US LHC Accelerator Project
Progress Report, 4th Quarter FY 2003
15 December 2003
J. Strait, Project Manager

I. Summary

Good technical progress continues across most of the Project. The beam separation dipoles, IR absorbers, and DFBX feedboxes are in production and progressing well. The sole technical set-back resulted from the unsuccessful testing of the third Q3 quadrupole.

The Project has an unfavorable cost variance of -\$3.0M (-3%) and schedule variance of -\$5.1M (-5%), both are improvements from last quarter. The unfavorable change in cost variance is principally in the dipole and feedbox programs. The schedule remains in an unfavorable condition due to delays in quadrupole and dipole production, and in cable deliveries from CERN for testing. Based on an earned value of \$94.3M, the project is 89% complete. The EAC is \$107.8M and has been updated with the most recent BCRs in process.

The second Q3 quadrupole (LQXB02), consisting of cold masses MQXB03 and MQXB04, was cold tested and found to be unacceptable because cold mass MQXB04 was unable to reach the required current level of 12KA. We are evaluating several alternatives for rebuilding cold mass MQXB04 or replacing it with the prototype cold mass. The third Q2 (LQXB03), consisting of cold masses MQXB05 and MQXB06, is nearly complete. It will be tested next quarter. Cold masses 7-11 are now complete and the twelfth is nearly complete. They will make up the fourth through sixth Q2 magnets once correction magnets are received from CERN. Additional cold mass production has been stopped pending further analysis of the testing failure of MQXB04. The delivery schedule for MCBX corrector magnets from CERN continues to be a concern. CERN cold tests the MCBX magnets upon receipt from the vendor and sends them to us. The tests are typically averaging one per month. If this continues, the corrector deliveries from CERN will become the critical path for quadrupole assembly at Fermilab. We discussed our concerns directly with CERN management during a visit in September. Separately the issue has been brought to the attention of DOE program management.

The fourth D1 dipole magnets, D1L102, arrived at CERN. All nine D2 magnets have been inserted into their cryostats, seven have been tested, and four have had cryogenic feed pipe assemblies, QQS, installed. The eighth D2 magnet is under test. All six D3 cold masses, which will be combined in pairs to become three magnet assemblies, are complete through electro/mechanical work on the ends. A production readiness review was conducted on the D3 magnet assembly. All three D4 cold masses are complete and the first is in its cryostat.

The cryogenic feedbox fabrication vendor is progressing well, being on schedule overall and ahead of schedule on small parts. The four TAS beam absorbers arrived at CERN and are undergoing tests there. The only remaining major TAN absorber subassembly, the beam tubes, have been received from the vendor after electron beam welding. Two of the four have been successfully baked out and leak checked at LBNL. The two other beam tubes have been returned to the vendor for repair.

Superconducting cable testing reached 90% of the planned rate this quarter, the highest of any quarter to-date, with 115% for August, the highest of any month-to-date.

II. Technical Status

1.1.1 IR quadrupoles

The second Q2 (LQXB02), which consists of cold masses MQXB03 and MQXB04, failed to reach the specified training gradient of 230 T/m. MQXB03 reached 230 T/m without quenching, but MQXB04 only reached 201 T/m, below the nominal operating field of 205 T/m. It appears there is a conductor limit in turns 12-14 of lead end of the inner coil of quadrant 2, within a few centimeters of the body-end transition. The magnet will be removed from the test stand and disassembled to determine the cause of the limit. Strategies for repair range from a complete rebuild of MQXB04 to replacing it with the prototype cold mass.

Assembly of LQXB03, consisting of MQXB05 and MQXB06, was nearly completed by the end of the quarter. It will be ready for installation on the test stand as soon as LQXB02 is removed. Cold masses 7-11 are complete and the twelfth is nearly complete. These will make up Q2 assemblies 4-6. The coils for the thirteenth cold mass are being prepared for collaring.

The delivery schedule of MCBX corrector magnets from CERN continues to be a concern. CERN cold tests the MCBX magnets upon receipt from the vendor and sends them to us. The tests have typically averaged one per month, but no less than three weeks. If this continues, the corrector deliveries from CERN will become the critical path for quadrupole assembly at Fermilab. This issue has been discussed with CERN management and it has been brought to the attention of DOE program management.

The first Q1, consisting of a cold mass from KEK in a Fermilab cryostat is being prepared for assembly. Sufficient Nitronic-40 material was found in-house from which to fabricate the laminations which will make up the absorber that goes between the cold bore tube and the coil.

A shipping cradle for the Q2 magnets has been designed, similar to the cradle being used by Brookhaven for the dipole magnets. The magnet will be mounted to this cradle and a crate will be constructed by a shipping company for the entire cradle-magnet assembly.

1.1.2 IR Dipoles and 1.2.1 RF Region Dipoles

The fourth D1 dipole magnet, D1L102, arrived at CERN in August. The last D1, D1L101, is being held at BNL for additional cold testing to confirm quench safety of the magnet, which has developed an electrical short between one of the quench heaters and magnet coil. The D1 non-lead end interconnect design was completed last quarter and the hardware is currently being fabricated in the BNL shops. The lead end interconnect design work is continuing.

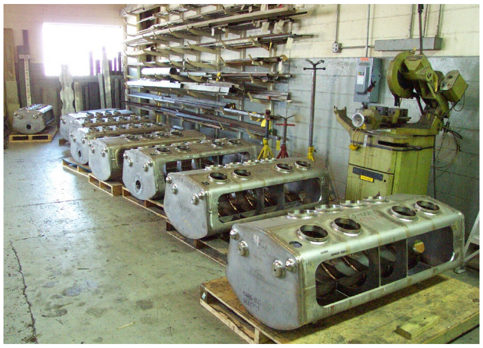
All nine D2 magnets are in their cryostats, seven have been tested, and four have had cryogenic feed pipe assemblies, QQS, installed. The eighth D2 magnet is under test.

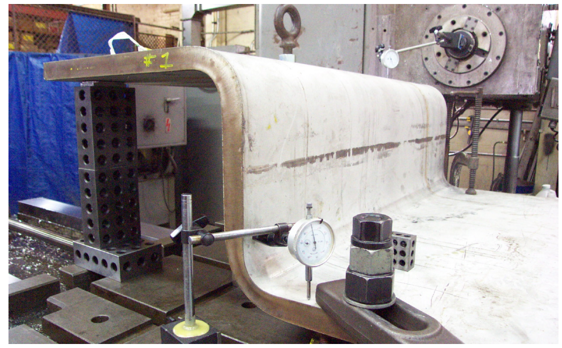
All six D3 cold masses, which will be become three D3 magnet assemblies, are complete through electro/mechanical work on the ends. The end volumes are complete on two cold masses that make up the first magnet assembly. A production readiness review was conducted on the D3 magnet assembly. A number of minor design modifications in the cryostat are being incorporated. These address constraints arising from the interface to the CERN-built QQS module, which is now being designed by CERN.

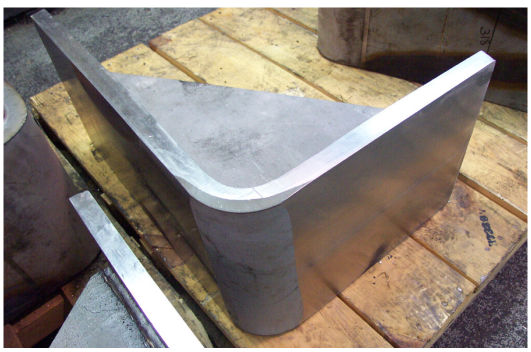
Cold mass assembly is complete on all three D4 magnets. Cryostat assembly is complete for the first magnet, including a change in the orientation of the instrument feedthrough system as requested by CERN.

