27 January 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 December 2003 Report

Attached is the monthly report summarizing the December 2003 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. 13
1 - 31 December 2003

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

The project received CD-3b for a revised baseline after the ESAAB meeting on 8 December 2003. The revised baseline had a significant reduction in costs, since all activities related to construction of the replacement silicon detector were dropped from the scope of the project.

The project is making good progress in a number of areas. The production order was submitted for the Pulsar boards in December, and should be placed in January 2004. The Preshower Detector had a production readiness review for its optical fiber components and production orders will soon be placed. These projects are working towards advancing the installation of their systems. Detailed installation schedules have been developed based on the premise of collision hall installation, which will minimize the downtime to the experiment, and take full advantage of accelerator maintenance periods.

Schedule slip has occurred in the TDC and XFT schedules, and is cause for concern. We are working to secure additional collaboration effort for the TDC project. The XFT group held a workshop in December that was well attended, and this project will ramp up very soon. A working group met to discuss the silicon data acquisition upgrades. The specifications for this subproject are not fully settled, although a course of action has been described to achieve them. The schedule for the event builder was modified to reflect the change in technical solution that has been made for this subproject. This change was recommended by our internal review in October.

III. PROJECT MILESTONE SUMMARY

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	19-Nov-03	CR in process
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	
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	
1.2.1.10.2	1st Calorimeter WLS fiber holder finished	1-Apr-04	1-Apr-04	
1.3.4.4.1.4	Prototype Event Builder hardware arrives	3-Jun-04	3-Jun-04	
1.2.1.10.4	1st CPR module finished and tested	4-Jun-04	4-Jun-04	
1.2.1.10.6	1st CCR module finished and tested	19-Jul-04	19-Jul-04	
1.3.2.9	Pulsar Level 2 subproject ready for installation	4-Aug-04	4-Aug-04	
1.2.1.10.5	2nd set of Calorimeter phototubes tested	6-Aug-04	6-Aug-04	
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

A second full-scale Preshower prototype was assembled at ANL, and the production order for the mechanical shell parts was placed.

V. PROJECT HIGHLIGHTS

1.1 – Silicon Detector

We are making good progress towards the completion of 15 staves. 70 hybrids have been shipped to Fermilab. These were built and tested at LBL, and burned-in and retested at UC Davis. One more batch of 40 is anticipated to arrive in January 2004. Of the 70 delivered hybrids, 50 have been installed on modules. The quality of the modules is excellent with less than 1% bad channels. Two full staves and one half stave have been built, using 15 out of the 50 modules. One stave has axial sensors on both sides, the other has axial modules on one side and stereo modules on the other. The half stave used axial sensors and was built to investigate different grounding and shielding options. In summary, we have completed 50% of the modules and 2 of the 15 staves for the silicon closeout.

1.2 – Calorimeter

1.2.1 Central Preshower and Crack Detector – Steve Kuhlmann

The Central Preshower/Crack Upgrade continued to make progress in December. After final R&D work at Rockefeller University, the production optical fibers for both Preshower and Crack detectors were ordered by INFN. A second full-scale Preshower prototype was assembled at ANL, and the production order for the mechanical shell parts was placed. All the parts for the Preshower detector have been ordered, and will arrive in January and February.

Definitive tests of tile-to-tile cross-talk were performed and, as expected, the irreducible 1% cross-talk in the phototube was observed and it dominated the cross-talk. This is completely consistent with the phototubes and can't get any better.

A production readiness review was held in early December for the optical fibers. Tests performed on both the clear and wavelength shifting fibers from Kuraray exceed the specifications, and were chosen for the production order of fibers to be used within the detector modules.

1.2.2 Electromagnetic Timing – Dave Toback

All EM Timing work has been completed and the components are ready to install.

