



---

# The Run IIb CDF Detector Project

## Baseline Change Discussion

Patrick T. Lukens  
Fermilab  
*28 April 2005*



# CDF's Run IIb Projects

---

- Closeout of the Silicon Detector upgrade (WBS 1.1)
- Calorimeter upgrades (WBS 1.2)
  - Preshower replacement
  - Electromagnetic timing
- Data Acquisition and Trigger upgrades (WBS 1.3)
  - Upgrade of drift chamber TDCs
  - Upgrade of Level 2 trigger infrastructure
  - Upgrade of track trigger
  - Upgrade of the event builder
  - Replacement of Level 3 trigger processors
  - Upgrade of the silicon vertex trigger



# CPR for March 2005

Cost Performance Report - Work Breakdown Structure														
Contractor:				Contract Type/No:				Project Name/No:			Report Period:			
Location:								CDF Rllb Mstr Equ - D			##### 3/31/2005			
Quantity		Negotiated Cost		Est. Cost Authorized		Tgt. Profit/		Tgt.		Est		Share		
		Unpriced Work		Fee %		Price		Price		Ratio		Contract		
1		8,701,999		0		0.00		8,701,999		0		0		
Funding Type-CA				Current Period				Cumulative to Date				At Completion		
WBS[2]				Budgeted Cost		Actual Cost		Budgeted Cost		Actual Cost		Latest		
WBS[3]				Variance		Variance		Variance		Revised				
Item		Scheduled	Performed	Performed	Schedule	Cost	Scheduled	Performed	Performed	Schedule	Cost	Budgeted	Estimate	Variance
<b>EQU Equipment</b>														
<b>1.2 Calorimeter Upgrades</b>														
1.2.1 Central Preshower and Crack Detector														
	0	0	1,613	0	-1,613	377,440	377,440	422,928	0	-45,488	377,440	447,113	69,673	
1.2.2 Electromagnetic timing														
	0	0	0	0	0	35,630	35,630	23,403	0	12,227	35,630	23,403	-12,227	
<b>WBS[2]Totals:</b>														
	0	0	1,613	0	-1,613	413,070	413,070	446,331	0	-33,261	413,070	470,516	57,446	
<b>1.3 Run 2b DAQ and Trigger Project</b>														
1.3.1 Run 2b TDC Project														
	42,496	34,818	11,588	-7,678	23,230	537,278	510,224	507,550	-27,054	2,675	741,434	760,465	19,032	
1.3.2 Run 2b Level 2 Project														
	11,152	8,778	8,968	-2,374	-190	387,585	388,226	370,170	641	18,055	437,236	438,964	1,729	
1.3.4 Event-Builder Upgrade														
	29,831	41,467	78,031	11,636	-36,564	446,782	447,871	208,268	1,089	239,603	518,180	435,363	-82,817	
1.3.5 Computer for Level3 PC Farm / DAQ														
	18,017	12,220	0	-5,797	12,220	162,151	178,601	220,806	16,450	-42,205	479,403	479,403	0	
1.3.6 SVT upgrade														
	54,220	28,847	171,477	-25,373	-142,629	220,841	213,664	188,422	-7,177	25,241	362,407	362,407	0	
1.3.11 Revised XFTII Project														
	302,772	115,134	183,210	-187,638	-68,077	849,808	565,855	445,512	-283,954	120,342	1,620,128	1,654,504	34,376	
<b>WBS[2]Totals:</b>														
	458,487	241,264	453,274	-217,223	-212,010	2,604,445	2,304,440	1,940,729	-300,005	363,711	4,158,787	4,131,106	-27,681	
<b>1.4 Administration</b>														
1.4.3 Construction Phase														
	26,008	24,226	15,465	-1,782	8,761	645,570	643,448	479,401	-2,122	164,047	958,867	958,859	-8	
<b>WBS[2]Totals:</b>														
	26,008	24,226	15,465	-1,782	8,761	645,570	643,448	479,401	-2,122	164,047	958,867	958,859	-8	
<b>Funding Type-CA Totals:</b>														
	484,495	265,490	470,352	-219,005	-204,862	3,663,086	3,360,958	2,866,461	-302,127	494,498	5,530,724	5,560,481	29,758	
Sub Total														
	484,495	265,490	470,352	-219,005	-204,862	3,663,086	3,360,958	2,866,461	-302,127	494,498	5,530,724	5,560,481	29,758	
Management Resrv.														
											3,171,276	3,141,518	-29,758	
<b>Total</b>														
	484,495	265,490	470,352	-219,005	-204,862	3,663,086	3,360,958	2,866,461	-302,127	494,498	8,701,999	8,701,999	0	