1.1.3 Cryogenic Feed Boxes

Feedbox fabrication is continuing on schedule at the vendor. The helium vessels are nearing completion as are most small parts. See Figure 1.


(a) Liquid helium vessels


(b) Top plate


(c) Support bracket


(d) Vacuum flanges

Figure 1 DFBX parts in fabrication at the vendor. Further images are at http://tdpc02.fnal.gov/peterson/tom/DFBXimages/IndexDFBX.html

The first set of vapor cooled leads were delivered from the vendor to the feedbox fabricator for installation into the first feedbox. See Figure 2. The delivery of the remaining sets is behind schedule but the vendor is expected to catch up and complete the shipments before the end of 2003, well in advance of the requirements for DFBX assembly.

All 40 HTS leads have been received at FNAL and testing of the leads is currently under way. See Figure 2. Twelve leads have been cold tested and found acceptable, four leads have been cold tested but must be repaired, seven leads need to be repaired before cold testing, and the remaining 17 leads are ready for cold testing. The vendor has agreed to send their representative to Fermilab in November to evaluate the test results and develop a plan to repair the leads.

Work on key feedbox subassemblies at LBNL continued. All four MBX1 bus duct assemblies have been fabricated and successfully tested. Work on the MQX1 bus duct assemblies is continuing. Six assemblies were completed and successfully tested. Parts for all eight beam tube assemblies were machined and the first beam tube assembly was completed.

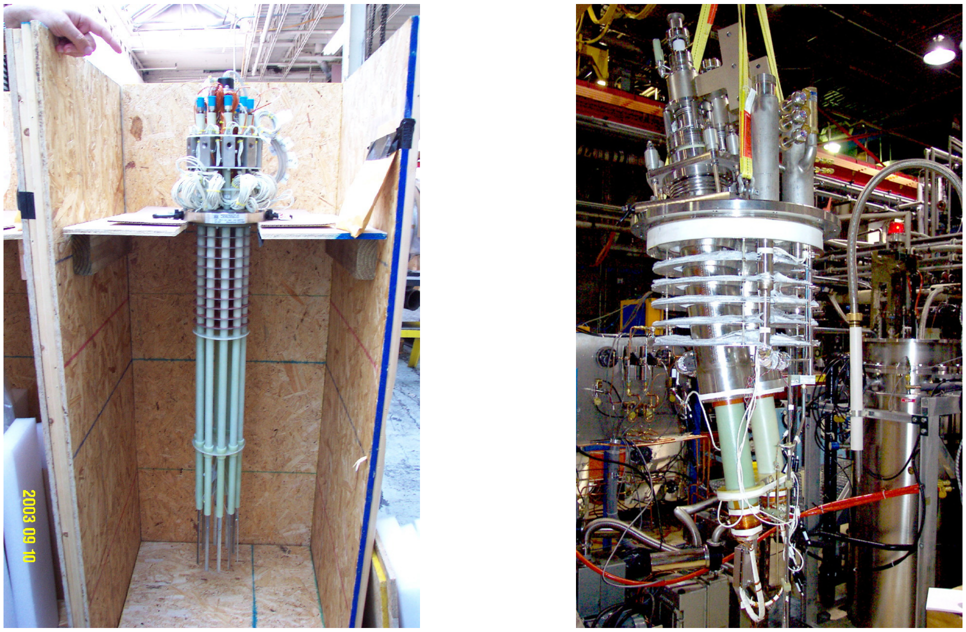


Figure 2 Left – first set of vapor cooled leads upon receipt at feedbox vendor.
Right – pair of HTS leads being prepared for cold test at Fermilab.

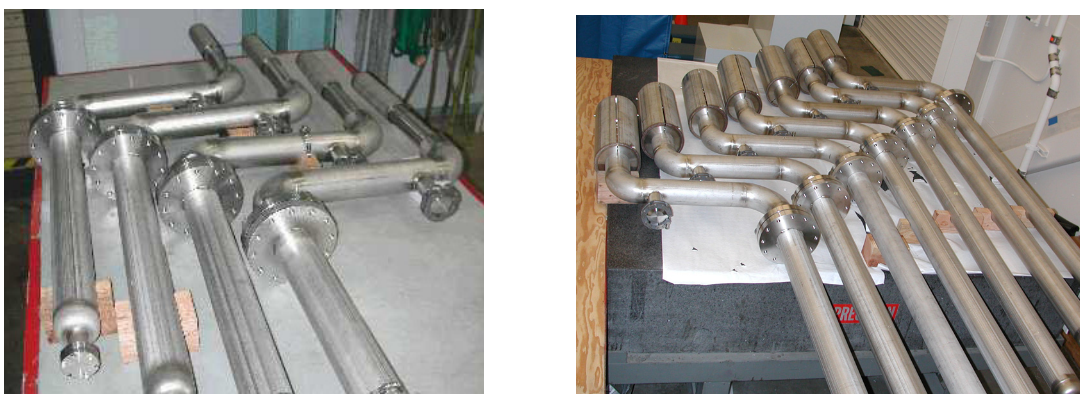


Figure 3 Left – MBX1 bus ducts complete and ready to ship to the feedbox vendor.
Right – MQX1 bus ducts nearing completion at LBNL.

<u>1.1.4 IR Absorbers</u>

The four TAS absorbers arrived at CERN in July and passed the preliminary inspection tests. Work is continuing on completing the documentation for the TAS system.

Four TAN absorber beam tubes have been electron beam welded at the vendor and returned to LBNL. See Figure 3. Two beam tubes passed the initial vacuum leak checks and two had leaks at one of the welds and were shipped back to the vendor. The two good beam tubes proceeded to the bake-out and final leak check. The bake out of the first beam tube was completed and the vacuum leak test met CERN's requirement.

1.1.5 IR System Design

The bus splice and expansion loop for the Q1 and Q3 are largely complete. A complete mock-up was assembled using a MCBX corrector and a model MQXA quadrupole. Parts have been received for the first production Q1 quadrupole.

The acceptance plan for LQXB is under final review and is being discussed informally with CERN before being officially submitted.

1.3.1 Superconductor Testing

Cable test activity occupied 38 days of testing at 4.3K, with 178 cable tests performed on LHC production cable samples, and four reference sample tests. See Table I. This is very close to the originally expected rate of 200 tests per quarter, thanks to an accelerated rate of delivery of samples from CERN, which in turn reflects the increased rate of production by CERN's cable vendors. Several tests were extended to measure in both a- and b-directions as requested by CERN.