1.3 – Data Acquisition and Trigger

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

The TDC card has been redone taking into account the drivers on the Repeater cards. These require a termination of 1.5v which is not standard and caused us to relocate the original receivers and add a bank of separate LVDS converters in small chips that will allow the placement of the passive terminations in a suitable location. The board has to be routed again and now we are studying the effects of removing some line terminations which are no longer readily available. This will require a slight adjustment of the circuit layout. We expect to have a board designed and ready for fabrication this month.

Meanwhile, an investigation of the input signal path for our test stands has shown that the proposed test stand arrangement will require the construction of small paddle boards to use a high performance cable which is different from the original custom ribbon cable used in the real setup. This cable should need no compensation. We have acquired the proposed cable and we are in the process of ordering connectors which are appropriate for this application. Our intention is to test with the standard cable setup in addition to using the proposed test system.

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.

The mezzanine card production has been finished and all testing has been completed. Preproduction of the Back of crate transition modules has been completed. The Production Readiness Review has been done and production has begun. We are now in the Production phase and we have started to order the S-Link LDC/LSC cards.

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

The Linker upgrade work at Ohio State University has been focused on implementing the improved tracking linking algorithm in the latest Altera Stratix devices. We have fit the design into the target device (an EP1S25), and we have successfully tested the full design with the simulator. Work continues on the Linker and Finder upgrade modules to determine which devices will actually be used on the board and their specific layout (schematic capture). Recent hiring actions at both OSU and University of Illinois have increased the physicist effort on this project, and will improve progress. A workshop was held at Fermilab during December to discuss our progress to date. A number of institutions have expressed interest in participating in the work effort.

1.3.4 Event Builder – Bruce Knuteson

A purchase order has been generated for a second Cisco switch for prototyping software changes after the final system is in place. We still await the delivery of the primary Cisco 6509 switch and prototype VMIC 7805 boards, both expected early January 2004. Prep work on B0 3rd floor is continuing to take much longer than anticipated. In the meantime we have installed a test stand on B0 2nd floor to develop software for reading out VRBs.

1.3.6 SVT (Silicon Vertex Tracker) – Luciano Ristori

No work is scheduled to begin on the Silicon Vertex tracker trackfitter and merger boards until later in calendar year 2004.

1.3.7 Silicon Detector DAQ Upgrades – Nicola Bacchetta

Work has begun 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 both within the present hardware configuration or by using the already developed PULSAR board with an additional interface card instead of the old SRC.

Results from simulations and from a more in-depth analysis of new data from CDF on this subject should be available in four to six weeks. By the end of February we should be in a position to decide whether it is worth implementing this new scheme and whether the implementation is more convenient by using the old SRC or by adding an interface card to the PULSAR.

VI. FINANCIAL STATUS (as of 31 December 2003)

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 costs of the silicon closeout are listed in Table VIa and the costs of the scope of the Run IIb Project are listed in Table VIb, the Cost Performance Report.

Silicon Closeout Costs

Item	Cost ($K)
Obligations in FY03	$ 1,452
Obligations in Sep 03	$ 170
Overhead on Sep 03	$ 45
Sensor Order Cancellation	$ (622)
Closeout Schedule estimate	$ 628
Total	$ 1,673

Table VIa

The accompanying CDF Project Cost Performance 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.

The CPR included in this report has some inaccuracy in the BCWS amounts for the Current Period (columns 2 – 6). This is a technical problem with the Project tracking software due to the rebaselining of our schedules. We fully anticipate this to be resolved for the January 2004 report. The costs for columns 7 - 12 accurately reflect the cumulative Project progress.

