

DOE/NSF Project Manager's Quarterly Progress Report U.S. Large Hadron Collider Project

1. PROJECT IDENTIFIERS

Reporting Period: Through December 31, 1998
Program Sponsors: DOE Division of High Energy Physics/NSF Physics Division
DOE/NSF Program Manager: T. Toohig, (301) 903-4115, timothy.toohig@science.doe.gov
DOE/NSF Associate Program Manager: M. Goldberg, (703) 306-1894, mgoldber@nsf.gov
Operations Office: Chicago Operations Office/Fermi Group
DOE/NSF Project Manager: J. Yeck, (630) 840-2530, jim.yeck@ch.doe.gov

2. PROJECT DESCRIPTION

The Department of Energy (DOE) and the National Science Foundation (NSF) have signed agreements committing to collaboration in the construction of the Large Hadron Collider (LHC) at CERN (European Laboratory for Particle Physics) and two of its associated detectors. The U.S. fabrication effort will be carried out at, or under the supervision of, U.S. universities and national laboratories under the terms and conditions described in the International Collaboration Agreement (Agreement) and its Accelerator and Experiments Protocols. The U.S. LHC Project is defined by the goods and services to be provided to CERN under the terms of the Agreement between DOE, NSF, and CERN. These goods and services include DOE contributions to the LHC accelerator, and DOE and NSF contributions to the ATLAS (A Toroidal LHC Apparatus) and CMS (Compact Muon Solenoid) experiments.

The DOE contribution to the LHC accelerator consists of items provided by DOE National Laboratories and CERN direct purchases from U.S. industrial firms. The scope of these contributions is addressed in the Accelerator Protocol and described in detail in an Implementing Arrangement between the collaborating DOE National Laboratories and CERN. The DOE and NSF contributions to the ATLAS and CMS detectors consist of items supplied by the collaborating U.S. universities and DOE National Laboratories. The scope of these contributions is addressed in the Experiments Protocol and described in detail in Memoranda of Understanding for collaboration on construction of each experiment.

The U.S. LHC Project includes the U.S. ATLAS, U.S. CMS, and U.S. LHC Accelerator projects. This report summarizes the overall status of the U.S. LHC Project effort and includes status specific to each sub-project. Additional information can be accessed at the following web sites:

U.S. LHC Project - <http://www.hep.net/doe-hep/lhc.html>
LHC Project - <http://www.lhc.cern.ch/> U.S. LHC Accelerator - <http://www-td.fnal.gov/>
ATLAS - <http://atlasinfo.cern.ch/Atlas/Welcome.html> U.S. ATLAS - <http://www.usatlas.bnl.gov/>
CMS - <http://cmsinfo.cern.ch/Welcome.html> U.S. CMS - <http://uscms.fnal.gov/>

**Project Manager's Quarterly Progress Report
1st Quarter FY 1999**

3. PROJECT MANAGER'S NARRATIVE HIGHLIGHTS

The DOE/NSF Joint Oversight Group approved the U.S. LHC Project Execution Plan (U.S. LHC PEP) on December 1. The PEP is a complete description of the organization and management systems for the U.S. LHC project. As described in the PEP, DOE/NSF conducts regular reviews and status meetings. A listing of current project reviews and status meetings is shown below:

<u>Activity</u>	<u>Date</u>
U.S. ATLAS Quarterly Status Meeting	January 20, 1999
U.S. LHC Accelerator Quarterly Status Meeting	January 25, 1999
U.S. CMS DOE/NSF Review	February 17-19, 1999
U.S. LHC Accelerator Project DOE/NSF Review	April 8, 1999
U.S. ATLAS Project DOE/NSF Review	May 6, 1999
U.S. CMS Quarterly Status Meeting	May 19, 1999
U.S. CMS Project DOE/NSF Review	August 19, 1999

The results of these activities are documented in formal reports and meeting notes. In addition to the reviews and status meetings organized by DOE/NSF, the U.S. LHC project manager and U.S. LHC program managers continue to participate in various internal reviews conducted by the contractor project management teams. These reviews include management oversight reviews conducted by the host/lead laboratory managers and reviews held by the U.S. ATLAS, CMS, and LHC Accelerator project managers. Cost and schedule performance is summarized below.