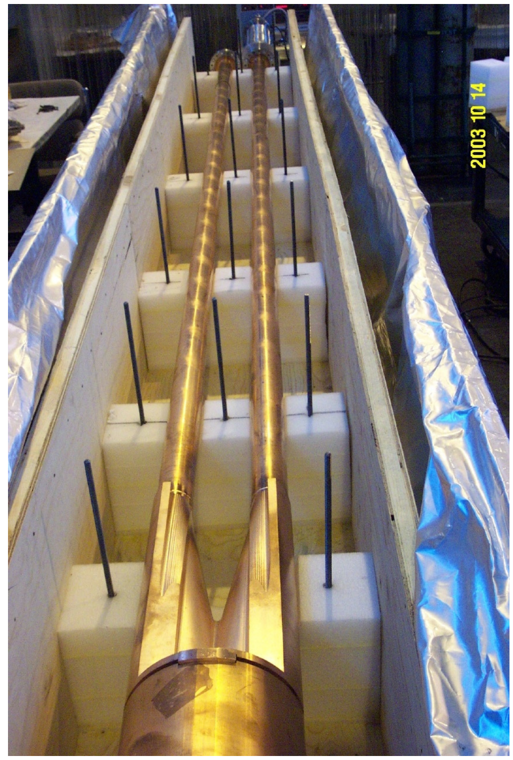


Figure 4 TAN beam tube after electron beam welding.

Table I. Number of Superconducting Cable Tests.

EFT = Equivalent 4.2K Test	No. Days @4.2K	Non-prod. days	Fract of cryo for LHC	LHC EFTs	MQXB EFTs	BNL Dipole EFTs	Ref Cable Tests	All Tests
EFT Budget				3430	84	40	48	3602
Plan to Date				1948	84	40	30	2102
Total to Date	425	8		1505	74	44	36	1659
FY1999	31	3		65	10	8		83
FY2000	46	1		127	18	28		173
FY2001	98	3	0.39	320	42	4	10	376
FY2002	113	1	0.47	417	4	4	14	439
Oct 02	10	0	0.42	39	0	0	0	39
Nov 02	5	0	0.42	20	0	0	0	20
Dec 02	10	0	0.42	40	0	0	0	40
Jan 03	10	0	0.32	38	0	0	0	38
Feb 03	12	0	0.61	52	0	0	4	56
Mar 03	13	0	1.00	53	0	0	2	55
Apr 03	12	0	0.44	47	0	0	0	47
May 03	14	0	0.60	60	0	0	0	60
Jun 03	13	0	0.77	49	0	0	2	51
Jul 03	12	0	0.43	48	0	0	4	52
Aug 03	16	0	0.76	76	0	0	0	76
Sep 03	10	0	0.46	54	0	0	0	54
FY2003	137	0	0.55	576	0	0	12	588

1.3.2 Superconducting Cable Production Support

There was no activity during the reporting period. A small budget remains to cover the cost of shipping cable measuring equipment back to LBNL and for consulting on cable production issues.

1.4 Accelerator Physics

All Accelerator Physics tasks were completed 30 September 2002.

III. Financial Status

Cost and Schedule Performance

The current performance data at WBS level 2 are summarized in Table II (G&A is included on each line), and the changes since the last quarter for the program as a whole are contained in Table III. Variances by laboratory are summarized in Table IV. The CPR (Format 1, by WBS, and Format 2, by laboratory) for the reported quarter (the current period columns of the report represent three months of data) and three trend charts (cumulative performance, cost/schedule variance, and bull's-eye) are included as attachments.

Table II. Current cost performance data.

	Cumulative Costs to Date					Costs at Completion		
WBS	BCWS	BCWP	ACWP	SV	CV	BAC	EAC	VAC
1.1 IR Region	56,596	53,226	56,020	-3,370	-2,794	60,397	63,554	-3,157
1.2 RF Region	16,119	15,571	14,074	-548	+1,497	16,120	15,803	+317
1.3 SC Wire/Cable	10,986	9,826	9,723	-1,160	+103	13,091	11,970	+1,121
1.4 Accel Physics	3,359	3,359	3,288	0	+71	3,359	3,359	+0
1.5 Project Mgt	12,349	12,349	14,181	0	-1,832	13,270	13,123	+147
Contingency						3,763	2,191	+1,572
Total	99,409	94,331	97,286	-5,078	-2,955	110,000	110,000	0*

*Note: Total VAC is equal to sum of WBS VACs minus the Contingency VAC.

Table III. Cost performance changes since the previous report.

	Last Quarter	This Quarter
Total Project Cost (TPC)	110,000K	110,000K
Budget At Completion (BAC)	106,237K	106,237K
Cum Budget to Date (BCWS)	96,134K	99,409K
Earned Value (BCWP)	90,597K	94,331K
Actual cost & commitments (ACWP)	94,234K	97,286K
Budgeted Cost of Work Remaining (BCWR)	15,640K	11,906K
Schedule Variance (SV)	-5,538K (-6%)	-5,078K (-5%)
Cost Variance (CV)	-3,638K (-4%)	-2,955K (-3%)
Estimate At Completion (EAC)	108,091K	107,809K
Contingency (TPC – EAC)	1,909K	2,191K
Contingency as a % of BCWR	12%	18%

Table IV. Schedule and cost variances by laboratory.

Lab	SV – Quarter	CV – Quarter	SV – Cum	CV - Cum
BNL	+101K	-410K	-2,034K	-2,093K
FNAL	-340K	-53K	-2,637K	-450K
LBNL	+699K	+1,145K	-407K	-413K

Brookhaven's -\$410K cost variance for the quarter consists mainly of overruns in testing D2 magnets, in production and EDIA for D3 magnets, and in testing of superconducting cable samples. The +\$101K schedule variance for the quarter results from the improvements in the D4 dipole production, and D2 production and testing which is then largely offset by delays in the deliveries of superconducting cable samples from CERN.

Fermilab's -\$53K cost variance for the quarter results from mostly canceling modest positive variances in some areas (cryostat parts, project management) and negative variances in others (quadrupole assembly and testing, HTS lead testing, IR system design). The -\$340K schedule variance for the quarter is primarily due to the slow quadrupole production rate, driven in large part by the lack of delivery from CERN of correction coils, which must be incorporated into each quadrupole assembly. There is a small negative impact on both cost and schedule of the failure of MQXB04 to reach the required field gradient. This impact will be more notable in the next quarter.

Berkeley's +\$1,145K cost variance for the quarter and +\$699K schedule variance for the quarter result primarily from the implementation of a new baseline for DFBX production (BCR 51). The old baseline, which assumed in-house production at LBL, did not allow earned value to be taken against the actual costs paid to an industrial vendor for feedbox fabrication. With the new baseline in place the earned value could be taken, resulting in the large positive variance. Additional contributions to the positive variances come from another BCR (number 56), which provides additional budget for completion of the absorbers.

Estimate At Completion (EAC)

The EAC of \$107,809K is nearly unchanged from last quarter and results from a balance between cost increases recognized by BCRs and nearly equal work scope reductions mandated by project management, in agreement with management of the three US Laboratories. It also anticipates the formal approval of BCRs currently under review by project management.

Baseline Change Requests

There were five BCRs approved during this reporting period. BCR 51 re-baselines the DFBX fabrication estimate to complete (ETC) and changes the fabrication plan from in-house production to construction by an industrial vendor. BCR 53 changes the Q3 configuration to reposition the non-linear correction coil package from the IP end to the non-IP end of the Q3 cryoassembly (LQXC). BCR 54 revises the dipole testing plan to add cold field measurements for D2 #5 and #6, D3 #2 and #3, and quench and cold field measurements for D2 #7 through #9. In both BCRs 53 and 54, the cost increases of the additional work are offset by corresponding decreases in superconducting cable testing. BCR 56 re-baselines the estimate to complete (ETC) for the IR absorbers. BCR 57 updates the level 2 and level 3 DFBX milestones to correspond to the new BCR 51 fabrication baseline.

