Project Manager's Quarterly Progress Report – 4th Quarter FY 2000
U.S. Large Hadron Collider Construction Project

1. PROJECT IDENTIFIERS

Reporting Period:	Through **September 30, 2000**
Program Sponsors:	DOE High Energy Physics Division/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) 292-7374, 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 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

The current list of DOE/NSF project reviews and status meetings is provided below:

U.S. LHC Construction Project	Event	Date
U.S. CMS Detector	Quarterly Status Meeting	July 14, 2000
U.S. LHC Accelerator	Quarterly Status Meeting	August 22, 2000
U.S. ATLAS Detector	DOE/NSF Review	September 13, 2000
U.S. CMS Detector	DOE/NSF Review	October 11, 2000
U.S. LHC Accelerator	DOE/NSF Review	November 28-30, 2000
U.S. ATLAS Detector	Quarterly Status Meeting	December 12, 2000

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

Table 3.1, Schedule Performance Indices

	Planned Complete (BCWS/BAC)	Actual Complete (BCWP/BAC)	Schedule Performance (BCWP/BCWS)
U.S. ATLAS	34%	33%	96%
U.S. CMS	57%	48%	85%
U.S. LHC Accelerator	56%	51%	92%

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)
US ATLAS	163,750	129,002	34,897	42,572	86,430	40%
US CMS	167,250	130,307	36,943	63,065	67,242	55%
US Accelerator	110,000	96,655	13,345	49,566	47,089	28%

Table 3.3, 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	44,320	42,572	40,169	-1,748	2,403	163,750	163,750	0
U.S. CMS	73,827	63,065	72,519	-10,762	-9,454	167,250	167,250	0
U.S. LHC Accelerator	53,725	49,566	52,705	-4,154	-3,139	110,000	110,000	0
CERN Invoices	16,379	16,379	16,379	0	0	90,000	90,000	0
U.S. LHC Total	188,251	171,582	181,772	-16,669	-10,190	531,000	531,000	0

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 continue to track 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 behind plans averaging about ninety percent of the baseline plan. The CERN official schedule still calls for completing construction of the LHC 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. LHC Construction Project 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

LHC Schedules - CERN is completing a review of the schedules for the LHC machine and the ATLAS and CMS experiments. The results of this review will be presented at the CERN Council meeting in December 2000. We expect CERN to present a new commissioning scenario for the LHC machine. The goals of this scenario are beam in one ring in July 2005, two weeks of collisions in October 2005, and start of the physics run in April 2006. The revised schedule goals for the ATLAS and CMS experiments are "working" detectors in October 2005 and complete detectors in April 2006. DOE and NSF staff are closely monitoring this planning activity.

ATLAS and CMS Resources - Estimates of the resources required to complete the experiments exceed the funding currently identified. Funding shortfalls are driven by two factors: 1) various institutes not meeting their original commitments, e.g., Russian institutes; and, 2) better estimates of the funding required to complete the detectors. ATLAS and CMS management continue to address shortfalls when schedules dictate but at some point we should expect that CERN and the collaborations' management will attempt to address this issue in a comprehensive way.

ATLAS and CMS Technical Staffing – ATLAS and CMS technical integration staffing has been less than necessary. CERN provided additional positions to ATLAS and CMS but a shortfall remains. ATLAS is in the process of revising the Technical Coordination function.

Radiation Hard Electronics - Significant challenges remain in the development of radiation hard electronics for the ATLAS and CMS experiments including production yields and limited vendor options. Export license and dual-use technology issues are additional complications.

5. NARRATIVE SUMMARY

5.1 U.S. ATLAS CONSTRUCTION PROJECT

ATLAS International – The CERN LHC Committee (LHCC) conducted a comprehensive annual review of ATLAS in July 2000. The ATLAS collaboration approved a change to the ATLAS Technical Coordination (TC) organization, including the election of Marizo Nessi as a replacement for M. Price. U.S. ATLAS continues to support the efforts to strengthen ATLAS central management, and the enhancements to the TC function. US ATLAS management met with ATLAS leadership to begin addressing the issue of prioritization of US ATLAS goals for items outside the present baseline (i.e. management contingency items). Other recent ATLAS highlights are summarized below :

- The fabrication of the large, time-critical components of the common projects are well underway including the magnets and the liquid argon cryostats.
- Emphasis is being given to integration issues that are on the critical path.
- Critical items to be resolved include the barrel toroid coil casing, the liquid argon electrodes, the liquid argon endcap construction and cold tests, and radiation-hard electronics. The collaboration is making dedicated efforts to address these problems and to recover schedule.
- The overall ATLAS and detector subsystem schedules are under revision with the goal of a working detector in October 2005 and the full detector in April 2006.