Table 3.1, Contingency Status (in thousands of dollars)

U.S. Activity	Total Project Cost TPC	Budget at Completion BAC	Contingency	BCWP*	BAC-BCWP	Contingency/BAC-BCWP (%)
ATLAS [†]	163,750	100,056	39,918	12,787	87,269	45.7
CMS	167,250	111,787	48,543	15,905	95,882	50.6
Accelerator	110,000	89,418	20,582	21,197	68,221	30.1

Table 3.2, Schedule Performance Indices[‡]

	Planned Complete (%)	Actual Complete (%)	Schedule Performance
U.S. ATLAS	15.0	12.7	0.85
U.S. CMS	17.2	15.3	0.89
U.S. LHC Accelerator	28.2	23.7	0.84

* BCWP = Budgeted Cost of Work Performed. BAC = Budget at Completion.

[†] The Budget at Completion for U.S. ATLAS excludes \$19,776k for items that have no cost risk or capped.

[‡] Planned complete = Budget Cost of Work Scheduled (BCWS)/Budget At Completion (BAC). Actual complete = BCWP/BAC. Schedule performance = BCWP/BCWS.

Project Manager's Quarterly Progress Report 1st Quarter FY 1999

4. PROJECT MANAGER'S ASSESSMENT

Overall Assessment - Satisfactory

The project technical, cost, and schedule baselines are approved and subject to formal change control procedures. All projects are reporting against the approved baselines. Summary cost and schedule performance data are included in this report.

Cost - Project reviews continue to confirm that the projects have appropriate cost and contingency estimates. Cost performance is in accordance with plans with very limited use of contingency.

Schedule - CERN plans to complete construction of the LHC and commence initial operations in 2005. The U.S. ATLAS, U.S. CMS, and U.S. LHC Accelerator project baseline schedules are generally consistent with the ATLAS, CMS, and LHC schedules. There are a few cases in each of the projects where our schedules do not meet the required dates in the CERN "official" installation schedules. These inconsistencies are understood and actively being worked by the collaborators. A complete listing of the DOE/NSF control milestones is included in this report. Near term schedule progress is satisfactory, or within fifteen percent of the original plan.

Technical - Considerable effort was directed at defining a set of U.S. deliverables to CERN that we are confident can be realized, given the planned funding. The U.S. ATLAS, U.S. CMS, and U.S. LHC Accelerator projects have each developed a separate list of deliverables that has been formally accepted by CERN, and the DOE/NSF Joint Oversight Group. We expect to fulfill our commitments to CERN and hope that additional items can be provided to CERN, within the approved funding, should cost performance be favorable.

Issues

Russian Collaborators - Russian collaborators continue to face severe difficulties due to the financial crisis in Russia. CERN and the international ATLAS and CMS management are actively monitoring this issue in order to mitigate impacts on the LHC program. Since some of the U.S. ATLAS and U.S. CMS detector activities are dependent on Russian collaborators, U.S. managers are actively evaluating contingency plans.

ATLAS and CMS Schedules - The U.S. ATLAS and CMS detector efforts are dependent on progress of their international counterparts. There are instances where delays in the international ATLAS and CMS experiments have caused adverse schedule impacts to the U.S. activities. These types of issues continue to be addressed on a case-by-case basis.

NSF Cooperative Agreements - NSF will fund U.S. ATLAS and U.S. CMS activities through Cooperative Agreements with Columbia and Northeastern Universities, respectively. The NSF agreement with Columbia was recently approved and the agreement with Northeastern is now in draft. These agreements must be in place to utilize NSF funding for FY 1999 and future years.

Project Manager's Quarterly Progress Report 1st Quarter FY 1999

5. NARRATIVE SUMMARY

5.1 DETECTORS

U.S. ATLAS

The DOE/NSF review in October found that the project is making good progress. Recent accomplishments in selected U.S. ATLAS subsystems is summarized below:

Transition Radiation Tracker

- Completed module design with pre-production versions of module shell, high voltage plates, straws, and radiators.
- Completed cooling design and pre-production versions of both aluminum and pyrolytic graphite plates.
- Designed module cooling services with finite element studies and constructed a full scale, quarter sector mock up.
- Established assembly sites at Hampton, Duke, and Indiana University.

Pixel System

- Demonstrated near 100% efficiency using prototype integrated circuit electronics with baseline detectors irradiated to the lifetime fluence expected at the LHC.
- Continued construction and operation of prototype 16-chip modules.

Liquid Argon Calorimeter System

- Barrel Cryostat - The design is complete and the vendor is under contract at a very favorable price. The design was simplified keeping the physics performance, but allowing for safer and cheaper construction.
- Feedthroughs - Two full-scale prototypes were built and installed in the test beam cryostat at CERN. They performed well and validate the design.
- Motherboards – Module 0 summing boards, motherboards, and high voltage boards were delivered on time and used in the CERN test beam. They performed well and the data is being analyzed.
- Front End Board – Fully functional front end boards were tested on the bench and at the test beams at CERN. The performance of the boards has been very good. The design will be implemented more fully in the radiation tolerant electronics.
- System Crate – The first two system prototypes were installed and tested in the CERN test beam. Performance was good and supports completing the design of the crate, pedestal and low power bus.

