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

1. PROJECT IDENTIFIERS

Reporting Period:	Through **September 30, 1999**
Program Sponsors:	DOE High Energy Physics Division/NSF Physics Division
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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 Construction 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 Construction 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 Construction Project effort and includes more detailed status information on 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://wwwlhc.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/

3. PROJECT MANAGER'S NARRATIVE HIGHLIGHTS

A listing of current project reviews and status meetings is shown below:

Project	Event	Date
U.S. LHC Accelerator	DOE/NSF Review	October 19-20, 1999
U.S. CMS	Quarterly Status Meeting	November 23, 1999
U.S. ATLAS	Quarterly Status Meeting	December 20, 1999
U.S. ATLAS	DOE/NSF Review	February 28-March 2, 2000
U.S. CMS	DOE/NSF Review	April 11-13, 2000
U.S. LHC Accelerator	Quarterly Status Meeting	January 25, 2000

The results of these activities are documented in formal reports and meeting notes. The U.S. CMS and ATLAS projects submit monthly reports to DOE/NSF and the U.S. LHC Accelerator project submits a quarterly report. Current performance data is summarized below.

Table 3.1, Cost & Schedule Performance (in thousands of dollars)

	Cumulative Costs to Date					Costs at Completion		
	Budgeted Cost			Variance			Revised	
	Work Scheduled	Work Performed	Actual Cost	Schedule	Cost	Budgeted	Estimate	Variance
U.S. ATLAS	31,689	23,757	20,310	(7,932)	3,447	163,750	163,750	0
U.S. CMS	54,156	48,632	49,890	(5,524)	(1,258)	167,250	167,250	0
U.S. LHC Accelerator	37,693	34,357	34,080	(3,336)	277	110,000	110,000	0
CERN Invoices	8,091	8,091	8,091	0	0	90,000	90,000	0
U.S. LHC Total	131,629	114,837	112,371	(16,792)	2,466	531,000	531,000	0

Table 3.2, Contingency Status (in thousands of dollars)

	Total Project Cost (TPC)	Budget at Completion (BAC)	Contingency	Budgeted Cost of Work Performed (BCWP)	Remaining Work to be Performed (BAC-BCWP)	Contingency/ (BAC-BCWP)
ATLAS	163,750	120,048	43,702	23,757	96,291	45.4%
CMS	167,250	124,396	42,854	48,632	75,764	56.5%
Accelerator	110,000	93,854	16,146	34,357	59,497	27.1%

Table 3.3, Schedule Performance Indices

	Planned Percent Complete (BCWS/BAC)	Actual Percent Complete (BCWP/BAC)	Schedule Performance Percentage (BCWP/BCWS)
U.S. ATLAS	26.4	19.8	75
U.S. CMS	43.5	39.1	90
U.S. LHC Accelerator	40.1	36.6	91

4. PROJECT MANAGER'S ASSESSMENT

The U.S. projects continue to meet their goals and are reliable and influential partners in the construction of the ATLAS and CMS detectors and the LHC machine.

Cost - Cost performance is good as material contracts are typically below estimates and labor costs are tracking close to plans. Project reviews and reports confirm that each project has adequate contingency available. The detector projects are in the production phase and cost experience on production labor will be an important future indicator of cost performance.

Schedule - Schedule performance is measured through milestone completion and by earned value. These measurements indicate that schedule progress is slightly behind plans averaging about eighty-five percent of the baseline plan. CERN expects to complete construction of the LHC and commence initial operations in 2005. The U.S. schedules are consistent with this goal.

Technical - We remain confident that the U.S. deliverables to CERN can be realized with the planned funding. The U.S. ATLAS, CMS, and LHC Accelerator project's deliverables are accepted by CERN and approved by the DOE/NSF Joint Oversight Group. We hope to provide additional items to CERN, within the approved funding, should cost performance be favorable.

