

5 December 2003

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 October 2003 Report

Attached is the monthly report summarizing the October 2003 activities and progress for the Fermilab RunIIb CDF Detector Project. This report is available electronically at:

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

electronic cc: J. Appel
E. Arroyo
N. Bacchetta
D. Benjamin
J. Cooper
B. Flaugher
H. Frisch
J. Huston
R. Hughes
D. Knapp
B. Knuteson
J. Kotcher
S. Kuhlmann
T. Liu
N. Lockyer
P. Lukens
T. Miao
J. Monhart
H. Montgomery
V. Pavlicek
K. Pitts
L. Ristori
R. Roser
TJ Sarlina
K. Stanfield
E. Temple
D. Toback
C. Trimby
V. White
B. Winer
M. Witherell
P. Wittich

RunIIb CDF Detector Project
Progress Report No. 11
1 - 31 October 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 held internal reviews of the subprojects during the month of October, to reevaluate the subprojects in the context of the silicon construction cancellation. The calorimeter upgrades were discussed at a review meeting on 10 October, and the data acquisition upgrades were reviewed on 13 October. The reviews were well attended and all the subproject proponents expressed a desire to continue on with their upgrades. The plans for all the projects is to focus on the regularly scheduled summer shutdowns for their installation, rather than follow a silicon detector installation.

A draft Baseline Change Proposal (BCP) was submitted to DOE as requested on 31 October. This BCP is under discussion now, and will provide the new total cost for the reduced scope of the project. New versions of the Project Execution Plan and Project Management Plan are being developed for the project. It is anticipated that CD-3 will be granted in December for the reduced scope.

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
1.3.5.2.5	Arrival of 0/10 PCs from the vendor	10-Sep-03	10-Sep-03	CR submitted
1.2.1.10.2	1 st Calorimeter WLS fiber holder finished	7-Oct-03	4-Dec-03	
1.2.2.2.7.8	VME Crate ready for installation	7-Oct-03	30-Apr-03	Yes
1.3.1.6.7	First Prototype TDC available for test	19-Nov-03	19-Nov-03	
1.2.1.10.4	1 st CPR module finished and tested	11-Dec-03	12-Feb-04	
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
1.2.1.10.6	1 st CCR module finished and tested	12-Feb-04	8-Apr-04	
1.3.3.8.1.9	Prototype XFT Linker Module available for testing	26-Mar-04	26-Mar-04	
1.2.1.10.5	2 nd set of Calorimeter phototubes tested	21-May-04	18-Feb-04	
1.3.4.4.1.4	Prototype Event Builder hardware arrives	3-Jun-04	3-Jun-04	
1.2.1.10.7	50% Calorimeter CPR Detectors Tested	4-Jun-04	2-Aug-04	
1.3.4.5.3	Production Readiness Rev - Event Builder	24-Jun-04	24-Jun-04	
1.2.1.10.8	50% Calorimeter CCR Detectors tested	30-Aug-04	26-Oct-04	
1.3.2.6.3	Begin production of Level 2 Pulsar system	17-Sep-04	17-Sep-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	
1.3.4.5.4.4	Arrival of Event Builder hardware	3-Feb-05	3-Feb-05	
1.2.1.10.10	Final Calorimeter CCR Detector Tested	24-Mar-05	19-May05	
1.2.1.10.9	Final Calorimeter CPR Detector Tested	24-Mar-05	19-May05	
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	
1.3.4.8	Finish Event-Builder Upgrade	5-May-05	5-May-05	
1.2.1.10.11	Final set of Calorimeter phototubes tested	6-May-05	29-Apr-05	
1.2.1.10.12	End of Central Preshower Project	6-May-05	19-May05	
1.2.3.5	End of Calorimetry Project: Level 2	6-May-05	19-May05	
1.3.2.9	Pulsar Level 2 subproject ready for installation	9-Jun-05	9-Jun-05	
1.3.1.14.16	Data Concentrator Production Completed	29-Jul-05	29-Jul-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	23-Sep-05	
1.3.1.16	Run 2b TDC Ready for Installation	30-Sep-05	23-Sep-05	
1.3.8	Finish Run 2b Trigger DAQ project	30-Sep-05	30-Sep-05	

IV. PROCUREMENT – P. Lukens

There were no significant procurements during October 2003.

V. PROJECT HIGHLIGHTS

1.1 – Silicon Detector

A “close out” plan for the silicon project is currently being developed. The current scope of the close out includes construction of 15 staves and a small number of Layer 0 modules. These units will be mounted onto a prototype barrel structure, and a full system readout test will be performed. Results of this will be published, and the work done to develop the Run IIb silicon detector will then be available to future detector developers.

1.2 – Calorimeter

1.2.1 Central Preshower and Crack Detector – Steve Kuhlmann

The Central Preshower/Crack Upgrade continued to make progress in October. The focus this month was on the construction and testing of the first full-scale Crack prototype. This went well, and it appears that the light output of this module will allow (for the first time) the detection of minimum-ionizing particles. This will give CDF a new capability for electron identification in the crack regions.

In addition, full approval of funding from INFN was given in late September. This was one year later than the baseline schedule and caused us to miss a Level 2 milestone this month related to fiber production. However, this should not present any major obstacles and the project is still on schedule to finish in Fall 2004. This INFN funds must be spent by the end of CY 2003 and have been dedicated for the purchase of scintillator from Dubna. This purchase is underway and is progressing smoothly. We are also working to finish the specifications of the high voltage system and fibers, which will also be purchased by INFN.