Funding

The overall funding available is anticipated to be adequate to support the program for the coming year, as indicated in the attached funds tracking chart.

IV. Milestone Status

Tables V and VI list all level 1 and 2 milestones through the end of the Project in 2005, and Table VII shows the level 3 milestones affected during the quarter. Changes are highlighted in bold print. Actual dates are shown for completed milestones and forecast dates are given for milestones that have slipped out of the quarter or, due to pending changes in the program schedule, are expected to be achieved at times substantially different from the baseline dates. Level 1 and 2 milestones are displayed graphically in an attachment. The forecast dates have been entered in cases in which the projected completion date is later than the baseline date.

Table V. Level 1 U.S. LHC Accelerator Project level 1 milestones.

Milestone No.			Baseline Date	Forecast Date	Actual Date
1 - 1		Project Start	1 Oct 1995		1 Oct 1995
1 - 2 C		Decision as to whether or not the U.S. Project includes RF region quadrupoles	1 Jul 2001		20 Jun 2001
1 - 3		Project Completion	30 Sep 2005	30 Sep 2005	

Table VI-a. U.S. LHC Accelerator Project interaction region level 2 milestones.

Milestone No.		Baseline Date	Forecast Date	Actual Date
	WBS 1.1 Interaction Regions			
2 -1.1- 1	Begin 1st inner triplet quadrupole model magnet	1 Jul 1997		1 Jul 1997
2 -1.1- 2	Complete inner triplet quadrupole model magnet program phase 1	1 Dec 1999		28 Sep 1999
2 -1.1- 3	Complete inner triplet quadrupole model magnet program phase 2	1 Mar 2000		17 Mar 2000
2 -1.1- 4	Place purchase order for HTS power leads	1 Feb 2000		30 Aug 2000
2 -1.1- 5	Begin absorber fabrication	1 Nov 2000		30 Oct 2000
2 -1.1- 6	Complete inner triplet quadrupole prototype magnet program	1 Oct 2001		31 Aug 2001
2 -1.1- 7	Begin interaction region beam separation dipole production assembly	1 Oct 2000		25 Jul 2000
2 -1.1- 8	Begin inner triplet feedbox fabrication	1 Mar 2001		27 Mar 2003
2 -1.1- 9	Begin inner triplet quadrupole production assembly	1 Nov 2001		1 May 2001
2 -1.1- 10	Complete 1st inner triplet quadrupole magnet	1 Sep 2002		11 Mar 2003
2 -1.1- 12	Complete inner triplet feedbox fabrication	**31 Aug 2005**	31 Aug 2005	
2 -1.1- 13a C	Delivery of inner triplet magnets for IR8 left (MQX, D1, D2)	19 Dec 2003	**31 May 2004**	
2 -1.1- 13b C	Delivery DFBX for IR8 left	13 Aug 2004		
2 -1.1- 15	Complete absorber fabrication	1 Feb 2003	**31 Jan 2004**	
2 -1.1- 16a C	Delivery of inner triplet magnets for IR8 right (MQX, D1, D2)	8 Oct 2004		
2 -1.1- 16b C	Delivery DFBX for IR8 right	25 Feb 2005		
2 -1.1- 18	Complete interaction region beam separation dipole production assembly	1 Apr 2003	14 Jan 2004	
2 -1.1- 19a C	Delivery of inner triplet magnets and absorbers for IR1 left (MQX, D2, TAS, TAN)	6 Aug 2004		
2 -1.1- 19b C	Delivery of DFBX for IR1 left	25 Feb 2005		
2 -1.1- 23a C	Delivery of inner triplet magnets and absorbers for IR5 left (MQX, D2, TAS, TAN)	31 Aug 2005		
2 -1.1- 23b C	Delivery of DFBX for IR5 left	31 Aug 2005		
2 -1.1- 25a C	Delivery of inner triplet magnets and absorbers for IR5 right (MQX, D2, TAS, TAN)	29 Apr 2005		
2 -1.1- 25b C	Delivery of DFBX for IR5 right	31 Aug 2005		
2 -1.1- 26a C	Delivery of inner triplet magnets for IR2 right (MQX, D1, D2)	30 Apr 2004		
2 -1.1- 26b C	Delivery of DFBX for IR2 right	1 Oct 2004		
2 -1.1- 27a C	Delivery of inner triplet magnets and absorbers for IR1 right (MQX, D2, TAS, TAN)	21 Jan 2005		
2 -1.1- 27b C	Delivery of DFBX for IR1 right	12 Aug 2005		
2 -1.1- 30	Complete inner triplet quadrupole production	1 Mar 2005		
2 -1.1- 32a C	Delivery of inner triplet magnets for IR2 left (MQX, D1, D2)	4 Feb 2005		
2 -1.1- 32b C	Delivery of DFBX for IR2 left	12 Aug 2005		
2 -1.1- 33	Interaction Region task complete	30 Sep 2005		

Table VI-b. U.S. LHC Accelerator Project RF region and SC cable level 2 milestones.

	WBS 1.2 RF Region				
2 -1.2- 1		Begin assembly of 1st dipole model magnet	1 Sep 1999		10 Jun 1999
2 -1.2- 2		Complete dipole model magnet program	1 Aug 2000		8 Nov 2000
2 -1.2- 3		Begin RF region beam separation dipole production assembly	1 Jan 2002		3 Dec 2001
2 -1.2- 4 C		Delivery of D3, D4 for IR4 right	24 Jun 2005		
2 -1.2- 5		Complete RF region beam separation dipole production assembly	1 Sep 2003	**1 Jun 2004**	
2 -1.2- 6 C		Delivery of D3, D4 for IR4 left	31 Aug 2005		
2 -1.2- 7		RF Region task complete	30 Sep 2005		
	WBS 1.3 Superconducting Wire and Cable				
2 -1.3- 1		All cable production support equipment delivered to CERN	1 Sep 1999		28 May 1999
2 -1.3- 2		Complete SC testing facility upgrades	1 Jun 1999		30 Sep 1999
2 -1.3- 3		Series wire and cable testing complete	31 Mar 2005	31 Aug 2005	
2 -1.3- 4		Superconducting Wire and Cable task complete	30 Sep 2005		

Table VII. U.S. LHC Accelerator Project level 3 milestones active during the current quarter.