ISSUES

DOE Contractor Travel Restrictions - FY 2000 appropriations law reduces travel budgets at DOE National Laboratories. These reductions are adversely impacting U.S. LHC activities.

ATLAS and CMS Integration – The resources available for ATLAS and CMS integration are believed to be insufficient to meet schedule and technical assurance requirements. This issue was originally raised based on concerns with the level of ATLAS centralized engineering but is now also a concern with CMS electronics integration. DOE and NSF staff have brought this issue to the attention of CERN management.

ATLAS and CMS Schedules - The U.S. detector activities are tied to the international schedules. There are instances where delays in the international schedules are causing adverse impacts to the U.S. activities. The U.S. project managers and the CMS and ATLAS Spokespersons are aware of these schedule conflicts and continue to address these issues on a case-by-case basis.

Russian Collaborators - Russian collaborators are not able to meet all of their original commitments to the ATLAS and CMS collaborations. ATLAS and CMS management continue to address shortfalls from Russian and other collaborators when schedules dictate. U.S. CMS has accepted responsibility for additional hadron calorimeter tasks in order to assure that this U.S. CMS managed detector system is delivered on schedule.

LHC Machine Schedule - CERN maintains that the machine completion schedule is still viable with machine commissioning/first physics run in the summer of 2005. This goal has become more challenging due to schedule delays in the start of industrial magnet production program and delays on civil construction work. There will be a better sense of the schedule in about one year when the civil work is advanced and vendors are producing magnets that meet LHC requirements.

5. NARRATIVE SUMMARY

5.1 U.S. ATLAS

ATLAS International – The ATLAS Spokesperson, Peter Jenni, addressed the status of the overall ATLAS experiment at the October ATLAS Resource Review Board meeting at CERN. P. Jenni indicated that there a number of areas where the schedules are now critical and corrective action is necessary. Noteworthy items are summarized below:

- There has been an impressive effort to improve the schedule for the ATLAS barrel toroid magnet. This magnet is a considerable technical challenge and schedule critical.
- Plans have been finalized to integrate and cold test the liquid argon barrel cryostat with the dummy warm vessel in Japan instead of at CERN as originally planned. The U.S. is responsible for the barrel cryostat and participated in the development of this plan.
- The cash flow from the Russian government is below agreed values but ATLAS has found ways to avoid delays. There is good progress on the scintillator for the tile calorimeter.
- The muon system passed a production readiness review and the end plugs for the drift tubes are in production.
- The liquid argon system has experienced several schedule delays and is now receiving increased attention from the ATLAS Technical Coordination Group and CERN.

U.S. ATLAS - A DOE/NSF Quarterly Status Meeting was held in August 1999. The project is making good progress and is now 20% complete. Schedule progress is behind the baseline plan and there have been delays in completing interim milestones. Additional engineering effort has been added in order to improve schedule performance in specific cases where it is warranted. Costs are close to plan so the focus continues to be on resolving technical issues and meeting schedules. Noteworthy items are summarized below:

- The **Silicon Strip and Pixel** detector managers continue to report interesting results and a number of problems. This is an ambitious and diverse subsystem that pushes the frontier of technology more than any other detector in ATLAS. Additional iterations of the designs/prototypes of the microelectronics are required with associated schedule delays.
- The **Transition Radiation Tracker** continues to progress well and efforts are underway to resolve problems with increased power in the electronics.
- The **Liquid Argon Electromagnetic Calorimeter** continues to show very good progress on the barrel cryostat and fabrication work in Japan is progressing well. The readout

electrodes are under contract with increased management attention by the ATLAS technical coordinator and CERN management.

- The submodule production rates for the **Tile Hadronic Calorimeter** are quite favorable with three sites in production. Production delays on the Gap submodule are a concern and efforts are underway to accelerate this work so that it does not delay module assembly.
- The muon drift tube chamber tooling for the **Muon Tracking** detector is slipping further behind schedule as well as the schedule for delivery of end-plugs from CERN. Additional manpower has been added.
- The **Trigger and Data Acquisition Subsystems** are progressing according to plans.