U.S. ATLAS - The overall project, as of September 30, 2000, was actually 37.5 percent complete versus the 39.1 percent planned. A DOE/NSF semi-annual review was conducted at the University of Michigan on September 13, 2000. Project highlights are listed below:

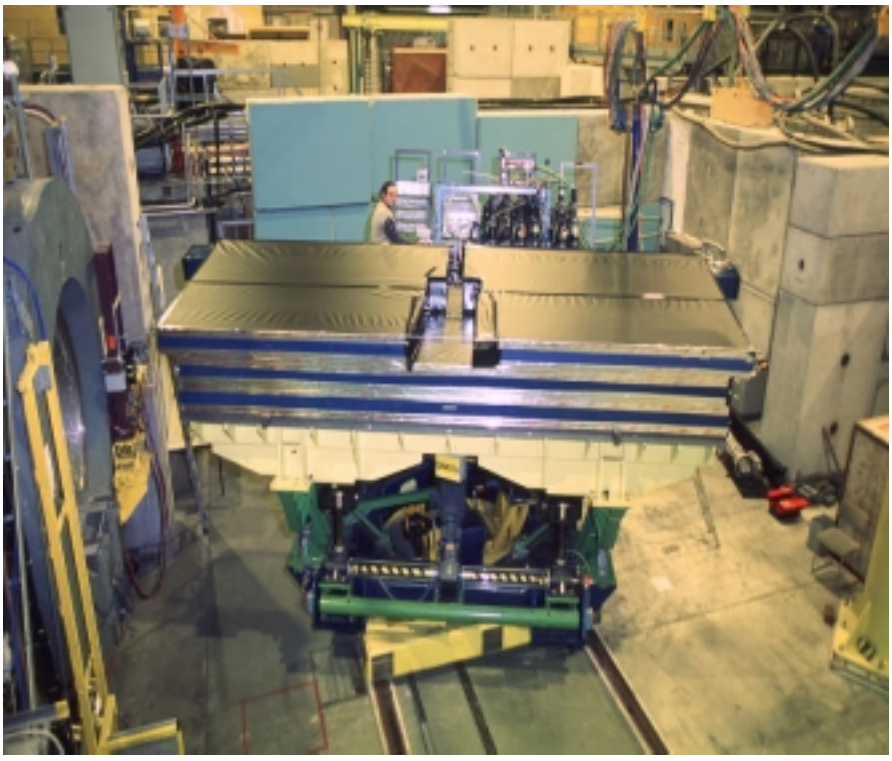
- An alternative pixel layout was proposed to the Inner Detector Steering Group (IDSG) on September 7 to address schedule delays in electronics. Both pixel and inner tracker groups were asked to consider a major redesign of both systems to allow insertion and removal of the entire pixel system from outside the detector. A preliminary study was started of the redesign, which could gain 18 months relative to the current electronics and module production schedule. The study, and potential impact on installation scenarios, will be considered by the IDSG over the next few months.
- Transition Radiation Tracker module production and component production of straws, radiator packs and dividers are underway. Production of module 1.0 is complete.
- All three Muon Drift Tube assembly facilities entered production mode, with initial chamber construction activities underway to support full production and chamber completion. Component supply continues to be monitored against critical path for chamber completion activities.
- The cold vessel of the Liquid Argon Barrel Cryostat was tested at Kawasaki Heavy Industry (KHI) and they have now moved to the final assembly after the vessel has been accepted. The Feedthroughs have assembled three full assemblies and are now limited by the delivery rate

of the Pin Carriers. The order for the pedestals, crates and power bus for the System Crates has been signed. Preamps and motherboard system are in the first stages of production.