Milestone No.			Baseline Date	Forecast Date	Actual Date
	WBS 1.1.1 Interaction Region Quadrupoles				
3 -1.1.1- 6b C		MQXA to LQX Cryostat Interface Specification approved	1 Jan 2001	**1 Feb 2004**	
3 -1.1.1- 10c C		TAS2/3 Functional Specification approved	1 Dec 2000	**1 Feb 2004**	
3 -1.1.1- 15 C		LQX Tunnel Installation and Alignment Specifications approved	1 Jun 2001	**1 Feb 2004**	
3 -1.1.1- 16b C		LQX Cold Bore Tube Interface Specification Approved	1 Jan 2001	**1 Feb 2004**	
3 -1.1.1- 16c C		LQX to BPM Interface Specification Approved	1 Apr 2001	**1 Feb 2004**	
3 -1.1.1- 16d C		LQX to LQX Interface Specification Approved	1 Jun 2001	**1 Feb 2004**	
3 -1.1.1- 16e C		LQX (Q1) to Warm Beam Vacuum Interface Specification Approved	1 Jun 2001	**1 Feb 2004**	
3 -1.1.1- 25		Begin assembly of first MQXA	1 Aug 2002	1 Dec 2003	
3 -1.1.1- 26		IR8 left MQX ready to deliver	1 Mar 2003	1 May 2004	
	WBS 1.1.2 Interaction Region Dipoles				
3 -1.1.2- 9		D2 series production complete	1 Jan 2003	14 Jan 2004	
3 -1.1.2- 11		D1 production complete	1 Apr 2002	**1 Apr 2004**	
	WBS 1.1.3 Interaction Region Cryogenic Feed Boxes				
3 -1.1.3- 4 C		DFBX interface specification approved	1 Jul 1999	1 Feb 2004	
	WBS 1.1.4 Interaction Region Absorbers				
3 -1.1.4- 14		Complete assembly of TAN and TAS	1 Nov 2002	**31 Jan 2004**	
	WBS 1.2.1 RF Region Dipoles				
3 -1.2.1- 3c C		D3 interface specification approved	15 Mar 2002	**15 Feb 2004**	
3 -1.2.1- 9b		D3 production readiness review complete	15 Apr 2002		**19 Sep 2003**
3 -1.2.1- 12		D4 production complete	1 Mar 2003	**1 Mar 2004**	
3 -1.2.1- 15		D3 production complete	1 Jun 2003	**1 Jun 2004**	

COST PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE

DOLLARS IN: Thousands

1. CONTRACTOR	2. CONTRACT	3. PROGRAM	4. REPORT PERIOD
a. NAME US LHC Accelerator Project	**a. NAME** US LHC by Qtr	**a. NAME** US LHC Accelerator Project	**a. FROM** *(CCYYMMDD)* 20030701
b. LOCATION *(Address and ZIP code)* MS 343, PO Box 500, Batavia, IL 60510	**b. NUMBER**		**b. TO** *(CCYYMMDD)* 20030930
	c. TYPE / **d. SHARE RATIO** 100/0 100/0	**b. PHASE** *(X one)* ☐ RDT&E ☐ PRODUCTION	

5. CONTRACT DATA

a. QUANTITY	b. NEGOTIATED COST	c. EST COST AUTH UNPRICED WORK	d. TARGET PROFIT/ FEE	e. TARGET PRICE	f. ESTIMATED PRICE	g. CONTRACT CEILING	h. ESTIMATED CONTRACT CEILING
PROD: 0 R&D: 0	$106,237.4	$0.0	$0.0 / 0.0%	$106,237.4	$107,807.1	$110,000.0	$110,000.0

6. ESTIMATED COST AT COMPLETION

	MANAGEMENT ESTIMATE AT COMPLETION (1)	CONTRACT BUDGET BASE (2)	VARIANCE (3)
a. BEST CASE	$107,807.1		
b. WORST CASE	$107,807.1		
c. MOST LIKELY	$107,807.1	$106,237.4	$-1,569.7

7. AUTHORIZED CONTRACTOR REPRESENTATIVE

a. NAME *(Last, First, Middle Initial)*	b. TITLE
Jim Strait	US LHC Project Manager
c. SIGNATURE	**d. DATE** *(CCYYMMDD)* 20031013

8. PERFORMANCE DATA

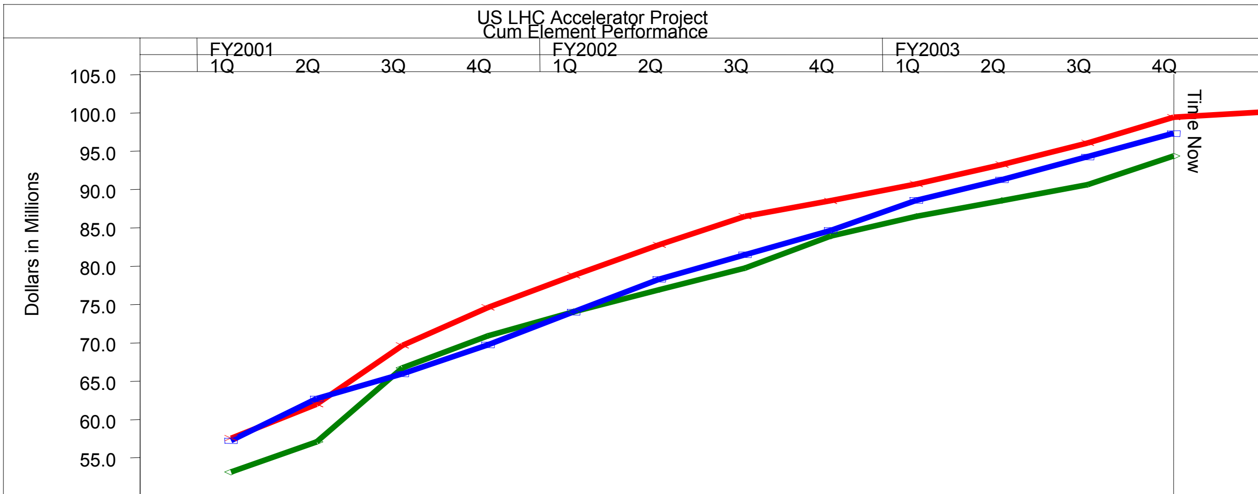
ITEM		CURRENT PERIOD					CUMULATIVE TO DATE					REPROGRAM ADJUSTMENTS		AT COMPLETION		
		BUDGETED COST		ACTUAL	VARIANCE		BUDGETED COST		ACTUAL	VARIANCE						
		WORK SCHEDULED	WORK PERFORMED	COST WORK PERFORMED	SCHEDULE	COST	WORK SCHEDULED	WORK PERFORMED	COST WORK PERFORMED	SCHEDULE	COST	COST VARIANCE	BUDGET	BUDGETED	ESTIMATED	VARIANCE
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
a. WBS ELEMENT																
1.1 - IR Regions	2	2,336.0	2,677.3	1,769.1	341.3	908.2	56,596.3	53,226.4	56,020.0	-3,369.8	-2,793.6			60,397.1	63,554.0	-3,156.9
1.1.1 - IR Quadrupoles	3	784.6	429.1	516.6	-355.4	-87.5	33,354.2	30,833.5	31,527.6	-2,520.7	-694.1			35,128.9	35,872.2	-743.3
1.1.2 - IR Dipoles	3	12.3	72.9	176.3	60.6	-103.5	8,886.7	8,615.9	10,229.7	-270.8	-1,613.9			8,886.7	11,143.4	-2,256.7
1.1.3 - Cryo Feedboxes	3	1,240.2	1,828.7	893.6	588.5	935.2	7,954.5	7,500.1	7,854.4	-454.5	-354.3			9,921.5	10,016.0	-94.5
1.1.4 - Absorbers	3	284.2	331.8	151.1	47.6	180.7	5,281.9	5,158.0	5,258.7	-123.9	-100.7			5,281.8	5,281.8	0.0
1.1.5 - System Design	3	14.7	14.7	31.5	0.0	-16.8	1,119.0	1,119.0	1,149.6	0.0	-30.6			1,178.3	1,240.6	-62.3
1.2 - RF Region	2	218.1	389.2	583.8	171.2	-194.6	16,119.6	15,571.1	14,074.6	-548.5	1,496.5			16,119.6	15,803.1	316.5
1.2.1 - RF Dipoles	3	218.1	389.2	583.8	171.2	-194.6	16,119.6	15,571.1	14,074.6	-548.5	1,496.5			16,119.6	15,803.1	316.5
1.3 - SC Wire & Cable	2	431.5	296.4	335.2	-135.1	-38.9	10,985.5	9,826.4	9,722.8	-1,159.1	103.5			13,091.0	11,969.9	1,121.1
1.3.1 - SC Testing	3	427.1	296.4	335.2	-130.7	-38.9	9,959.3	8,793.4	8,651.0	-1,165.9	142.3			12,058.1	10,937.0	1,121.1
1.3.2 - Cable Prod S'pt	3	4.4	0.0	0.0	-4.4	0.0	1,026.2	1,033.0	1,071.8	6.8	-38.8			1,032.9	1,032.9	0.0
1.4 - Accel Physics	2	0.0	0.0	0.0	0.0	0.0	3,358.8	3,358.8	3,288.1	0.0	70.7			3,358.8	3,356.9	1.9
1.4.1 - BNL AP	3	0.0	0.0	0.0	0.0	0.0	1,394.5	1,394.5	1,234.7	0.0	159.9			1,394.5	1,393.0	1.5
1.4.2 - FNAL AP	3	0.0	0.0	0.0	0.0	0.0	1,120.1	1,120.1	1,207.6	0.0	-87.4			1,120.1	1,119.8	0.3
1.4.3 - LBNL AP	3	0.0	0.0	0.0	0.0	0.0	844.2	844.2	845.9	0.0	-1.7			844.1	844.1	0.0
1.5 - Project Mgt	2	371.6	371.6	363.9	0.0	7.7	12,348.5	12,348.5	14,180.9	0.0	-1,832.3			13,270.6	13,122.8	147.8
1.5.1 - US LHC PM	3	108.8	108.8	78.4	0.0	30.4	3,356.0	3,356.0	3,240.6	0.0	115.4			3,690.6	3,661.6	29.0

