

27 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 April 2004 Report - Revised

Attached is the monthly report summarizing the April 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. 17
1 - 30 April 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

A Director's review of the project is anticipated for July 2004. The charge and agenda are being developed, but we anticipate discussion of the installation needs of the project and how they will impact the operations schedule during the fall 2004 shutdown. In addition, we are using this review as an internal deadline for any schedule or scope corrections needed for the project.

Production continues on the Calorimeter Preshower modules. Installation this year is being coordinated with the needs of CDF operations. Detailed schedules of these activities are being developed.

Internal reviews of the TDC and XFT projects have been scheduled for 21 and 25 May 2004 respectively.

A workshop was held in April to discuss the appropriate directions that the development of the upgrades to the silicon vertex trigger should take. This will be settled by the July review.

III. PROJECT MILESTONE SUMMARY (as of 30 April 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
1.3.2.6.3	Begin production of Level 2 Pulsar system	12 Nov 03	12 Nov 03	Yes
1.3.1.6.6	First Prototype TDC available for testing	19-Nov-03	16-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	31 Mar 04	Yes
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	
1.3.4.5.3	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	30 Nov 04	
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	30 Dec 04	
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

No significant procurements were placed in April 2004. A few small orders were placed that complete the silicon closeout. No further orders related to that activity will be placed.

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. Testing on the completed devices continued in April in prep for publication.

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 April. Two Preshower modules were assembled and tested at ANL, using fiber pigtailed produced at MSU. Spliced fibers are being shipped from FNAL Lab 7 to MSU at about 5 modules/week. Twenty-nine modules of Dubna scintillator have been delivered to FNAL Lab 8 where the groove is cut. All of the mechanical parts have been delivered. Assembly time is about 1 module per assembly area per shift. ANL has setup two assembly areas, and INFN is providing additional technical manpower starting in mid-May for assembly.

All of the Crack detector mechanical parts were delivered in April. The Crack scintillator is scheduled to be delivered in May.

Component	Total needed	Produced
Preshower tiles	2592	270
Preshower fiber pigtailed	192	20
Preshower clear fiber cable	192	4
Preshower modules	48	5
Crack chamber tiles	480	15
Crack chamber modules	48	1
Transition cards	96	10
PMT boxes	48	10

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

Internal pulsing test with CDF trigger and clock protocol provided from TestClock card showed the chips are working as designed. The two boards sent out for assembly at end of March were returned and tested satisfactorily. Extensive debugging and testing of proposed CBLT read-out protocol is underway at the University of Chicago. Testing is underway at FNAL for the input and output functions of the new TDC in preparation for the Design Review at the end of May.

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 table below shows the current production status of the Level 2 components.

Component	Total needed	Produced
Pulsar boards	30	4
Slink LSC/LDC cards	20	20
Slink PCI cards	12	6
Slink fibers	30	30
AUX cards	20	20
Hotlink mezzanine cards	20	20
Taxi mezzanine cards	30	30
Hotlink/Taxi fibers	120	120
Fiber splitters	60	40
L2 decision CPUs	6	2

Production has begun on pulsar motherboards and the first two have arrived. They have been fully tested and no problems were found. The rest of them will arrive in May.

We have ordered 19 pairs of the S-Link LDC/LSC cards and 6 pairs have already arrived at Fermilab and have tested satisfactorily. The rest of them will arrive in May. The firmware implementation and testing for various data paths is in progress and some of them have already been tested with beam successfully. 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 complete and several test passes have already been tested with the split 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

We have verified that the VMIC 7805 boards can be used as the SCPUs in the new Event Builder system. Rates of 35 MB/s have been achieved, reading out VRBs and sending event fragments over the Cisco 6509 GbE switch to PCs acting as Level 3 nodes. An order for the remaining 18 boards in the final system is working its way through Fermilab purchasing.

The required messages, passed between the new Event Builder and the other DAQ components (Run Control, Trigger Manager, Error Logger, Level 3) to which it interfaces, have been specified. A high level block design with two primary components – the SCPU and EvbProxy – has been fleshed out, and needed message passing specified. A class diagram design of these two components has begun.

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 expect to be able to review those results during May.

VI. FINANCIAL STATUS (as of 30 April 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 table is attached:

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.

CDF Project Obligations Report Through 30 April 2004

CDF RIIb EQU - Apr FY04 IN \$K							
Task Number	Expenditure Category	Current			YTD		Prior Yr Total Cost
		Mth Total Cost	Current Mth Obligation	YTD Total Cost	Obligations w/Indirect	Current PO Open Comm	
	M&S	64.7	0.6	259.7	272.1	756.7	221.0
	SWF	8.7	8.7	221.8	221.8	0.0	346.1
	OH	4.8	0.0	87.1	87.1	0.0	140.2
	Total 1.1	78.2	9.4	568.7	581.0	756.7	707.2
	M&S	2.6	0.6	37.8	228.8	191.0	0.0
	SWF	17.6	17.6	47.1	47.1	0.0	20.6
	OH	5.6	0.0	20.3	20.3	0.0	6.3
	Total 1.2	20.6	18.3	105.2	296.2	191.0	26.9
	M&S	35.0	68.3	202.9	281.1	212.6	2.9
	SWF	18.7	18.7	53.5	53.5	0.0	0.0
	OH	6.3	0.0	27.5	27.5	0.0	0.5
	Total 1.3	60.0	87.0	284.0	362.1	212.6	3.4
	M&S	0.0	0.0	9.1	9.1	0.0	13.3
	SWF	9.2	9.2	86.3	86.3	0.0	126.7
	OH	2.8	0.0	27.1	27.1	0.0	40.1
	Total 1.4	12.0	9.2	122.6	122.6	0.0	180.1
Total Project	M&S	97.0	69.6	509.6	791.2	1160.3	237.2
	SWF	54.3	54.3	408.8	408.8	0.0	493.5
	OH	19.5	0.0	162.0	162.0	0.0	187.0
Grand Total		170.8	123.9	1080.4	1361.9	1160.3	917.6

TOTAL PROJECT COST (INCEPTION TO DATE): 1998.0

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 reviews.

VIII. BASELINE CHANGES

No Change Control action documents were approved during April 2004.

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