- Tile Calorimeter submodule and module construction are on or ahead of schedule, with 281 submodules of the 576 total having been completed. To date 18 modules have been built and 13 instrumented and tested out of 64 total.

At left:
US ATLAS (BNL) half Cold Vessel for Liquid Argon Barrel Cryostat at KHI , Japan, for testing (now moved to final assembly after vessel has been accepted)

At right:
US ATLAS (ANL) Tile Calorimeter module, with other modules from Barcelona and Dubna, at CERN test beam facility (Summer, 2000)



5.2 U.S. CMS CONSTRUCTION PROJECT

CMS International – The CERN LHC Committee (LHCC) conducted a comprehensive annual review of CMS in early October, 2000. CMS presented a new schedule which completes installation of the full detector by April 2006, with a variant of the schedule that compresses the installation so that a working detector is possible in October 2005. Other recent CMS highlights are summarized below:

- The surface building is nearly full with muon steel and structural steel.
- CMS shaft excavation is proceeding as planned and progressed beyond the need to freeze the local groundwater.
- CMS leadership has evaluated the risk of funding shortfalls from collaborating countries including Russia and has developed contingency plans for addressing the shortfall.
- CMS continues planning for a "working" detector ready for first beam in 2005, taking into account technical and financial constraints. This plan supports completion of major fractions of each detector subsystem in time for first beam.

U.S. CMS - As of September 30, 2000, the overall U.S. CMS Construction Project was 48 percent complete vs. the scheduled 57% complete. A Quarterly Status Review was conducted by the DOE/NSF Joint Oversight Group and Project Office on July 27, 2000. The review found that recommendations from the April, 2000 DOE/NSF were generally being addressed. It was found that performance with respect to technical and cost goals remained good, and there was clear progress in Endcap Muon Cathode Strip Chamber (CSC) production. The electromagnetic and hadron calorimeter front end electronics presented schedule concerns that continue to be tracked by the DOE/NSF Project Office. Listed below are project highlights:

- A CMS electronics system review of Endcap Muon front end electronics was completed in September, allowing plans to proceed for procuring both ASIC and front end boards. Radiation tests resulted in a need to redesign an Endcap Muon trigger electronics board, which may ultimately impact schedule for CSC production.
- The Hadron Calorimeter readout box production schedule has been affected by system integration issues currently under negotiation within CMS. A potentially serious delay in Hadron Calorimeter front end electronics was carefully evaluated, and this resulted in selection of an option with overall positive cost, schedule and performance benefits, rather than adopting a variation of Electromagnetic Calorimeter electronics as a solution.
- A change was made in the Electromagnetic Calorimeter bit-serializer technology option, from a Honeywell process to an IBM process, due to failures in the Honeywell process. This will result in net decrease in cost of ~276k since the IBM process is less expensive, but also presents a need to address associated schedule and technical issues.
- A successful performance test of Forward Pixel detector spatial resolution in a high magnetic field was completed in July at a CERN test beam.
- There was a review in September of an increase in scope planned for the Silicon Strip Tracker, to support future baselining of this subsystem.

First half barrel of the CMS Hadron Calorimeter, for which the U.S. has overall international responsibility, at factory in Spain where preassembly and survey took place.

5.3 U.S LHC ACCELERATOR CONSTRUCTION PROJECT

LHC - CERN is maintaining the July 2005 turn on date for the machine. Interim milestones are routinely met but there is essentially no schedule float. The commissioning scenario is being revised with a goal of beam in one ring in July 2005, collisions for two weeks in October 2005, and the start of the physics run in April 2006.

U.S. LHC Accelerator - As of September 30, 2000, the overall project was 51 percent complete versus the scheduled plan of 56 percent complete. The schedule of deliverables remains well in advance of CERN requirements. Contingency is adequate to address the existing cost variance and the remaining cost risk. The next DOE/NSF review is schedule for November 29-30, 2000, at LBNL. Project highlights are listed below:

Interaction Region (IR) Quadrupoles

- Production of the first of two planned full-scale prototype interaction region quadrupole magnets continues. Coils for the prototype are complete, and final coil assembly has begun.
- Parts have been ordered for the interaction region quadrupole cryostats.
- Testing at CERN of the heat exchanger test unit built by Fermilab was completed. Preliminary results indicate the design will meet the requirements for cooling the interaction region quadrupoles.