5.2 U.S. CMS

CMS International - The CMS Spokesperson, Michel Della Negra, presented the status of CMS at the October Resource Review Board Meeting. Noteworthy items are summarized below:

- The solenoid magnet is on budget and schedule. The contract for winding the magnet coil was awarded and now over 70% of the total magnet costs are now fixed.
- The collaboration is developing a new strategy for the central tracker that avoids staging. This strategy should result in a tracker design that eliminates the micro-strip gas chambers (MSGCs) and relies entirely on silicon layers. A decision is planned for December 1999.
- Preliminary test beam data from the Hadron Calorimeter (HCAL) Barrel prototypes is being analyzed. Engineering design reviews were successfully completed on the HCAL End-caps and the Outer Barrel and construction is now underway.
- There was a successful design review of the Electromagnetic Calorimeter (ECAL) Barrel in July and construction is underway. Agreements are in place with Russia and China for the full requirements of ECAL crystals.
- Fabrication work on the magnet barrel yoke and muon end cap steel is progressing well.
- CMS has evaluated the risk of funding shortfalls from collaborating countries including Russia. Current estimates project about 17 million Swiss Francs in deliverable value corresponding to about 30 million dollars in U.S. accounting, i.e., including labor. The collaboration is developing contingency plans for addressing the projected shortfall.

U.S. CMS - The U.S. CMS project is making good progress and is 39% complete. The relatively high completion percentage at this early stage in the project is due primarily to the success placing contracts for 100% of the U.S. commitments to CMS common projects ($23 million). Noteworthy items are summarized below:

- The U.S. has management responsibility for the **Hadron Calorimeter (HCAL)** which passed two Engineering Design Reviews in June, Endcap and Outer Barrel calorimeter. Absorber and scintillator production is underway. In order to keep the schedule the U.S. is planning to take on some additional tasks that had been assigned to other collaborators.
- The **Endcap Muon** system has begun full-scale production of the cathode panels for the cathode strip chambers. In response to the 1998 test beam results, the application specific integrated circuit chips were resubmitted to the vendor for additional iteration. These

chips are back and will be included in the CERN test beam cycle this year.

- 1000 avalanche photodiodes from Hamamatsu for the **Electromagnetic Calorimeter** were received, tested, and characterized. Problems with radiation hardness are being addressed through work on an alternative design.
- The **Trigger/Data Acquisition System** Application Specific Integrated Circuit (ASIC) contract is awarded for the CMS trigger.
- An initial readout chip for the **Forward Pixels** is undergoing tests.
- All U.S. responsibilities for CMS **Common Projects** are under contract as Fermilab awarded the final contracts for aluminum stabilizer and bulk aluminum. Deliveries are underway and the first 1400-ton barrel yoke ring is complete.

5.3 U.S LHC ACCELERATOR

LHC - CERN is maintaining the July 2005 turn on date for the machine. Interim milestones are being achieved but there is essentially no schedule float. Vendor contracts are generally below the cost estimates with the notable exception of the contracts for the main ring superconducting dipole magnets. The strategy for these contracts has been changed to introduce more price competition.

U.S. LHC Accelerator - The project is making good progress and is approximately 37% complete. Noteworthy items are summarized below:

Interaction Region (IR) Quadrupoles

- Short model phase 1 milestone completed. Recent models were very successful with adequate quench and magnetic field quality performance.
- Heat exchanger test units delivered to Fermilab and prepared for shipment to CERN.
- Mixed configuration of Fermilab and KEK magnets for the IRs confirmed.
- KEK schedules revised to be consistent with Fermilab/CERN requirements.

Beam Separation Dipoles

- Started fabrication of the first 3-meter prototype magnet and initiated parts orders for the production magnets.
- Significant fraction of parts ordered for production magnets.
- Good progress on documentation and resolution of specification and interface issues.