# Obligations Report for March, 2005

CDF RIIb EQU - March FY05 IN \$K							
Schedule	Expenditure Category	Current Month Total Cost	Current Month Obligation	YTD Total Cost	YTD Obligations w/ Indirect	Current PO Open Comm	Prior Yr Total Cost
Silicon	M&S	(3.6)	(3.6)	(0.3)	(103.7)	0.0	539.0
	SWF	0.0	0.0	(1.1)	(1.1)	0.0	571.1
	OH	(0.6)	0.0	(2.7)	(2.7)	0.0	230.9
	<b>Total 1.1</b>	<b>(4.2)</b>	<b>(3.6)</b>	<b>(4.1)</b>	<b>(107.5)</b>	<b>0.0</b>	<b>1,341.0</b>
Calorimeter	M&S	1.5	17.1	43.5	21.2	21.3	211.8
	SWF	0.0	0.0	0.0	0.0	0.0	139.1
	OH	0.1	0.0	0.9	0.9	0.0	51.5
	<b>Total 1.2</b>	<b>1.6</b>	<b>17.1</b>	<b>44.3</b>	<b>22.1</b>	<b>21.3</b>	<b>402.3</b>
Trigger/DAQ	M&S	397.2	259.7	604.6	1,123.0	576.0	708.2
	SWF	37.2	37.2	183.5	183.5	0.0	220.7
	OH	18.9	0.0	94.2	94.2	0.0	129.2
	<b>Total 1.3</b>	<b>453.3</b>	<b>297.0</b>	<b>882.3</b>	<b>1,400.7</b>	<b>576.0</b>	<b>1,058.1</b>
Administration	M&S	0.2	0.2	0.3	0.3	0.0	29.1
	SWF	11.7	11.7	74.7	74.7	0.0	268.2
	OH	3.6	0.0	22.7	22.7	0.0	84.4
	<b>Total 1.4</b>	<b>15.5</b>	<b>11.9</b>	<b>97.7</b>	<b>97.7</b>	<b>0.0</b>	<b>381.7</b>
<b>Total Project</b>	M&S	395.2	273.4	648.1	1,040.8	597.2	1,488.2
	SWF	48.9	48.9	257.1	257.1	0.0	1,199.0
	OH	22.0	0.0	115.0	115.0	0.0	495.9
<b>Grand Total</b>		<b>466.2</b>	<b>322.4</b>	<b>1,020.2</b>	<b>1,412.9</b>	<b>597.2</b>	<b>3,183.1</b>
<b>Total Project Cost (Inception To Date):</b>			<b>\$4,203.3</b>				



# Completed Subprojects

---

- Silicon codes were closed at the end of FY04
  - Remaining BAC was returned to contingency in Feb 05
- Calorimeter work is now complete
  - Codes are closed now.
- One last P.O. (with MSU) was placed to close out the optical fiber work.
- Total costs will be \$468K, current baseline is \$413K
- We have Change Request #19 to submit for this adjustment. Then we're done.



# Status of Remaining Subprojects

- Status of the DAQ subprojects as measured by costs:

Subproject	% Complete	SPI	CPI
TDCs	0.69	0.95	1.00
XFT	0.35	0.67	1.27
Level 2	0.89	1.00	1.05
Event Builder	0.86	1.00	2.15
Level 3/DAQ Comp.	0.37	1.10	0.81
SVT	0.59	0.97	1.14
Total DAQ SubProject	0.55	0.88	1.19

$$\% Com. = \frac{BCWP}{BAC} \quad SPI = \frac{BCWP}{BCWS} \quad CPI = \frac{BCWP}{ACWP}$$



# Adjustments to the Cost Estimates

- TDC Modifications –
  - A review of the project so far suggests that the labor estimate may have been too high.
  - Estimate has been adjusted down, consistent with experience – net adjustment of -\$86K
    - Contingency on this will be retained at 30% of the remaining work.
- Level 2 Trigger Crate –
  - This is close to completion, installed now
  - Some labor remains. Some additional hardware is desired
    - Cost adjustment of \$38K, contingency on additional hardware, and possible extension of the labor