Tile Calorimeter

- Completed tooling for production of submodules at Argonne National Laboratory.
- Completed fabrication of the scintillator sleeves.

Project Manager's Quarterly Progress Report 1st Quarter FY 1999

Muon System

- Drift Tube Mechanics – Developed tube wiring and chamber assembly tooling.
- Drift Tube Electronics – Steady progress on front-end development including on-chamber tests meeting performance specifications on noise, timing, cross talk, and radiation tolerance.
- Alignment – Developed B-Cam, an elegant, low cost precision alignment tool.
- Cathode Strip Chambers – Demonstrated performance under background conditions five times those expected at LHC.

U.S. CMS

The U.S. CMS project office submitted its second monthly report addressing technical, cost, and schedule performance through the end of December. Good progress continues with schedule performance and acceleration a high priority. Progress in selected subsystems is described below:

End Cap Muon

- Completed a successful CMS engineering design review of the cathode strip chambers.
- Established cathode strip chamber factory at Fermilab.
-

Hadron Calorimeter (HCAL)

- Barrel - Completed a successful CMS engineering design review.
- Scintillator - Placed purchase orders for entire quantity of production scintillator.
- Absorber – Advanced purchases of brass plates for 36 wedges.
- Preproduction prototypes – PPP1 delivered to CERN and PPP2 fabrication in progress.
- Optics – Established optics factory at Fermilab.

Trigger/Data Acquisition

- Completed full trigger conceptual design.
- Completed DAQ readout and filter unit prototypes.

Electromagnetic Calorimeter

- Secured favorable cost estimates for Avalanche Photodiodes.

Forward Pixels

- Continued research and development.

Common Projects

- Cost – Reached agreement with CMS that the U.S. CMS contribution to Common Projects is fixed in U.S. dollars, thus removing concerns about currency fluctuations.
- Endcap yoke - The University of Wisconsin awarded a contract for fabrication of the endcap yoke at a favorable price.
- Superconductor components – Develop specifications for procurement of superconductor for the CMS superconducting magnet.

**Project Manager's Quarterly Progress Report
1st Quarter FY 1999**

5.2 U.S LHC ACCELERATOR

The DOE review held in October found that the project is making good progress. The quench performance of the interaction region quadrupole model magnets is not yet satisfactory. Additional model magnets will be added to the R&D program. The MOU with CERN on mechanical safety was finalized. Recent accomplishments are summarized below:

Inter Triplet Quadrupoles

- Completed a revised plan for the model magnet program.
- Completed a conceptual design review of the magnet cryostat.

Interaction Region Dipoles/RF Region Dipoles

- Released several purchase orders for materials.
- Advanced fabrication tooling design and investigated acquiring CERN cryostat tooling.

Interaction Region Feedboxes/Interaction Region Absorbers

- Completed a conceptual design review for the distribution feedbox.
- Completed the functional specification for the absorbers.

Superconductor Testing/Cable Production Support

- Completed installing the second magnet into a cryostat as part of the facility upgrades.
- Completed fabrication of the eddy current flaw detector at SE Systems.

Accelerator Physics

- Evaluated the magnetic field performance of the KEK model quadrupole magnets.
- Completed a preliminary study of technology choices for the absorber instrumentation.

5.3 CERN DIRECT PURCHASES

DOE is receiving invoices from CERN for their payments to U.S. vendors per the U.S.-CERN Agreement and Accelerator Protocol. The status of payments to CERN is shown in Table 5.2.

Table 5.2, CERN Direct Purchases

Contract Item	U.S. Company	Amount Paid in \$	Contract Value
Niobium-titanium alloy bars and niobium barrier sheets	Wah Chang	4,020,116	
Dipole outerlayer and quadrupole superconducting cable [587 km]	IGC Advanced Superconductors	1,151,217	
Totals		5,171,333	