Interaction Region and RF Region Dipoles

- An Engineering Design Review of the interaction region separation dipoles (D1 and D2) was completed.
- Construction of the first D2 production magnet proceeded to the point of coil collaring. A practice collaring of a D1 magnet was successfully conducted, verifying that the reassembled RHIC production tooling is operational.

IR Feedboxes and Absorbers

- Detailed design work on Feedboxes and Absorbers is progressing well; an Engineering Design Review was completed for the absorbers.
- Seals for High Temperature Superconducting feedbox leads have been successfully tested.
- Beam tests of luminosity instrumentation were conducted, moving r&d closer to goal of a monitor suitable for installation into an absorber.

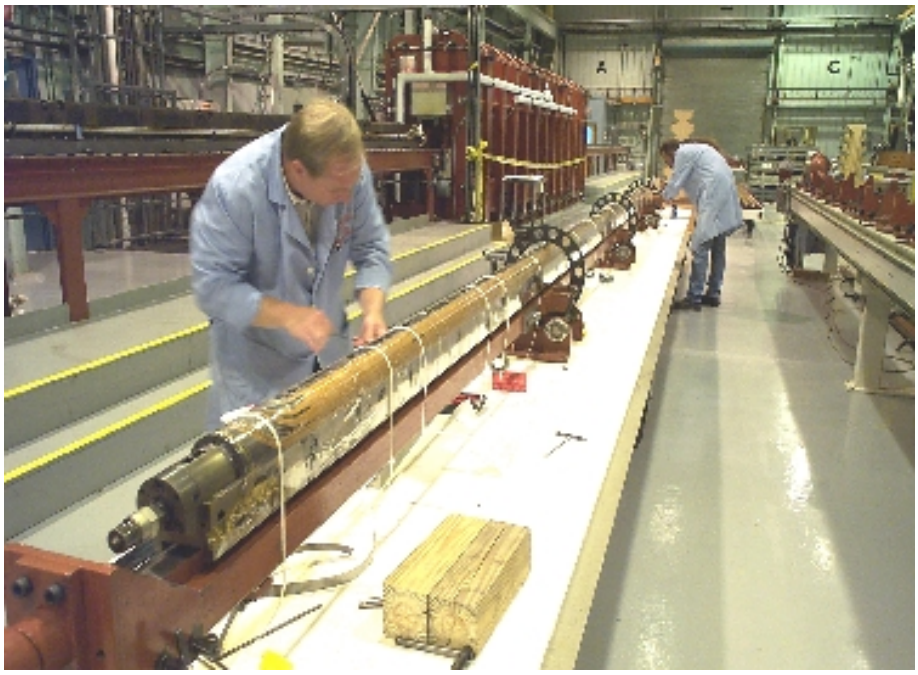
Superconducting Cable Testing and Production Support

- A Production Readiness Review for the Cable Test Facility at BNL was conducted.
- Several LHC magnet cable test runs completed at 4.3 K and 1.9 K, but overall test-rate remains low due to cable vendor and delivery problems.

Accelerator Physics

- Optics studies, beam-beam effect analyses, and calculations of energy deposition in high luminosity insertions were initiated or conducted.
- A BNL/Fermilab/CERN collaboration conducted interaction region studies with RHIC.

At left:
Heat Exchanger unit for interaction region quadrupole cryostat, built by Fermilab. Unit is shown at CERN, as viewed from the CERN test facility control room, where testing was completed.



At right:
Construction of a full-length coil for the first D2 interaction region separation dipole production magnet at BNL. The picture shows the coil on the mandrel (BNL/RHIC collaring and curing press in background on left). The coils for the first magnet are completed and are ready for collaring.

CERN Direct Purchases - DOE reimburses CERN for their payments to qualified U.S. vendors [Reference U.S.-CERN Agreement and Accelerator Protocol]. The status is shown in Table 5.1.