COST PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE

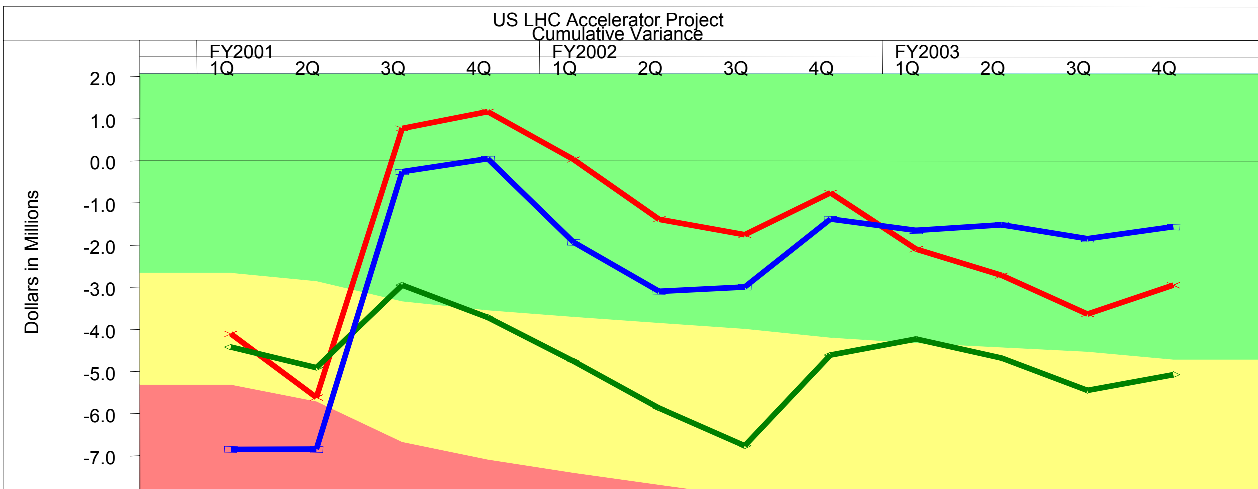
DOLLARS IN: Thousands

8. PERFORMANCE DATA

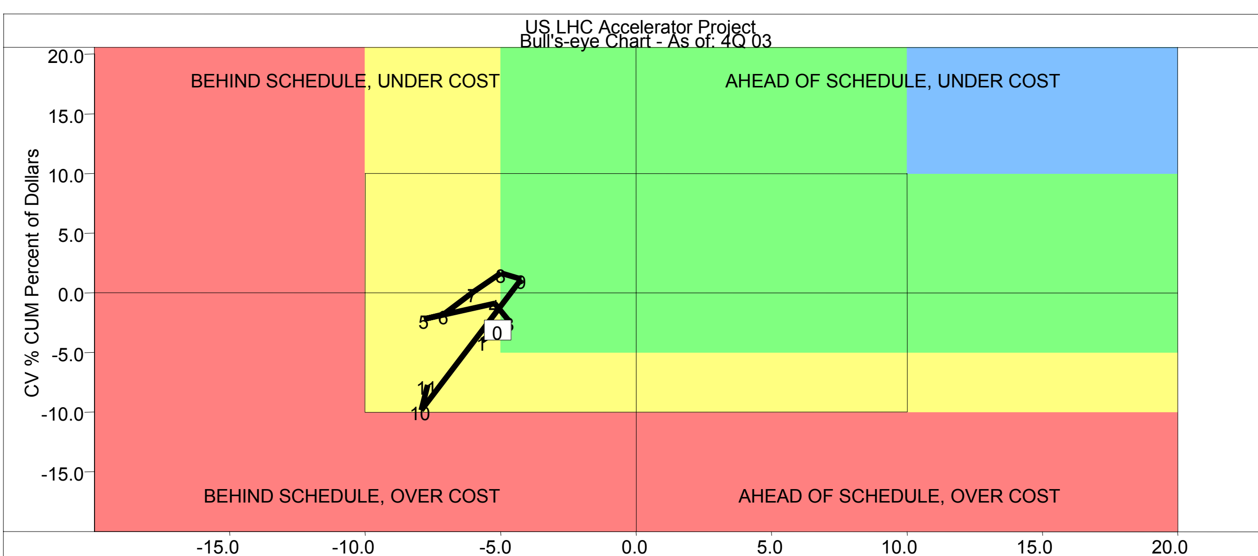
ITEM		CURRENT PERIOD					CUMULATIVE TO DATE					REPROGRAM ADJUSTMENTS		AT COMPLETION		
		BUDGETED COST		ACTUAL	VARIANCE		BUDGETED COST		ACTUAL	VARIANCE						
		WORK SCHEDULED	WORK PERFORMED	COST WORK PERFORMED	SCHEDULE	COST	WORK SCHEDULED	WORK PERFORMED	COST WORK PERFORMED	SCHEDULE	COST	COST VARIANCE	BUDGET	BUDGETED	ESTIMATED	VARIANCE
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
a. WBS ELEMENT																
1.5.2 - BNL PM	3	130.6	130.6	203.9	0.0	-73.3	5,134.3	5,134.3	7,400.5	0.0	-2,266.2			5,321.5	5,445.0	-123.5
1.5.3 - FNAL PM	3	97.7	97.7	37.1	0.0	60.7	2,258.4	2,258.4	1,971.8	0.0	286.6			2,547.4	2,305.0	242.4
1.5.4 - LBNL PM	3	34.4	34.4	44.5	0.0	-10.1	1,599.8	1,599.8	1,567.9	0.0	31.9			1,711.0	1,711.2	-0.2
[OH] - Overhead	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0
b. COST OF MONEY	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0
c. GENERAL & ADMINISTRATIVE	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0
d. UNDISTRIBUTED BUDGET	2													0.0	0.0	0.0
e. SUBTOTAL *(Performance Measurement Baseline)*		3,357.1	3,734.5	3,052.1	377.4	682.4	99,408.7	94,331.2	97,286.4	-5,077.5	-2,955.2	0.0	0.0	106,237.1	107,806.7	-1,569.6
f. MANAGEMENT RESERVE	2												0.0	0.0		
g. TOTAL		3,357.1	3,734.5	3,052.1	377.4	682.4	99,408.7	94,331.2	97,286.4	-5,077.5	-2,955.2	0.0	0.0	106,237.1		
9. RECONCILIATION TO CONTRACT BUDGET BASE																
a. VARIANCE ADJUSTMENT										0.0	0.0					
b. TOTAL CONTRACT VARIANCE										-5,077.5	-2,955.2			106,237.1	107,807.1	-1,570.0