**Project Manager's Quarterly Progress Report
1st Quarter FY 1999**

6. FINANCIAL/COST STATUS AND PLANS

TOTAL PROJECT FUNDING PLAN (then year millions of dollars)*

Fiscal Year	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	Total
Machine Funding Profiles (DOE)											
US LHC Accelerator	2.00	6.67	14.00	15.40	20.10	17.80	17.00	10.20	6.83	0.00	110.00
CERN Direct	0.00	0.00	0.00	14.34	11.10	14.26	14.20	18.80	17.30	0.00	90.00
Machine Total	2.00	6.67	14.00	29.74	31.20	32.06	31.20	29.00	24.13	0.00	200.00
Detector Funding Profiles (DOE and NSF)											
US ATLAS	1.70	3.71	10.05	27.83	27.44	27.59	27.85	22.89	14.69	0.00	163.75
DOE	1.70	3.71	10.05	11.20	15.50	15.30	15.20	15.60	14.69	0.00	102.95
NSF	0.00	0.00	0.00	16.63	11.94	12.29	12.65	7.29	0.00	0.00	60.80
US CMS	2.30	4.62	10.95	29.58	27.26	26.72	27.81	22.83	15.18	0.00	167.25
DOE	2.30	4.62	10.95	24.06	23.30	22.64	23.60	20.40	15.18	0.00	147.05
NSF	0.00	0.00	0.00	5.52	3.96	4.08	4.21	2.43	0.00	0.00	20.20
Detectors Total	4.00	8.33	21.00	57.41	54.70	54.31	55.66	45.72	29.87	0.00	331.00

FUNDS, COSTS, & COMMITMENTS (cumulative in thousands of dollars)†

Project Element	A = Funds Allocated‡	B = Actual Costs	C = Open Commit.	D = B+C Total	A - D = Funds Available
U.S. ATLAS	26,660	11,627	2,131	13,758	12,902
U.S. CMS	41,930	11,380	7,723	19,103	22,827
U.S. LHC Accelerator	38,070	21,975	1,992	23,967	14,103
CERN Direct Purchases	14,340	5,171	0	5,171	9,169
U.S. LHC Total	121,000	50,153	11,846	61,999	59,001

COST AND SCHEDULE STATUS PERFORMANCE REPORT (thousands of dollars)

	Cumulative Costs to Date					At Completion		
	Budgeted Cost		Actual Cost	Variance Schedule	Variance Cost	Revised		
	Work Scheduled	Work Performed				Budgeted	Estimate	Variance
U.S. ATLAS	15,052	12,787	11,627	(2,265)	1,160	163,750	163,750	0
U.S. CMS	17,820	15,905	11,380	(1,915)	4,524	167,250	167,250	0
U.S. LHC Accelerator	25,237	21,197	21,975	(4,040)	(778)	110,000	110,000	0
CERN Invoices	5,171	5,171	5,171	0	0	90,000	90,000	0
U.S. LHC Total	63,280	55,060	50,153	(8,220)	4,906	531,000	531,000	0

* The annual funding distribution for the U.S. LHC projects is subject to change. In December was a change to the DOE funding allocations for FY 1999 – FY 2000 as the result of reduced requirements for CERN direct purchases.

† The figures are based on financial reports from the U.S. ATLAS, CMS, and LHC Accelerator projects.

‡ NSF funding for FY 1999 has not yet been released to the U.S. ATLAS and U.S. CMS projects.

**Project Manager's Quarterly Progress Report
1st Quarter FY 1999**

DOE/NSF COST BASELINE (in thousands of dollars)

U.S. ATLAS Cost Baseline

<u>WBS No.</u>	<u>Description</u>	<u>Original</u>	<u>Change</u>	<u>Current</u>
1.1	Silicon System	15,677	286	15,963
1.2	Transition Radiation Tracker	6,563	794	7,357
1.3	Liquid Argon Calorimeter	34,922	0	34,922
1.4	Tile Calorimeter	6,576	0	6,576
1.5	Muon Spectrometer	17,928	0	17,928
1.6	Trigger/Data Acquisition System	13,245	0	13,245
1.7	Common Projects	8,089	0	8,089
1.8	Education	270	0	270
1.9	Project Management	6,863	0	6,863
	Contingency	37,068	(1080)	35,988
	Total in FY 1997 dollars	147,201	0	147,201
	Escalation (FY 1997 to as spent \$)	16,549	0	16,549
	U.S. ATLAS Total Cost Baseline	163,750	0	163,750

U.S. CMS Cost Baseline

<u>WBS No.</u>	<u>Description</u>	<u>Original</u>	<u>Change</u>	<u>Current</u>
1.1	Endcap Muon	26,551	(345)	26,206
1.2	Hadron Calorimeter	30,255	481	30,736
1.3	Trigger and Data Acquisition	12,393	(11)	12,382
1.4	Electromagnetic Calorimeter	7,728	241	7,969
1.5	Forward Pixels	5,208	(32)	5,176
1.6	Common Projects	23,714	160	23,874
1.7	Project Office	5,738	(293)	5,445
	Contingency	48,743	(200)	48,543
	FY 1996 & FY 1997 Expenditures	6,920	0	6,920
	U.S. CMS Total Cost Baseline	167,250	0	167,250