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

Contract Item	Company (U.S. supplier)	Amount Paid	Contract Price	w/ options & escalation
Niobium-Titanium Alloy Bars	Wah Chang	13,351	38,667	48,431
Niobium Sheets	Wah Chang	1,877	5,633	6,951
Polyamide Insulation Film	Kaneka High Tech Materials	0	5,425	6,510
Superconducting Cable	IGC Advanced Superconductors	1,151	16,447	20,985
Enameled Superconductor	IGC Advanced Superconductors	0	746	968
Cryogenic Temperature Sensor	Lakeshore	0	695	695
Totals		16,379	67,613	84,540

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	24.92	9.38	14.20	11.20	8.33	3.90	110.00
CERN Direct	0.00	0.00	0.00	8.09	8.29	17.92	15.00	14.90	15.00	10.80	90
Machine Total	2.00	6.67	14.00	23.49	33.21	27.30	29.20	26.10	23.33	14.70	200.00
Detector Funding Profiles (DOE and NSF)											
US ATLAS	1.70	3.71	10.05	25.63	28.43	26.80	25.85	21.89	14.69	5.00	163.75
DOE	1.70	3.71	10.05	9.00	16.49	14.51	13.20	14.60	14.69	5.00	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	21.81	21.73	15.98	6.30	167.25
DOE	2.30	4.62	10.95	32.51	20.30	17.19	17.60	19.30	15.98	6.30	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

TOTAL DOE & NSF FUNDS, COSTS, & COMMITMENTS (cumulative $000)†

U.S. LHC Construction Project	A = Funds Allocated	B = Estimate Actual Costs	C = Open Commitments	D= B+C Total	A–D = Funds Available
U.S. ATLAS	69,520	40,168	8,392	48,560	20,960
U.S. CMS	80,160	70,129	2,392	72,521	7,639
U.S. LHC Accelerator	58,170	49,549	3,156	52,705	5,465
CERN Direct Purchases	16,380	16,379	0	16,379	1
Total	224,230	176,910	13,940	190,850	33,380

* This report includes a revision to the funding profile for the U.S. LHC Construction Project that is addressed in the FY 2001 budget planning for DOE. The revision to the original profile was made in order to better match the needs of the construction projects. This report also includes a change in the distribution of funds between the U.S. LHC Accelerator project and the CERN direct project to address delays in CERN invoices.

† Based on financial reports from the U.S. LHC construction projects. NSF funding is provided after the beginning of the fiscal year and therefore it is necessary to carry-over funding into the subsequent fiscal years.

7. DOE/NSF COST BASELINES AT LEVEL 2 (in $000)

U.S. ATLAS Cost Baseline

WBS	Description	Previous	Change	Current
1.1	Silicon System	18,569		18,569
1.2	Transition Radiation Tracker	9,079		9,079
1.3	Liquid Argon Calorimeter	40,972		40,972
1.4	Tile Calorimeter	7,912	17	7,929
1.5	Muon Spectrometer	23,943	160	24,103
1.6	Trigger/Data Acquisition System	10,957		10,957
1.7	Common Projects	9,179		9,179
1.8	Education	286		286
1.9	Project Management	7,779		7,779
	Contingency	35,074	-177	34,897
	U.S. ATLAS Total Project Cost Baseline	163,750	0	163,750

U.S. CMS Cost Baseline

WBS	Description	Previous	Change	Current
1.1	Endcap Muon	34,299	685	34,984
1.2	Hadron Calorimeter	37,308	347	37,655
1.3	Trigger and Data Acquisition	12,987		12,987
1.4	Electromagnetic Calorimeter	9,458	-280	9,178
1.5	Forward Pixels	6,028	350	6,378
1.6	Common Projects	23,000		23,000
1.7	Project Office	6,125		6,125
1.8	Silicon	0		0
	Contingency	38,045	-1,102	36,943
	U.S. CMS Total Project Cost Baseline	167,250	0	167,250

U.S. LHC Accelerator Cost Baseline

WBS	Description	Previous	Change	Current
1.1	Interaction Region Components	49,527	801	50,328
1.2	Radio Frequency Straight Section	14,646	1,068	15,714
1.3	Superconducting Wire and Cable	11,868		11,868
1.4	Accelerator Physics	5,133		5,133
1.5	Project Management	13,550	62	13,612
	Contingency	15,276	-1,931	13,345
	U.S. LHC Accelerator Total Project Cost Baseline	110,000	0	110,000

8. SCHEDULE STATUS AND PLANS

8.1 U.S. ATLAS Construction Project Milestones

The milestones have been updated with the new ETC baseline dates.