A number of specialized financial terms and abbreviations 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		Report Period: 10/1/2003	12/31/2003	
Quantity 1	Negotiated Cost 8,702,000		Est. Cost Authorized Unpriced Work 0		Tgt. Profit/ Fee % 0	0	Tgt. Price 8,702,000	Est Price 0	Share Ratio	Contract Ceiling 0	Estimated Contract Ceiling 0	
Funding Type-CA WBS[2] WBS[3] Item	Current Period					Cumulative to Date					At Completion	
	Budgeted Cost		Actual Cost	Variance		Budgeted Cost		Actual Cost	Variance			
	Work Scheduled	Work Performed	Work Performed	Schedule	Cost	Work Scheduled	Work Performed	Work Performed	Schedule	Cost	Budgeted	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
EQU Equipment												
1.2 Calorimeter Upgrades												
1.2.1 Central Preshower and Crack Detectors	204,266	16,942	32,436	-187,325	-15,495	204,266	63,567	35,616	-140,700	27,951	359,754	
1.2.2 Electromagnetic timing	0	0	0	0	0	35,630	35,630	23,403	0	12,227	35,630	
WBS[2]Totals:	204,266	16,942	32,436	-187,325	-15,495	239,897	99,197	59,019	-140,700	40,178	395,384	
1.3 Run 2b DAQ and Trigger Project												
1.3.7 Silcon Detector DAQ Upgrades	117,008	30,703	0	-86,305	30,703	117,008	30,703	0	-86,305	30,703	849,568	
1.3.1 Run 2b TDC Project	7,828	0	0	-7,828	0	110,802	55,710	6	-55,092	55,704	1,105,744	
1.3.2 Run 2b Level 2 Project	81,699	87,134	34,990	5,434	52,144	89,333	107,669	38,353	18,337	69,316	366,655	
1.3.3 Run 2b XFTII Project	80,205	155	0	-80,051	155	193,466	293	0	-193,173	293	1,146,971	
1.3.4 Event-Builder Upgrade	83,570	55,161	0	-28,408	55,161	83,570	55,161	0	-28,408	55,161	517,361	
1.3.5 Computer for Level3 PC Farm / DAQ	0	0	0	0	0	0	0	0	0	0	478,908	
1.3.6 SVT upgrade	0	0	0	0	0	0	0	0	0	0	174,441	
WBS[2]Totals:	370,310	173,153	34,990	-197,157	138,163	594,178	249,536	38,359	-344,641	211,178	4,639,648	
1.4 Administration												
1.4.3 Construction Phase	285,264	20,199	71,102	-265,065	-50,903	285,264	265,490	251,205	-19,774	14,285	963,692	
WBS[2]Totals:	285,264	20,199	71,102	-265,065	-50,903	285,264	265,490	251,205	-19,774	14,285	963,692	
Funding Type-CATotals:	**859,841**	**210,293**	**138,528**	**-649,547**	**71,766**	**1,119,338**	**614,223**	**348,583**	**-505,115**	**265,640**	**5,998,723**	
Gen. and Admin.	0	0	0	0	0	0	0	0	0	0	0	
Undist. Budget											0	
Sub Total	859,841	210,293	138,528	-649,547	71,766	1,119,338	614,223	348,583	-505,115	265,640	5,998,723	
Management Resrv.											2,703,277	
Total	859,841	210,293	138,528	-649,547	71,766	1,119,338	614,223	348,583	-505,115	265,640	8,702,000	

Table VIb

VII. VARIANCE ANALYSIS – P. Lukens

The most significant variance the Project has from the baseline schedule is in the TDC development. This will be best remedied by additional manpower from the collaboration, and we are currently trying to secure this effort.

VIII. BASELINE CHANGES

Four Change Control action documents were approved during December 2003 and are listed below.

- Change Control #5 – This change details the cost decrease in the Project due to the Director's decision to halt and cancel the Silicon Detector construction.
- Change Control #6 – This change reorganizes the WBS of the project. Four items at level 4 in the silicon WBS were moved to the Data Acquisition subproject, and the silicon subproject was deleted.
- Change Control #8 – This change reduces the Administration costs due to the Silicon cancellation.
- Change Control #9 – This change is a reallocation of costs between different WBS items within the Trigger/DAQ schedule.

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