IR Feedboxes and Absorbers

- Feedbox detailed design work is well underway and Absorber design work continues.
- Functional specification for IR absorbers submitted to CERN for approval.

Superconducting Cable Testing and Production Support

- Completed upgrades to the superconductor test facility at BNL. First production samples delivered by CERN to BNL.
- Completed delivery of all promised cable measurement equipment to CERN.

Accelerator Physics

- Interaction Region Alignment Workshop (Fermilab, October 1999) resulted in full discussion by all relevant parties (US, CERN, KEK).

CERN Direct Purchases - DOE reimburses CERN for their payments to U.S. vendors [ref. U.S.-CERN Agreement and Accelerator Protocol]. The status is shown in the following table.

Table 5.1, Status of DOE Payments (in $000)

Contract Item	U.S. Company	Amount Paid	Contract Value Est.	w/ Escalation
Niobium-titanium alloy bars and niobium sheets - two contracts	Wah Chang	6,940	44,333	46,500
Dipole outerlayer and quadrupole superconducting cable [587 km]	IGC Advanced Superconductors	1,151	16,491	17,500
Totals		8,091	60,824	64,000

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	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	8.09	13.11	18.50	14.20	18.80	17.30	0.00	90.00
Machine Total	2.00	6.67	14.00	23.49	33.21	36.30	31.20	29.00	24.13	0.00	200.00
Detector Funding Profiles (DOE and NSF)											
US ATLAS	1.70	3.71	10.05	25.63	28.43	28.80	27.85	22.89	14.69	0.00	163.75
DOE	1.70	3.71	10.05	9.00	16.49	16.51	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	38.03	24.26	21.27	27.81	22.83	15.18	0.00	167.25
DOE	2.30	4.62	10.95	32.51	20.30	17.19	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	63.66	52.69	50.07	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	41,089	20,310	2,607	22,917	18,172
U.S. CMS	55,900	33,490	19,249	52,739	6,144
U.S. LHC Accelerator	38,070	32,051	1,582	33,633	4,438
CERN Direct Purchases	8,091	8,091	0	8,091	0
U.S. LHC Total	143,150	93,942	23,438	117,380	25,770

* The annual funding distribution between U.S. LHC projects is subject to change. The annual total is unchanged.
† Based on financial reports from the U.S. LHC projects. U.S. ATLAS committed all DOE funding and about two-thirds of the $16.6 M in NSF funding provided in FY 1999. Estimated total accruals for U.S. CMS is $49.89 M.
‡ NSF funding for FY 1999 was authorized late in the fiscal year. The U.S. ATLAS and CMS projects will fully obligate this funding in FY 2000.

DOE/NSF COST BASELINE (in thousands of dollars)

U.S. ATLAS Cost Baseline

WBS No.	Description	Previous	Change	Current
1.1	Silicon System	17,927		17,927
1.2	Transition Radiation Tracker	7,966	221	8,187
1.3	Liquid Argon Calorimeter	35,241		35,241
1.4	Tile Calorimeter	6,843		6,843
1.5	Muon Spectrometer	19,702	133	19,835
1.6	Trigger/Data Acquisition System	15,211		15,211
1.7	Common Projects	9,179		9,179
1.8	Education	204	82	286
1.9	Project Management	7,339		7,339
	Contingency	44,138	(436)	43,702
	U.S. ATLAS Total Cost Baseline	163,750	0	163,750

U.S. CMS Cost Baseline

WBS No.	Description	Previous	Change	Current
1.1	Endcap Muon	26,935	5,049	31,984
1.2	Hadron Calorimeter	30,482	2,568	33,050
1.3	Trigger and Data Acquisition	12,351	964	13,315
1.4	Electromagnetic Calorimeter	7,773	867	8,640
1.5	Forward Pixels	5,272	777	6,049
1.6	Common Projects	23,874	118	23,992
1.7	Project Office	5,433	1,932	7,365
	Contingency	48,210	(5,355)	42,855
	FY 1996 & FY 1997 Expenditures	6,920	(6,920)	0
	U.S. CMS Total Cost Baseline	167,250	0	167,250