U.S. LHC Accelerator Cost Baseline*

<u>WBS No.</u>	<u>Description</u>	<u>Original</u>	<u>Change</u>	<u>Current</u>
1.1	Interaction Region Components	42,147	2,594	44,741
1.2	Radio Frequency Straight Section	12,636	856	13,492
1.3	Superconducting Wire and Cable	10,608	744	11,352
1.4	Accelerator Physics	4,508	417	4,925
1.5	Project Management	14,175	732	14,907
	Escalation (FY 1997 to as spent \$)	7,117	(7,117)	0
	Total in as spent \$	91,191	(1,774)	89,417
	Contingency	18,809	1,774	20,583
	U.S. LHC Accelerator Total Cost Baseline	110,000	0	110,000

* The current baseline addresses the conversion from FY 1997 to then year dollars.

**Project Manager's Quarterly Progress Report
1st Quarter FY 1999**

7. SCHEDULE STATUS AND PLANS

U.S. ATLAS Baseline Milestones (through 2001)

<u>WBS</u>	<u>Milestone Description</u>	<u>Baseline Date</u>	<u>Forecast (F)/ Actual (A)</u>
1	Project Start	10/01/95	10/01/95 (A)
	Project Completion	09/30/05	09/30/05 (F)
Tile Cal	Start Submodule Procurement	09/01/97	09/01/97 (A)
Tile Cal	Technology Choice for F/E Electronics	11/15/97	11/15/97 (A)
LarCal	Cryostat Contract Award	07/24/98	08/05/98 (A)
LarCal	Barrel Feedthroughs Final Design Review	09/30/98	10/02/98 (A)
LarCal	FCAL Mechanical Design Review	12/14/98	04/01/99 (F)
TRT	Mechanical Design Frozen	12/31/98	12/07/98 (A)
Muon	Start MDT Chambers Lines 1 and 2	01/04/99	12/13/99 (F)
Tile Cal	Start Module Construction	05/01/99	05/01/99 (F)
LarCal	Start Electronics Production (Preamps)	06/01/99	11/01/99 (F)
Muon	Start CSC Chamber Production	07/01/99	11/15/99 (F)
Tile Cal	Start Production Motherboards & Digitizer boards	07/02/99	07/02/99 (F)
Silicon	Start Full Strip Module Production	10/15/99	06/05/01 (F)
Muon	ASD Chip Design Complete	10/29/99	10/29/99 (F)
LarCal	FE Board SCA Production Chip Submission	11/01/99	07/03/00 (F)
Tri/DAQ	Select Final LVL2 Architecture	12/31/99	06/30/99 (F)
LarCal	Level 1 Trigger Final Design Complete	03/01/00	03/01/00 (F)
Silicon	ROD Design Complete	04/14/00	11/22/00 (F)
Muon	Final Design Global Alignment Devices Complete	04/28/00	04/28/00 (F)
LarCal	ROD Final Design Complete	06/01/00	06/01/00 (F)
Muon	CSC IC Production Complete	06/30/00	06/30/00 (F)
TRT	Select Final Electrical Design	07/31/00	07/31/00 (F)
TRT	Start Production (Electrical)	07/31/00	01/10/01 (F)
LarCal	Motherboard System Production Complete	01/01/01	01/01/01 (F)
Muon	MDT Supports,Mounts,Connect. Design Complete	01/30/01	01/30/01 (F)
Silicon	Start Full Silicon Strip Electronics Production	03/30/01	03/30/01 (F)
LarCal	Cryostat Arrives at CERN	03/30/01	03/30/01 (F)
LarCal	Barrel Feedthroughs Production Complete	07/18/01	07/18/01 (F)
LarCal	FCAL-C Delivered to EC	09/03/01	09/03/01 (F)
Tri/DAQ	LVL2 Trigger Design Complete	12/31/01	12/31/01 (F)
Tri/DAQ	LVL2 Trigger Development/Prototype Complete	12/31/01	09/30/01 (F)
Tri/DAQ	Start Production	01/08/02	01/08/02 (F)
Tri/DAQ	Start Installation and Commissioning	03/05/02	03/05/02 (F)
TRT	Module Production Complete	03/29/02	06/03/02 (F)
Tile Cal	Start Installation at CERN	06/01/02	06/01/02 (F)