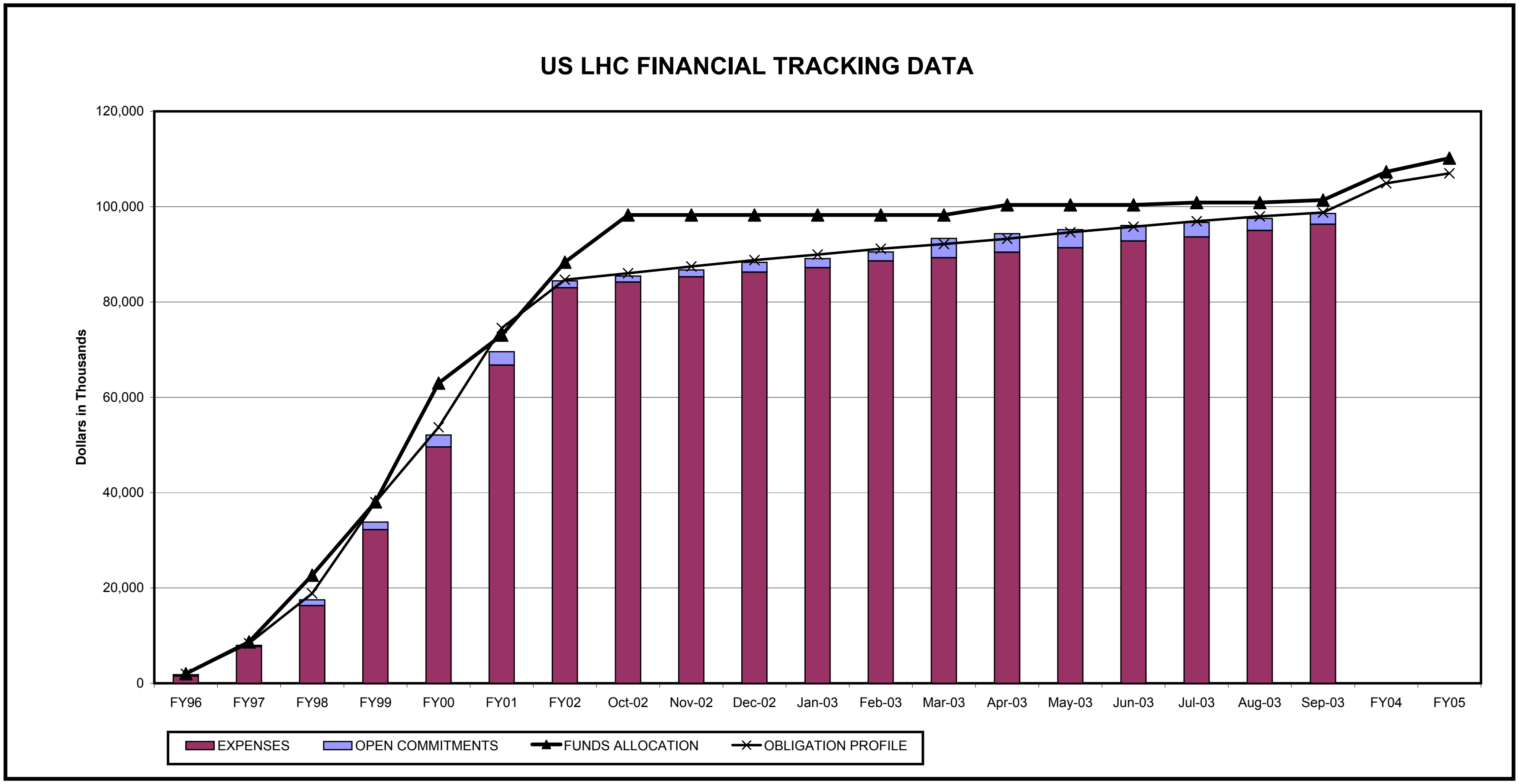


BCWS	57.5	62.0	69.7	74.6	78.8	82.8	86.5	88.5	90.7	93.2	96.1	99.4
BCWP	53.1	57.1	66.7	70.9	74.0	76.9	79.7	83.9	86.5	88.5	90.6	94.3
ACWP	57.2	62.7	65.9	69.7	74.0	78.3	81.5	84.7	88.6	91.3	94.2	97.3



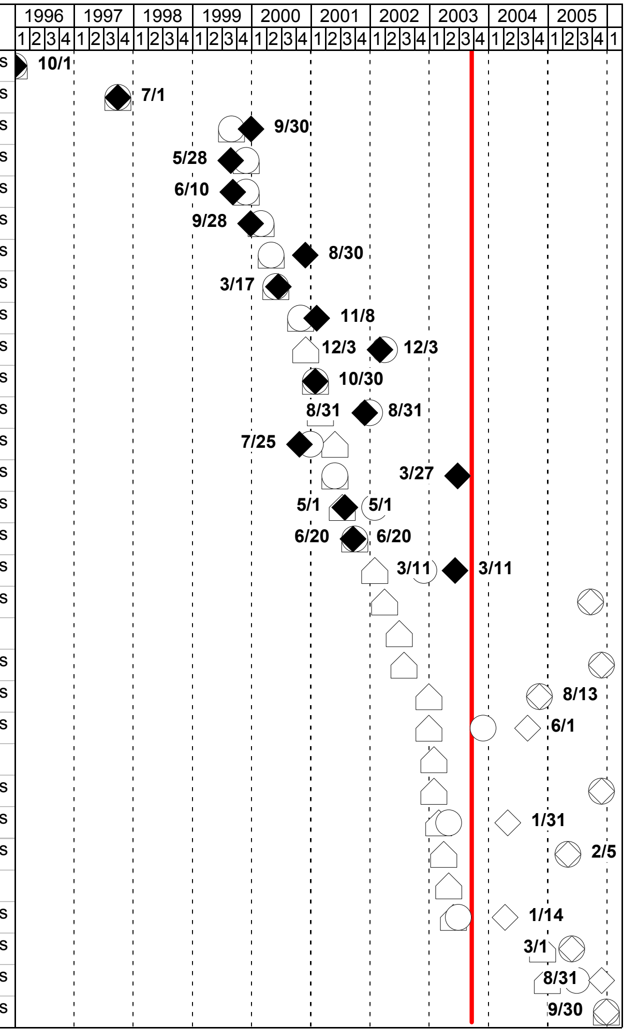
COST	-4.1	-5.6	0.8	1.2	0.0	-1.4	-1.8	-0.8	-2.1	-2.7	-3.6	-3.0
SCHED	-4.4	-4.9	-2.9	-3.7	-4.8	-5.9	-6.8	-4.6	-4.2	-4.7	-5.5	-5.1
VAC	-6.8	-6.8	-0.3	0.0	-1.9	-3.1	-3.0	-1.4	-1.7	-1.5	-1.9	-1.6