U.S. LHC Accelerator Cost Baseline

WBS No.	Description	Previous	Change	Current
1.1	Interaction Region Components	46,778	2,072	48,850
1.2	Radio Frequency Straight Section	13,493	0	13,493
1.3	Superconducting Wire and Cable	11,352	0	11,352
1.4	Accelerator Physics	4,925	0	4,925
1.5	Project Management	14,907	384	15,291
	Contingency	18,545	(2,456)	16,089
	U.S. LHC Accelerator Total Cost Baseline	110,000	0	110,000

7. SCHEDULE STATUS AND PLANS*

U.S. ATLAS Baseline Milestones (through 2001)

WBS Identifiers	Milestone Description	Baseline Date	Forecast (F)/ Actual (A)
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 Complete	12/14/98	**12/15/99 (F)**
TRT	Mechanical Design Frozen (final design complete)	12/31/98	12/07/98 (A)
Muon	Start MDT Chambers Lines 1 and 3	01/04/99	**12/13/99 (F)**
Tile Cal	Start Module Construction	05/01/99	**09/20/99 (A)**
LarCal	Start Electronics Production (Preamps)	06/01/99	**11/01/99 (F)**
Muon	Start CSC Chamber Production	07/01/99	**04/15/00 (F)**
Tile Cal	Start Production Motherboards & Digitizer Boards	07/02/99	**05/01/00 (F)**
Silicon	Start Full Strip Module Production	10/15/99	**06/05/01 (F)**
Muon	ASD Chip Design Complete	10/29/99	**02/01/01 (F)**
LarCal	FE Board SCA Production Chip Submission	07/03/00	07/03/00 (F)
Tri/DAQ	Select Final LVL2 Architecture	12/31/99	12/31/99 (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	06/01/01 (F)
Muon	CSC IC Production Complete	06/30/00	06/30/00 (F)
TRT	Select Final Electrical Design	07/31/00	**07/19/00 (F)**
TRT	Start Production (Electrical)	07/31/00	**01/10/01 (F)**
LarCal	Motherboard System Production Complete	01/01/01	**06/01/01 (F)**
Muon	Kinematic Mount 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	**07/31/01 (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 Prototype Complete	12/31/01	**09/30/01 (F)**

* Items in bold denote changes and/or forecast dates that differ from the approved baseline.