**Project Manager's Quarterly Progress Report
1st Quarter FY 1999**

U.S. CMS Baseline Milestones

<u>WBS Identifiers</u>	<u>Milestone Description</u>	<u>Baseline Date</u>	<u>Forecast (F)/ Actual (A)</u>
1	DOE/NSF CERN Agreement	12/97	12/08/98 (A)
	Approve Baseline	07/98	10/19/98 (A)
	Approve Project Management Plan	09/98	12/01/98 (A)
	U.S. CMS Project Complete	10/05	09/30/05 (F)
CP	Move 2nd Year Funding - Common Package (CP) A	10/98	01/99 (A)
EMU	Muon Cathode Strip Chamber (CSC) Factory Start	01/99	01/99 (A)
HCAL	HCAL Optics Factory Start	01/99	01/99 (A)
HCAL	1st 18 Wedges Optics @ CERN	06/00	06/00 (F)
HCAL	1st 18 Wedges HCAL Brass @ CERN	11/00	11/00 (F)
FPIX	Forward Pix Cooling Distribution Design Complete	01/01	01/01 (F)
CP	4th Year CP Package A Payment Complete	06/01	06/01 (F)
EMU	1st 17 Endcap Muon CSC Chambers Complete	06/01	06/01 (F)
HCAL	Finish Production Brass Wedges @ CERN	12/01	12/01 (F)
HCAL	Finish Production Optical System @ CERN	12/01	12/01 (F)
HCAL	HCAL Electronics Complete	01/02	01/02 (F)
ECAL	Final Production ECAL Serializer Wafer	02/02	02/02 (F)
TriDAS	Trigger MPC Board Assembly Complete	01/03	01/03 (F)
Inst	Start CMS Installation in Pit	01/03	01/03 (F)
CP	HE + YE + Connect	01/03	01/03 (F)
CP	HB in Vacuum Tank Test	03/03	03/03 (F)
CP	HE - YE - Connect	05/03	05/03 (F)
EMU	1st Half CSC Assembly at CERN Complete	07/03	07/03 (F)
TriDAS	Data Acquisition Event Manager Boards Complete	08/03	08/03 (F)
CP	Magnet Full Field Test Completed @ CERN	09/03	09/03 (F)
Inst	BO Underground Counting House	09/03	09/03 (F)
ECAL	Complete Production of Avalanche Photodiodes	09/03	09/03 (F)
Inst	Install Magnet in Collision Hall	10/03	10/03 (F)
EMU	All ME234/2 Assembled & Tested	10/03	10/03 (F)
EMU	EMU Electronics Complete	12/03	12/03 (F)
ECAL	Forward Pixels Shipped to CERN	09/04	09/04 (F)
All	U.S. CMS Construction Complete	09/04	09/04 (F)

**Project Manager's Quarterly Progress Report
1st Quarter FY 1999**

U.S. LHC Accelerator Baseline Milestones (through 2002+)

<u>WBS Identifiers</u>	<u>Milestone Description</u>	<u>Baseline Date</u>	<u>Forecast (F)/ Actual (A)</u>
1	Project Start	10/01/95	10/01/95 (A)
	Decision on RF Region Quadrupoles	07/01/01	07/01/01 (F)
	Project Completion	09/30/05	09/30/05 (F)
IR Region	Begin 1 st Inner Triplet Quadrupole Model Magnet	07/01/97	07/01/97 (A)
SC	All Cable Production Support Equipment Delivered to CERN	03/01/99	03/01/99 (F)
IR Region	Complete Inner Triplet Quadrupole Model Magnet Program Phase 1	06/01/99	10/01/99 (F)
SC	Complete Superconductor Test Facility Upgrades	06/01/99	06/01/99 (F)
RF Region	Begin Assembly of 1 st Dipole Model Magnet	09/01/99	09/01/99 (F)
IR Region	Complete Inner Triplet Quadrupole Model Magnet Program Phase 2	01/01/00	01/01/00 (F)
IR Region	Complete Tests of Prototype HTS Power Leads	01/01/00	01/01/00 (F)
RF Region	Complete Dipole Model Magnet Program	08/01/00	08/01/00 (F)
RF Region	Begin RF Region Dipole Production Assembly	09/01/00	09/01/00 (F)
IR Region	Begin Absorber Fabrication	11/01/00	11/01/00 (F)
IR Region	Complete Inner Triplet Quadrupole Prototype Magnet Program	12/01/00	12/01/00 (F)
IR Region	Begin Interaction Region Beam Separation Dipole Production Assembly	03/01/01	03/01/01 (F)
IR Region	Begin Inner Triplet Feedbox Fabrication	03/01/01	03/01/01 (F)
IR Region	Begin Inner Triplet Quadrupole Production Assembly	04/15/01	04/15/01 (F)
IR Region	Complete 1 st Inner Triplet Quadrupole Magnet	11/01/01	11/01/01 (F)
RF Region	Delivery of D3, D4 for IR4 right	01/01/02	01/01/02 (F)
IR Region	Delivery of D2 for IR8 Left	04/01/02	04/01/02 (F)
IR Region	Complete Inner Triplet Feedbox Fabrication	05/01/02	05/01/02 (F)
IR Region	Delivery of All Inner Triplet System Components for IR8 Left (MQX, DFBX, D1)	10/01/02	10/01/02 (F)
RF Region	Complete RF Region Dipole Production Assembly	10/01/02	10/01/02 (F)
IR Region	Delivery of D2 for IR5 Left	11/01/02	11/01/02 (F)
RF Region	Delivery of D3, D4 for IR4 left	11/01/02	11/01/02 (F)
IR Region	Complete Absorber Fabrication	12/01/02	12/01/02 (F)
IR Region	Delivery of All Inner Triplet System Components for IR8 Right (MQX, DFBX, D1)	01/01/03	01/01/03 (F)
IR Region	Delivery of D2 for IR8 Right	02/01/03	02/01/03 (F)
IR Region	Complete Interaction Region Dipole Production Assembly	03/01/03	03/01/03 (F)