# Adjustments to the Cost Estimates

- Track Trigger adjustments
  - Adjustment needed for schedule slip - \$34K
  - A “bottoms up” assessment of productions costs has been done.
  - Contingency has been reevaluated, and calculated based on remaining work and our contingency guidelines.
  - Here we wish to keep \$458K as contingency
- Event Builder
  - Several engineering tasks were overestimated, and/or performed by physicists.
  - Budget for these completed tasks has been identified
  - Cost can be readjusted by -\$83K



# Adjustments to the Cost Estimates

---

- Silicon Vertex Trigger
  - Recently had a baseline change. No adjustments identified.
  - Remaining cost has contingency – mostly labor for firmware



# Adjustments to the Cost Estimates – Computers

---

- Our current baseline has estimates based on 2001-02 experience (very little)
- The system will be experiencing a threefold increase in input when the event builder is installed
  - Event complexity at higher luminosity increases the processing need even further. More hits → more tracks
- We need to complete the Run IIb upgrade with a substantial increase in Level 3 capacity.



# Adjustments to the Cost Estimates – Computers

---

- We plan to replace file servers instead of the replacement computers in our baseline
  - \$37K→\$91K increase. Better suited to our needs
- We propose to double the number of level 3 processors in our current system.
  - Currently 6 racks of processor nodes; grow to 12.
  - Recent purchases have been more expensive than baseline estimates (\$1.5K/node →\$2.5K/node)
  - Total \$680K increase from our baseline is needed.



# Level 3 scope

- The level 3 proposal is based on some experience.
- Projections for future needs are at the 4-6 THz level.
- This proposal will get us ~half the way.
  - Fine through the event builder turn on.
  - Algorithm modifications probably are needed for the highest luminosities.

Rack	CPU/rack	Speed(GHz)	Totals	Running total
1	64	2	128	128
2	64	2	128	256
3	64	2.6	166.4	422.4
4	64	2.6	166.4	588.8
5	64	3.2	204.8	793.6
6	64	3.2	204.8	998.4
7	64	3.5	224	1222.4
8	64	3.5	224	1446.4
9	64	3.5	224	1670.4
10	64	3.5	224	1894.4
11	64	3.5	224	2118.4
12	64	3.5	224	2342.4

- Black nodes represent the current system
- Red represents the proposal



# Original Project Costs

	Total Obligations in Current Year \$K					
	FY02	FY03	FY04	FY05	FY06	Total
Silicon	\$ 1,670	\$ 1,525	\$ 1,110	\$ 713	\$ 55	\$ 5,073
Calorimeter	\$ 41	\$ 597	\$ 617	\$ 62	\$ 49	\$ 1,366
DAQ	\$ 22	\$ 363	\$ 1,307	\$ 4,069	\$ 36	\$ 5,796
Administration	\$ -	\$ 213	\$ 422	\$ 433	\$ 240	\$ 1,309
Total	\$ 1,733	\$ 2,698	\$ 3,456	\$ 5,277	\$ 380	\$ 13,544

	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	\$ 9	\$ 642
U.S. Universities	\$ 24	\$ 225	\$ 103	\$ 26	\$ 378
Total	\$ 5,193	\$ 4,556	\$ 2,028	\$ 1,767	\$ 13,544

- All costs are in AY \$K, and include G&A
- Additional contributed labor is required (but not included)
  - Physicists are not considered part of the project cost.