Project Manager's Quarterly Progress Report
4th Quarter FY 1999

U.S. CMS Baseline Milestones*

WBS Identifiers	Milestone Description	Baseline Date	Forecast (F)/ Actual (A)
1	Project Start	Oct-95	10/95 (A)
	Project Completion	Sep-05	09/05 (F)
ECAL L2	Choice of Avalanche Photodiodes	Jun-98	Jun-98
HCAL L2	HB: PP1 Absorber Delivered to CERN	Oct-98	Oct-98
HCAL L2	HB: Mechanical Engineering Design Review	Nov-98	Nov-98
Trigger L2	Complete Initial Muon, Cal., & Global Trigger Design	Nov-98	Nov-98
EMU L2	Mechanical Engineering Design Review	Dec-98	Dec-98
HCAL L2	HB: PPP2 Absorber Delivered to CERN	Apr-99	Apr-99
EMU L2	Begin Production of Cathode Strip Chamber Panels	Apr-99	Apr-99
DAQ L2	Design of Readout Unit Prototype 2 Complete	May-99	May-99
DAQ L2	Event Builder Prototype 1 Complete	May-99	May-99
HCAL L2	HO Engineering Design Review	Jun-99	Jun-99
FPIX L2	Remaining Milestones up to 2005	Jul-99	Jul-99
HCAL L2	HE Mechanical Engineering Design Review	Sep-99	Sep-99
EMU L2	Begin Assembly of Cathode Strip Chambers at FNAL	Oct-99	Oct-99
EMU L2	Pre-production App.-Spec.-Integrated Circuits Ready	Nov-99	Nov-99
Trigger L2	Complete Phase 1 Prototype Design	Nov-99	Nov-99
DAQ L2	Readout Unit Prototype 2 Complete	Nov-99	Nov-99
DAQ L2	Filter Unit Prototype 1 Complete	Nov-99	Nov-99
DAQ L2	Vertical DAQ Chain Prototype Complete	Nov-99	Nov-99
DAQ L2	High Level Trigger Prototype 1 Complete	Nov-99	Nov-99
ECAL L2	500 Electronics Channels Test	Dec-99	Dec-99
ECAL L2	Module (400 channels) Prototype	Dec-99	Dec-99
DAQ L2	Full DAQ Prototype Tests Complete	May-00	May-00
ECAL L2	Super-module 1 Completed	Jun-00	Jun-00
EMU L2	Begin Mass Production of Electronics Boards	Aug-00	Aug-00
EMU L2	Begin Mounting Electronics and Testing at UCLA/UF	Sep-00	Sep-00
HCAL L2	HF Engineering Design Review Complete	Oct-00	Oct-00
HCAL L2	HB-1 Absorber Delivered to CERN	Nov-00	Nov-00
DAQ L2	Technologies Choice Preparation	Nov-00	Nov-00
FPIX L2	Final Full Size Sensors Submission	Jan-01	Jan-01
HCAL L2	HF: Define Fiber Diameter	Jan-01	Jan-01
EMU L2	Begin CSC Assembly-PNPI (Russia) & IHEP (China)	Jan-01	Jan-01
FPIX L2	Final Full Size Readout Chip Submission	Feb-01	Feb-01
HCAL L2	Complete Front-end Electronics Production	Jun-01	Jun-01
ECAL L2	Super-module 1 Calibration	Aug-01	Aug-01

* U.S. CMS Level 2 baseline schedule milestones were revised to correspond directly with CMS milestones tracked by the CERN LHC Committee. CMS Level 1 and Level 2 milestones are denoted by the subscripts L1 and L2.

Project Manager's Quarterly Progress Report
4th Quarter FY 1999

Tri/DAQ $_{L1}$	Submit Data Acquisition System TDR	Dec-01	Dec-01
HCAL $_{L2}$	HB+1 Absorber Delivered to CERN	Dec-01	Dec-01
Tri/DAQ$_{L1}$	Submit Trigger Technical Design Report (TDR)	Sep-02	Sep-02
HCAL $_{L1}$	End Assembly of HB (barrel) in Surface Hall (SX5)	Sep-02	Sep-02
ECAL $_{L2}$	Half-barrel (18 super-modules) calibrated	Sep-02	Sep-02
HCAL $_{L1}$	End Assembly of HE (endcap) in SX5	Feb-03	Feb-03
HCAL $_{L1}$	End Trial Insertion of HB in Vacuum Tank	May-03	May-03
HCAL $_{L2}$	HO Optics Installation on YB Completed	Jun-03	Jun-03
HCAL $_{L1}$	Trial Mounting ECAL-barrel Super-module on HB	Jul-03	Jul-03
EMU $_{L2}$	Install One-half of the Chambers	Jul-03	Jul-03
CP $_{L1}$	Close Yoke and Start Magnet Test in SX5	Sep-03	Sep-03
EMU $_{L2}$	All Large Chambers Assembled and Tested	Oct-03	Oct-03
HCAL $_{L2}$	HB: End Installation in Solenoid in UX5	Dec-03	Dec-03
EMU $_{L2}$	All Chambers Installed	Mar-04	Mar-04
HCAL $_{L1}$	End Installation and Test of HB in UX5	May-04	May-04
ECAL $_{L2}$	Full-barrel (36 super-modules) calibrated	Jun-04	Jun-04
HCAL $_{L1}$	End Installation and Test of HE in UX5	Jul-04	Jul-04
ECAL $_{L1}$	End Inst., Testing, & Debug. of EB (barrel) in UX5	Oct-04	Oct-04
EMU $_{L1}$	End Install. of ME (endcap) Stations in YE in UX5	Mar-05	Mar-05
HCAL $_{L2}$	HO End Installation and Tests in UX5	Apr-05	Apr-05
Tracker $_{L1}$	End Installation and Test of Tracker in UX5	Jun-05	Jun-05
HCAL $_{L1}$	End Installation and Test of HF in UX5	Jun-05	Jun-05