**Project Manager's Quarterly Progress Report
1st Quarter FY 1999**

8. TECHNICAL BASELINE STATUS

U.S. ATLAS

The U.S. ATLAS collaboration defined a list of initial deliverables representing the U.S. contribution to ATLAS. This list was approved by the JOG in March 1998 and sent to the CERN Director of Research in April 1998. Additional deliverables have already been identified as potential future contributions, should cost performance permit. Reference the U.S. ATLAS Project Management Plan, Appendix 3, (Approved 3/18/98).

U.S. CMS

The U.S. CMS collaboration defined a list of deliverables representing the U.S. contribution to CMS. This list was sent to the CERN Director of Research in August 1998 and approved by the JOG in October 1998. Reference the U.S. CMS Project Management Plan, Appendix 2, (Approved 10/19/98).

U.S. LHC Machine

U.S. LHC Accelerator Project - The U.S. deliverables to CERN are defined in the Implementing Arrangement to the Accelerator Protocol. The Implementing Arrangement was signed by the CERN and U.S. signatories in July 1998. Reference the U.S. LHC Accelerator Project Management Plan, Annex II, (Approved 6/15/98).

CERN Direct Purchases - CERN will procure from U.S. industrial firms supplies required to construct the LHC accelerator. These supplies will include superconducting alloy, cable, insulation, and other materials.

9. BASELINE CHANGE ACTIVITY

<u>Baseline Control Level</u>	<u>Baseline Change Description</u>
Level 1, DOE/NSF Joint Oversight Group	No changes this quarter
Level 2, DOE/NSF Project Office	
U.S. ATLAS	6 changes approved.
U.S. CMS	7 changes at Level 3 approved.
U.S. LHC Accelerator Project	1 change this quarter.

U.S. ATLAS – There were six Level 2 changes approved this quarter resulting in a \$1,080k reduction in the contingency budget and revised milestones for the silicon system.

U.S. CMS – There were no Level 2 changes this quarter. There were seven Level 3 changes resulting in a \$200k reduction in the contingency budget.

U.S. LHC Accelerator – There was one Level 2 change to the cost baseline this quarter. The revised cost baseline reflects the conversion from FY 1997 dollars to escalated dollars, accelerated schedules, and minor adjustments to the Level 2 cost estimates.

**Project Manager's Quarterly Progress Report
1st Quarter FY 1999**

APPENDIX A - FUNDING BY INSTITUTION (in thousands of dollars)

	U.S. LHC Accelerator FY 1998	U.S. LHC Accelerator FY 1999
FNAL	4,304	6,014
BNL	3,999	9,494
LBNL	2,140	1,491
Total	10,443	16,999