	FY96	FY97	FY98	FY99	FY00	FY01	FY02	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03	Aug-03	Sep-03	FY04	FY05
INCREMENTAL																					
FUNDS ALLOCATION	2,000	6,670	14,000	15,400	24,917	10,062	15,304	9,900	0	0	0	0	0	2,105	0	0	495	0	542	5,912	2,870
OBLIGATION PROFILE	1,962	6,427	10,466	19,155	15,714	20,803	10,127	1,388	1,395	1,343	1,180	1,197	1,007	1,083	1,388	1,156	1,159	1,015	804	6,132	2,106
EXPENSES	1,515	6,186	8,594	15,946	17,307	17,193	16,232	1,195	1,104	992	928	1,420	677	1,150	920	1,444	837	1,352	1,307		
OPEN COMMITMENTS	296	-43	964	366	965	280	-1,365	-172	159	615	-148	-14	2,153	-160	-77	-583	-192	-518	-240		
CUMULATIVE																					
FUNDS ALLOCATION	2,000	8,670	22,670	38,070	62,987	73,049	88,354	98,254	98,254	98,254	98,254	98,254	98,254	100,359	100,359	100,359	100,854	100,854	101,396	107,308	110,178
OBLIGATION PROFILE	1,962	8,390	18,856	38,011	53,725	74,528	84,655	86,043	87,438	88,781	89,961	91,158	92,165	93,247	94,635	95,791	96,950	97,965	98,769	104,901	107,007
EXPENSES	1,515	7,701	16,296	32,242	49,549	66,742	82,974	84,168	85,273	86,264	87,192	88,612	89,289	90,439	91,359	92,804	93,641	94,993	96,300		
OPEN COMMITMENTS	296	253	1,217	1,582	2,547	2,828	1,463	1,291	1,450	2,065	1,917	1,902	4,056	3,896	3,819	3,236	3,043	2,526	2,285		

Number	ID	Milestone	Original	Revised	Forecast	Actual	Variance
1-1		Project Start (10/1/95)	10/1/95	10/1/95	10/1/95	10/1/95	0 days
2-1.1-1	IR	Begin 1st Inner Triplet Quadrupole Model Magnet	7/1/97	7/1/97	7/1/97	7/1/97	0 days
2-1.3-2	SC	Complete Superconductor Test Facility Upgrades	6/1/99	6/1/99	9/30/99	9/30/99	87 days
2-1.3-1	SC	All Cable Production Support Equipment Delivered to CERN	9/1/99	9/1/99	5/28/99	5/28/99	-68 days
2-1.2-1	RF	Begin Assembly of 1st Dipole Model Magnet	9/1/99	9/1/99	6/10/99	6/10/99	-59 days
2-1.1-2	IR	Complete Inner Triplet Quadrupole Model Magnet Program Phase 1	12/1/99	12/1/99	9/28/99	9/28/99	-46 days
2-1.1-4	IR	Place Purchase Order for HTS Power Leads	2/1/00	2/1/00	8/30/00	8/30/00	151 days
2-1.1-3	IR	Complete Inner Triplet Quadrupole Model Magnet Program Phase 2	3/1/00	3/1/00	3/17/00	3/17/00	12 days
2-1.2-2	RF	Complete Dipole Model Magnet Program	8/1/00	8/1/00	11/8/00	11/8/00	71 days
2-1.2-3	RF	Begin RF Region Dipole Production Assembly	9/1/00	1/1/02	12/3/01	12/3/01	-21 days
2-1.1-5	IR	Begin Absorber Fabrication	11/1/00	11/1/00	10/30/00	10/30/00	-2 days
2-1.1-6	IR	Complete Inner Triplet Quadrupole Prototype Magnet Program	12/1/00	10/1/01	8/31/01	8/31/01	-21 days
2-1.1-7	IR	Begin Interaction Region Beam Separation Dipole Prod. Assembly	3/1/01	10/1/00	7/25/00	7/25/00	-49 days
2-1.1-8	IR	Begin Inner Triplet Feedbox Fabrication	3/1/01	3/1/01	3/27/03	3/27/03	540 days
2-1.1-9	IR	Begin Inner Triplet Quadrupole Production Assembly	4/15/01	11/1/01	5/1/01	5/1/01	-132 days
1-2		Decision on RF Region Quadrupoles	7/1/01	7/1/01	6/20/01	6/20/01	-8 days
2-1.1-10	IR	Complete 1st Inner Triplet Quadrupole Magnet	11/1/01	9/1/02	3/11/03	3/11/03	136 days
2-1.2-4	RF	Delivery of D3, D4 for IR4 right	1/1/02	6/24/05	6/24/05	NA	0 days
2-1.1-11	IR	Delivery of D2 for IR8 Left **DELETED**	4/1/02				
2-1.1-12	IR	Complete Inner Triplet Feedbox Fabrication	5/1/02	8/31/05	8/31/05	NA	0 days
2-1.1-13	IR	Delivery of All Inner Triplet System Components for IR8 Left (MQX,DFBX,D1,D2)	10/1/02	8/13/04	8/13/04	NA	0 days
2-1.2-5	RF	Complete RF Region Dipole Production Assembly	10/1/02	9/1/03	6/1/04	NA	196 days
2-1.1-14	IR	Delivery of D2 for IR5 Left **DELETED**	11/1/02				
2-1.2-6	RF	Delivery of D3, D4 for IR4 left	11/1/02	8/31/05	8/31/05	NA	0 days
2-1.1-15	IR	Complete Absorber Fabrication	12/1/02	2/1/03	1/31/04	NA	260 days
2-1.1-16	IR	Delivery of All Inner Triplet System Components for IR8 Right (MQX,DFBX,D1,D2	1/1/03	2/5/05	2/5/05	NA	0 days
2-1.1-17	IR	Delivery of D2 for IR8 Right**DELETED**	2/1/03				
2-1.1-18	IR	Complete Interaction Region Dipole Production Assembly	3/1/03	4/1/03	1/14/04	NA	206 days
2-1.1-30	IR	Complete Inner Triplet Quadrupole Production	9/1/04	3/1/05	3/1/05	NA	0 days
2-1.3-3	SC	Series Wire and Cable Testing Complete	10/1/04	3/31/05	8/31/05	NA	109 days
1-3		Project Completion (9/30/05)	9/30/05	9/30/05	9/30/05	NA	0 days



Date: 12/15/03

Original Baseline | Revised Baseline | Forecast | Actual