U.S. ATLAS Major Project Milestones (Level 1)

Description	Baseline Schedule	Forecast (F) Date	Actual (A) Date
Project Start	01-Oct-95	01-Oct-95 (F)	01-Oct-95 (A)
Project Completion	30-Sep-05	30-Sep-05 (F)	

U.S. ATLAS Major Project Milestones (Level 2)

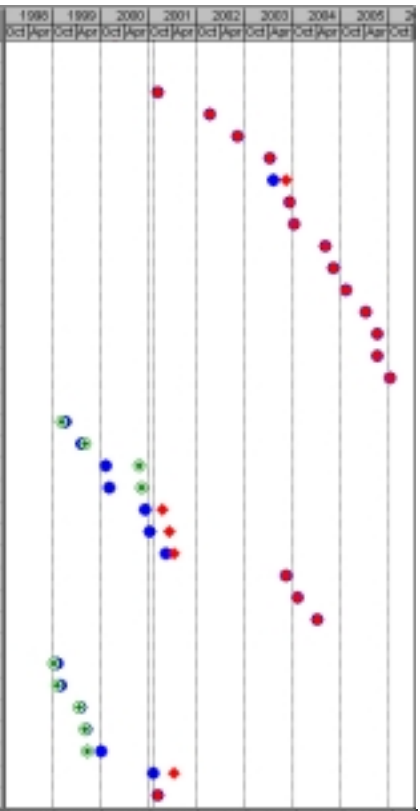
Subsystem	**Schedule Designator**	**Description**	**Baseline Schedule**	**Forecast (F) / Actual (A) Date**
Silicon (1.1)	SIL L2/1	Start Full Silicon Strip Electronics Production	23-Apr-01	23-Apr-01 (F)
	SIL L2/2	Start Full Strip Module Production	26-Nov-01	26-Nov-01 (F)
	SIL L2/3	ROD Design Complete	14-Jun-01	14-Jun-01 (F)
	SIL L2/4	Complete Shipment of Silicon Strip Module Production	13-Oct-03	13-Oct-03 (F)
	SIL L2/5	ROD Production/Testing Complete	13-Mar-03	13-Mar-03 (F)
TRT (1.2) Mechanical	TRT L2/1	Final Design Complete	31-Dec-98	07-Dec-98 (A)
	TRT L2/2	Module Production Complete	03-Feb-03	03-Feb-03 (F)
	TRT L2/3	Barrel Construction Complete	16-Sep-03	16-Sep-03 (F)
Electrical	TRT L2/4	Select Final Elec Design	15-Jun-01	15-Jun-01 (F)
	TRT L2/5	Start Production of ASICS	06-Dec-01	06-Dec-01 (F)
	TRT L2/6	Installation Complete	04-Jan-05	04-Jan-05 (F)
LAr Cal (1.3)	LAr L2/1	Cryostat Contract Award	24-Jul-98	05-Aug-98 (A)
	LAr L2/2	Barrel Feedthroughs Final Design Review	30-Sep-98	02-Oct-98 (A)
	LAr L2/3	Start Electronics Production (Preamps)	30-Jun-00	30-Jun-00 (A)
	LAr L2/4	FCAL Mechanical Design Complete	14-Dec-98	15-Dec-99 (A)
	LAr L2/5	FEB SCA Prod. Chip Submission/Contract Award	02-Mar-01	02-Mar-01 (F)
	LAr L2/6	Level 1 Trigger Final Design Complete	02-Jan-01	02-Jan-01 (F)
	LAr L2/7	ROD Final Design Complete	01-Jun-02	01-Jun-02 (F)
	LAr L2/8	Motherboard System Production Complete	01-Jun-02	01-Jun-02 (F)
	LAr L2/9	Cryostat Arrives at CERN	15-May-01	15-May-01 (F)
	LAr L2/10	Barrel Feedthroughs Production Complete	15-Oct-01	15-Oct-01 (F)
	LAr L2/11	FCAL-C Delivered to EC	17-Oct-02	17-Oct-02 (F)
	LAr L2/12	FCAL-A Delivered to EC	08-Dec-03	08-Dec-03 (F)

