile is shown below:

	Funding Plan in Current Year \$K				
	FY02	FY03	FY04	FY05	Total
DOE MIE	\$ 3,460	\$ 3,509	\$ 1,673	\$ 1,732	\$ 10,375
DOE R&D	\$ 1,670	\$ 480			\$ 2,150
Foreign Contributions	\$ 39	\$ 342	\$ 252	\$ 10	\$ 643
U.S. Universities	\$ 24	\$ 225	\$ 103	\$ 26	\$ 378
Total	\$ 5,193	\$ 4,556	\$ 2,028	\$ 1,768	\$ 13,545