# Other tracking quantities

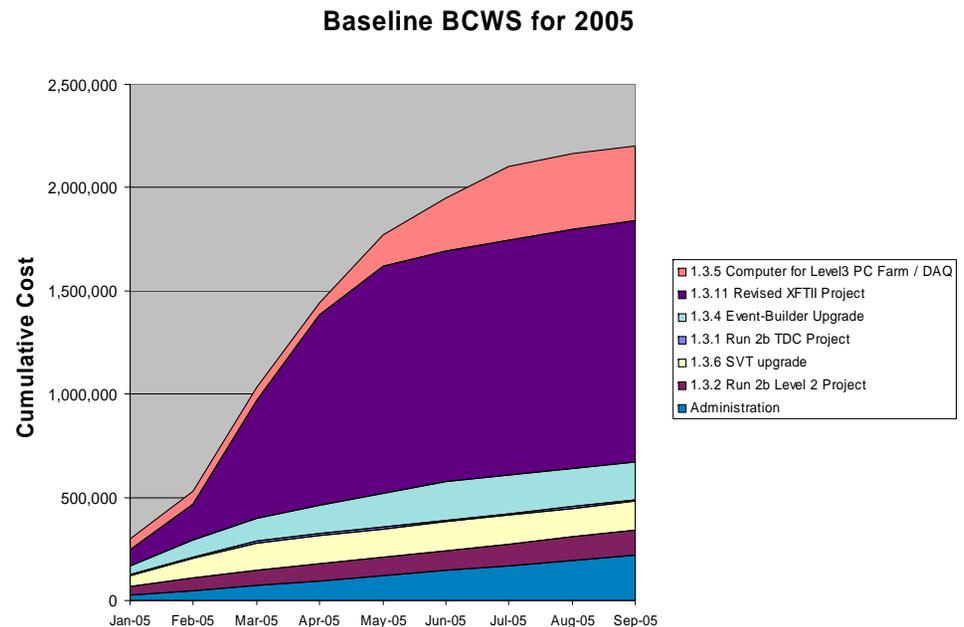
	ACWP		BCWP		BAC		Cont.	EAC	ETC	Complete
	Silicon	Nonsil.	Silicon	Nonsil.	Silicon	Nonsil.				
<b>August</b>	1321	1357	1321	1893	1673	5734	2967	6871	7160	43%
<b>September</b>	1342	1842	1342	2002	1673	5734	2967	7247	7030	45%
<b>October</b>	1342	1957	1342	2125	1673	5254	3448	6759	6908	50%
<b>November</b>	1357	2081	1357	2366	1673	5254	3448	6642	6652	54%
<b>December</b>	1341	2199	1341	2673	1673	5254	3448	6453	6361	58%
<b>January</b>	1341	2277	1341	2909	1673	5254	3448	6295	6125	61%
<b>February</b>	1341	2396	1341	3095	1341	5531	3503	6173	5939	65%
<b>March</b>	1341	2866	1341	3361	1341	5531	3503	6377	5673	68%

- We use the financial information available from the CPR and obligations reports to calculate other high level tracking quantities.
  - BAC – estimate of the total cost of the project at completion
  - $EAC = BAC - BCWP + ACWP$
  - $ETC = EAC - ACWP + Contingency$



# Remaining, Non-silicon BCWS

- The BCWS through March was \$3663K
  - \$1868K remains
- Large items remaining
  - XFT production boards
  - Level 3 computer purchases
- Steady engineering and technical effort drives the majority of the remaining cost.





# Contingency Estimates

---

- We have recalculated our contingency needs at the task level. Guidelines are unchanged.
- Today's contingency estimate reflects the fraction of work done
  - Total is scaled by the percent complete, at the task level.
- In total, we then have three kinds of costs
  - Baseline
  - Adjustment to cost – anticipated uses of contingency
  - Contingency – calculated on remaining work



# Forecast cost

WBS	Items	Project's Cost Estimate (Fully Loaded At Year) \$K						
		Baseline BAC (w/o cont.)	Anticipated Adjustments	ACWP	ETC (w/o cont.)	Contingency	% Contingency for Remaining Work	Total (BAC+Cont.)
1.1	Run IIb Silicon Project	1341	0	1341	0	0	0%	1341
1.2	Calorimeter Upgrades							
1.2.1	Central Preshower and Crack Detectors	377	68	423	22	0	0%	445
1.2.2	Electromagnetic timing	36	-13	23	0	0	0%	23
1.3	Run IIb DAQ and Trigger Project							
1.3.1	Run IIb TDC Project	741	-85	508	148	72	49%	728
1.3.2	Run IIb Level 2 Project	437	37	370	104	49	47%	523
1.3.4	Event-Builder Upgrade	518	-83	208	227	19	8%	454
1.3.5	Computer for Level 3 PC Farm / DAQ	479	622	221	880	235	27%	1336
1.3.6	SVT upgrade	362	0	188	174	67	39%	429
1.3.11	Revised XFTII Project	1620	34	446	1208	489	40%	2143
1.4	Administration							
1.4.3	Construction Phase	959	-215	430	314	30	10%	774
Project Totals		6,870	365	4,158	3,077	961	31%	8196



# Adjustments in Cost

- In conclusion, we have the following corrections:

	AY \$K
Calorimeter Closeout	\$54
TDC	(\$86)
Level 2	\$34
Event Builder	(\$81)
Level 3	\$622
Administration	(\$215)

- We are ready to submit change requests for these.
- Contingency on the remaining work has been estimated with the PMP guidelines



# Summary

---

- The calorimeter and Level 2 projects are in their closeout phase or near completion.
- Completion of some tasks and experience has given us better estimates for future costs, and reduced need for contingency.
- Total project cost estimate is not significantly different than the January review.
- The project can be completed with a total cost of \$8196K.