Project Manager's Quarterly Progress Report
4th Quarter FY 1999

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

WBS Identifiers	Milestone Description	Baseline Date	Forecast (F)/ Actual (A)
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 1st Inner Triplet Quadrupole Model Magnet	07/01/97	07/01/97 (A)
SC	All Cable Production Support Equipment Delivered to CERN	09/01/99	05/28/99 (A)
SC	Complete Superconductor Test Facility Upgrades	06/01/99	**09/30/99 (A)**
RF Region	Begin Assembly of 1st Dipole Model Magnet	09/01/99	**06/10/99 (A)**
IR Region	Complete Inner Triplet Quadrupole Model Magnet Program Phase 1	12/01/99	**09/28/99 (A)**
IR Region	Complete Inner Triplet Quadrupole Model Magnet Program Phase 2	03/01/00	03/01/00 (F)
IR Region	Place Purchase Order for HTS Power Leads	02/01/00	02/01/00 (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 1st 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)

8. TECHNICAL BASELINE STATUS

U.S. ATLAS Construction Project - No change. 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. Deliverables are listed in the U.S. ATLAS Construction Project Management Plan, Appendix 3.

U.S. CMS Construction Project - No change. The U.S. CMS collaboration defined a list of deliverables representing the U.S. contribution to CMS. This list was approved by the JOG in October 1998. The scope of U.S. CMS contribution is described in the U.S. CMS Management Plan, Appendix 2.

U.S. LHC Accelerator Construction Project - No change. 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 - No change. 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

Baseline Control Level	Baseline Changes
Level 1, DOE/NSF Joint Oversight Group	No changes this quarter
Level 2, DOE/NSF Project Office	
U.S. ATLAS	Changes this quarter.
U.S. CMS	Changes this quarter.
U.S. LHC Accelerator Project	Changes this quarter.

U.S. ATLAS – A total of six Level 2 changes were approved this quarter. Changes occurred in the Transition Radiation Tracker System, the Muon Spectrometer System, and the Education Program. The net use of contingency was $436,000.

U.S. CMS – There were changes to each Level 2 cost baseline element this quarter. The most significant changes were increases to the Endcap Muon system and the Project Office. In addition, $6,920,000 of prior year costs for FY1996 and FY1997 are now included in appropriate Level 2 cost baseline elements. Previously these cost had been reported as a separate line item.

U.S. LHC Accelerator – There were three changes to the Level 2 cost baseline this quarter. The net use of contingency for these changes was $2,456,000.