1.2.2 Electromagnetic Timing – Dave Toback

I have two pieces of good news to report. The first is that W.B.S. 1.2.2.2.3 (ASD and Transition Boards) is now complete, almost 4 months ahead of schedule. Congratulations go to the Marco, Fabio and the other Frascati folks for getting the boards designed, fabricated and stuffed and to us. At FNAL, thanks to Bob DeMaat and his crew for getting the front panels, stiffeners, and remaining connectors on so quickly. Also, to Max, Slava, Peter, Vadim, and Sungwon for their excellent job of testing, debugging and fixing. An enormous amount of preparation work went into this task, and it shows as the testing went very smoothly and there were virtually no problems out of the box.

This completes the L2 milestones 1.2.2.2.7.6 (EM Timing ASD/TB ready to install), 1.2.2.2.7.7 (All EM Timing downstairs components ready to install) and, most importantly, 1.2.2.2.7.11 (All EM Timing components ready to install). The construction phase of the EM Timing project is now officially complete, ahead of the 2004 completion data, and well ahead of the original 2006 installation date. Again, congratulations to everyone who worked on all

the individual components including Henry and the UC techs for their work on the splitter boards, Dervin and his crew for the harness construction, KSM and Steve Chappa for their work on the long cables, and Myron and company. for getting us all the TDCs early.

The second piece of good news, for those of you who hadn't heard, is that the PEM has been completely installed. The plug HV came back in a useful way yesterday and we were able to test the system. Greater than 96% of all channels simply worked as expected the first time we turned it on. We are enormously proud of this as it is a real testament to the careful testing and preparation of the TAMU students and postdocs, led by Max, at Fermilab. You can find preliminary plots at:

<http://txpc6.fnal.gov/~maxi/EMTiming/Calibrations/PlugLaser/171191/>

1.3 – Data Acquisition and Trigger

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

We are continuing on the board schematic for the TDC. At the same time, we are working on fixing some minor problems that still exist in the FPGA. The crucial problem is that we are failing in the transfer of the Level 2 small buffers to the one large memory that communicates with the VME bus. We suspect that the settling time is insufficient in the current design and we are currently engaged in trying to prove that this is the problem.

Discussions are underway with the Particle Physics Division Electrical Engineering group to add engineering support to this project in order to speed up the development and eventual testing of the prototypes.

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.

All Pulsar prototypes have been fully tested for robustness. No design problems have been identified therefore we are convinced there is no need for any design revisions. This includes the following components:

- Pulsar motherboard,
- Hotlink transmitter and receiver mezzanine cards,
- Taxi transmitter and receiver mezzanine cards, and
- Back of crate transition module.

Both Pulsar firmware and VME software have been greatly improved to allow fully automated testing. With the automated testing procedures and the complete success of all prototypes, we are ready for Pulsar hardware preproduction, roughly six months ahead of schedule. The mezzanine card production has been finished and all testing has been completed. Preproduction of the Back of crate transition modules have begun. One of the prototype Pulsar motherboards together with four Hotlink mezzanine cards have been configured as a Level 2 Muon interface board and has been successfully running in the

system and taking beam data for over one week. Total amount of data taken before shutdown was 2.6 inverse picobarns. Off-line analysis shows there was not a single error in processing the muon data through the Pulsar Muon Board. As a result, this board has been officially chosen to become the RunIIa Muon Interface Board and will replace the Michigan Muon Board.

The work on testing the CPU performance on modern CPUs with Linux operating system for the Level 2 trigger decision algorithm latency has been completed. The results indicate that modern CPUs (~2 GHz desktop PCs) with Linux operating systems have much better performance than the old Alpha's (500MHz without operating system) being used in the current Level 2 trigger system. The work on testing the SLINK to PCI card (S32PCI64, designed at CERN for Atlas) performance has been done and it performed as expected. We have measured the timing of this round trip and the performance is well within specifications. Two new Post-docs from Penn and University of Chicago are now working on two Level 2 data paths using the Pulsar board. More specific details about the project progress can be found at:

http://hep.uchicago.edu/~thliu/projects/Pulsar/L2_upgrade_meeting.html

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.

1.3.4 Event Builder – Bruce Knuteson

The Cisco switch is expected at Fermilab at the end of calendar year 2003. The VMIC 7805 boards that will be used to read out the VRBs are scheduled to arrive at Fermilab at the end of November. In the meantime, we are consolidating code from the D0 system and sketching out the software for the new system.

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.

VI. FINANCIAL STATUS

The status of the costs and obligations applicable to the Project are currently being re-evaluated and revised. A discussion of the Project financial status will be included in future reports after the new baseline is established.

VII. VARIANCE ANALYSIS – P. Lukens

Several Level 2 milestone dates have moved due to the restructuring of the overall Project. Change Requests have been created and are expected to take effect in December of 2003. The critical path to completion of the Project has not changed.

VIII. BASELINE CHANGES

Change Request #5 was submitted and approved in October. This change removes the silicon detector construction tasks from the baseline plan. The cost reduction from this change is contained within the draft BCP submitted on 31 October 2003.

IX. FUNDING PROFILES

The funding profile shown in the past is considered to be obsolete. A revised funding profile will be available after the new baseline is established.