U.S. ATLAS Major Project Milestones (Level 2) (Continued)

Subsystem	Schedule Designator	Description	Baseline Schedule	Forecast (F) / Actual (A) Date
Tile Cal (1.4)	Tile L2/1	Start Submodule Procurement	01-Sep-97	01-Sep-97 (A)
	Tile L2/2	Technology Choice for F/E Electronics	15-Nov-97	15-Nov-97 (A)
	Tile L2/3	Start Module Construction	01-May-99	20-Sep-99 (A)
	Tile L2/4	Start Production of Motherboards	01-Oct-00	01-Oct-00 (F)
	Tile L2/5	All Electronic Components Delivered to CERN	01-Oct-02	01-Oct-02 (F)
	Tile L2/6	Module Construction Complete	30-Sept-02	30-Sep-02 (F)
	Tile L2/7	All Modules Delivered to CERN	20-Dec-02	20-Dec-02 (F)
Muon (1.5)	Muon L2/1	Start MDT Chambers Lines 1 and 3	17-Jul-00	**15-Sep-00 (F)**
	Muon L2/2	Start CSC Chamber Production	01-Mar-01	01-Mar-01 (F)
	Muon L2/3	MDT Electronics ASD PRR	19-Oct-01	01-Oct-01 (F)
	Muon L2/4	Final Design of Global Alignment Devices Complete	01-Apr-02	01-Apr-02 (F)
	Muon L2/5	CSC IC Production Complete	18-Dec-02	18-Dec-02 (F)
	Muon L2/6	Kinematic Mount Design Complete	30-Jan-01	30-Jan-01 (F)
	Muon L2/7	MDT Chambers (U.S.) Production Complete	14-Sep-04	14-Sep-04 (F)
	Muon L2/8	Kinematic Mount Production Complete	22-May-04	22-May-04 (F)
	Muon L2/9	CSC ROD Production Complete	05-Nov-03	04-Nov-03 (F)
	Muon L2/10	MDT Elec.'s Mezzanine Production Complete	06-Dec-02	06-Dec-02 (F)
	Muon L2/11	CSC Assembly/Testing at CERN Complete	17-Dec-04	17-Dec-04 (F)
	Muon L2/12	Global Alignment System Final Delivery	30-Sep-04	30-Sep-04 (F)
Trigger/ DAQ (1.6)	TDAQ L2/1	Select Final LVL2 Architecture	31-Dec-99	31-Mar-00 (A)
	TDAQ L2/2	LVL2 Trigger Design Complete	31-Dec-01	31-Dec-01 (F)
	TDAQ L2/3	LVL2 Trigger Prototype Complete	30-Sep-01	30-Sep-01 (F)
	TDAQ L2/4	Start Production	08-Jan-02	08-Jan-02 (F)
	TDAQ L2/5	Start Installation & Commissioning	05-Mar-02	05-Mar-02 (F)
	TDAQ L2/6	Production Complete	29-Oct-04	29-Oct-04 (F)
	TDAQ L2/7	LVL2 Installation & Commissioning Complete	31-Dec-04	31-Dec-04 (F)