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

U.S. CMS

Institution	U.S. CMS Total FY 1998				U.S. CMS Total FY 1999 (as of 9/30/99)			
	DOE		NSF	Total	DOE		NSF	Total
	Grant	Contract			Grant	Contract		
FNAL	0	5,517	0	5,517	0	10,817	40	10,857
Faifield U.	0	29	0	29	0	0	0	0
U. of Maryland	90	65	0	155	0	132	131	263
Boston U.	0	32	0	32	31	111	0	142
Florida State U.	60	54	0	114	71	118	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	262	485	0	747
Notre Dame	0	52	0	52	0	44	184	228
Purdue U.	38	135	0	173	49	166	0	215
U of Miss.	46	100	0	146	68	91	0	159
U. of Florida	44	95	0	139	184	412	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	471	3,598	0	4,069
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	164	0	164
Johns Hopkins	0	29	0	29	0	0	70	70
Northwestern	0	59	0	59	5	26	0	31
Rutgers	0	13	0	13	0	0	34	34
Princeton	0	256	0	256	0	626	0	626
Caltech	0	148	0	148	0	458	0	458
U.C. San Diego	11	0	0	11	90	24	0	114
Northeastern	0	0	0	0	0	0	3,370	3,370
U. Ill. –Chicago	0	0	0	0	0	0	124	124
U. of Nebraska	0	0	0	0	0	0	24	24
MIT	0	37	0	37	15	67	0	82
Iowa State U.	0	0	0	0	0	0	19	19
Subtotal	1,568	9,382	0	10,950	2,053	18,606	3,996	24,655
Reserve	0	0	0	0	0	3,401	1,524	4,925
Total	1,568	9,382	0	10,950	2,053	22,007	5,520	29,580

Project Manager's Quarterly Progress Report
4th Quarter FY 1999

U.S. ATLAS

Institution	U.S. ATLAS Total FY 1998				U.S. ATLAS Total FY 1999 (as of 9/30/99)			
	DOE		NSF	Total	DOE		NSF	Total
	Grant	Contract			Grant	Contract		
ANL	0	1,098	0	1,098	0	967	0	967
BNL	0	3,903	0	3,903	0	2,481	0	2,481
LBNL	0	633	0	633	0	715	0	715
SUNY/Albany	20	0	0	20	48	0	0	48
U. of Arizona	320	100	0	420	634	0	0	634
Boston U.	224	0	0	224	298	0	0	298
Brandeis U.	265	45	0	310	0	0	593	593
U.C. Irvine	193	0	0	193	0	0	93	93
U.C. SantaCruz	404	0	0	404	63	0	0	63
U. of Chicago	0	54	0	54	0	0	1,069	1,069
Duke U.	190	0	0	190	601	0	0	601
Hampton U.	0	0	0	0	0	0	538	538
Harvard	234	0	0	234	0	0	654	654
U. of Illinois	50	159	0	209	347	0	0	347
Indiana U.	190	0	0	190	765	0	0	765
MIT	50	0	0	50	105	0	0	105
Michigan State	0	35	0	35	0	0	178	178
Nevis/Columbia	0	675	0	675	0	0	2,680	2,680
U. of New Mex.	20	0	0	20	30	0	0	30
Northern Illinois	0	0	0	0	0	0	0	0
Ohio State U.	0	0	0	0	100	0	0	100
U. of Michigan	62	254	0	316	716	0	0	716
U. of Oklahoma	30	0	0	30	0	0	41	41
U. of Penn.	250	0	0	250	300	0	0	300
U. of Pittsburg	110	0	0	110	0	0	150	150
U. of Rochester	0	0	0	0	0	0	3,587	3,587
U.T. Arlington	50	82	0	132	0	0	474	474
S. Methodist	40	0	0	40	124	0	0	124
SUNY/Stony B.	27	0	0	27	0	0	1,045	1,045
Tufts University	50	0	0	50	20	0	0	20
U. Washington	0	0	0	0	0	0	240	240
U. of Wisconsin	230	0	0	230	429	0	0	429
Subtotal	3,009	7,038	0	10,047	4,579	4,263	11,341	20,183
Reserve	0	3	0	3	157		5,289	5,446
Total	3,009	7,041	0	10,050	4,736	4,263	16,630	25,629

U.S. LHC Accelerator

	U.S. LHC Accelerator FY 1998	U.S. LHC Accelerator FY 1999
FNAL	4,304	6,520
BNL	3,999	7,690
LBNL	2,140	1,190
Reserve	0	0
Total	10,443	15,400