Institution	U.S. CMS Total FY 1998				U.S. CMS Total FY 1999* (as of 2/99)			
	DOE		NSF	Total	DOE		NSF	Total
	Grant	Contract [†]			Grant	Contract		
FNAL	0	5,517	0	5,517	0	10,060	40	10,100
Faifield U.	0	29	0	29	0	0	0	0
U. of Maryland	90	65	0	155	0	133	131	264
Boston U.	0	32	0	32	0	0(11)	0	11
Florida State U.	60	54	0	114	71	0(11)	0	189
U. of Minnesota	60	95	0	155	161	452	0	613
U. of Iowa	77	62	0	139	20	5	0	25
U. of Rochester	127	1,159	0	1,286	307	440	0	747
Notre Dame	0	52	0	52	0	123(44)	61	228
Purdue U.	38	135	0	173	15(116)	74(9)	0	214
U of Mississippi	46	100	0	146	68(4)	88(16)	0	160
U. of Florida	44	95	0	139	48(136)	73(339)	0	596
Ohio State U.	140	64	0	204	275	212	0	487
Carnegie M.	0	113	0	113	0	291	0	291
Rice U.	138	19	0	157	102	56	0	158
U. of Wisconsin	533	1,052	0	1,585	170(314)	68(4,816)	0	5,368
U. C. Davis	34	100	0	134	0	(78)	0	78
UCLA	150	87	0	237	249	173	0	422
U.C. Riverside	20	10	0	30	0(37)	(106)	0	143
John Hopkins	0	29	0	29	0	(40)	(30)	70
Northwestern	0	59	0	59	11	20	0	31
Rutgers	0	13	0	13	3	31	0	34
Princeton	0	256	0	256	0	626	0	626
Caltech	0	148	0	148	0	0	0	0
U.C. San Diego	11	0	0	11	0(90)	(24)	0	114
Northeastern	0	0	0	0	0	(11)	(3120)	3,131
U. Ill. –Chicago	0	0	0	0	0(83)	(42)	0	125
U. of Nebraska	0	0	0	0	0(24)	0	0	24
MIT	0	37	0	37	0(41)	(41)	0	82
Reserve	0	0	0	0	0	3,111	2,138	5,249
Total	1,568	9,382	0	10,950	2,345	21,715	5,520	29,580

* FY 1999 totals show all current plans. Allocations pending signed statements of work are shown in parenthesis.

[†] Contract reflects DOE funding provided to FNAL.

**Project Manager's Quarterly Progress Report
1st Quarter FY 1999**

APPENDIX A - FUNDING BY INSTITUTION (in thousands of dollars)

Institution	U.S. ATLAS Total FY 1998				U.S. ATLAS Total FY 1999* (as of 2/99)			
	DOE		NSF	Total	DOE		NSF	Total
	Grant	Contract [†]			Grant	Contract		
ANL	0	1,098	0	1,098	0	460	0	460
BNL	0	3,903	0	3,903	0	2,006	0	2,006
LBNL	0	633	0	633	0	350	0	350
SUNY/Albany	20	0	0	20	0	0	0	0
U. of Arizona	320	100	0	420	0	0	0	0
Boston U.	224	0	0	224	0	0	0	0
Brandeis U.	265	45	0	310	0	0	0	0
U.C. Irvine	193	0	0	193	0	0	0	0
U.C. SantaCruz	404	0	0	404	0	0	0	0
U. of Chicago	0	54	0	54	0	0	0	0
Duke University	190	0	0	190	0	0	0	0
Hampton U.	0	0	0	0	0	0	0	0
Harvard	234	0	0	234	0	0	0	0
U. of Illinois	50	159	0	209	0	0	0	0
Indiana U.	190	0	0	190	0	0	0	0
MIT	50	0	0	50	0	0	0	0
Michigan State	0	35	0	35	0	0	0	0
Nevis/Columbia	0	675	0	675	0	0	0	0
U. of New Mex.	20	0	0	20	0	0	0	0
Northern Illinois	0	0	0	0	0	0	0	0
Ohio State U.	0	0	0	0	0	0	0	0
U. of Michigan	62	254	0	316	0	0	0	0
U. of Oklahoma	30	0	0	30	0	0	0	0
U. of Penn.	250	0	0	250	0	0	0	0
U. of Pittsburg	110	0	0	110	0	0	0	0
U. of Rochester	0	0	0	0	0	0	0	0
U.T. Arlington	50	82	0	132	0	0	0	0
South.Methodist	40	0	0	40	0	0	0	0
SUNY/Stony B.	27	0	0	27	0	0	0	0
Tufts University	50	0	0	50	0	0	0	0
U. Washington	0	0	0	0	0	0	0	0
U. of Wisconsin	230	0	0	230	0	0	0	0
Total	3,009	7,038	0	10,047	0	2,816	0	2,816
Reserve	0	3	0	3	0	8,384	16,630	25,014
Total	3,009	7,041	0	10,050	0	11,200	16,630	27,830

* FY 1999 totals show all current plans. Allocations awaiting signed statements of work are shown in parenthesis.

[†] Contract reflects DOE funding provided to BNL.