8.2 U.S. CMS Construction Project Milestones

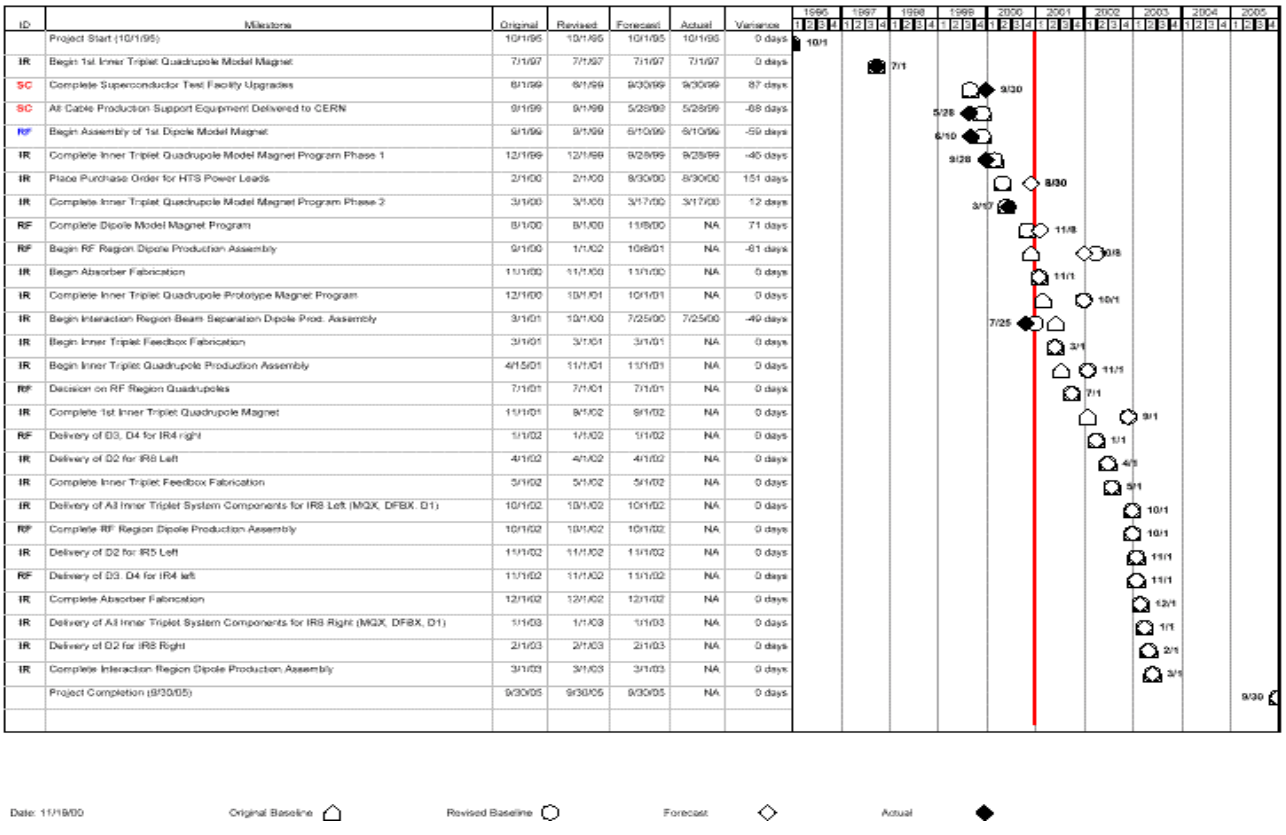
System	Level?	CMS ID	Milestone	Variance	Baseline Start	Start
			CMS L1 Milestones	**0 days**	**NA**	**Oct 31 '95**
CMS1	ML1		Project Start (10Oct.95)	0 days	Oct 31 '95	Oct 31 '95
CMS1	ML1	D-804	Submit Trigger Technical Design Report (TDR)	0 days	Nov 30 '00	Nov 30 '00
CMS1	ML1	D-814	Submit DAQ Technical Design Report (TDR)	0 days	Dec 31 '01	Dec 31 '01
CMS1	ML1	HB-017	End Assembly of HB (Barrel) in Surface Hall (SX5)	0 days	Jul 31 '02	Jul 31 '02
CMS1	ML1	HE-012	End Assembly of HE (Endcap) in SX5	0 days	Mar 31 '03	Mar 31 '03
CMS1	ML1	HB-018	End Trial Insertion of HB in Vacuum Tank	65 days	May 01 '03	Jul 31 '03
CMS1	ML1	E-815	Trial Mounting of EB Supermodule on HB Complete	0 days	Aug 31 '03	Aug 31 '03
CMS1	ML1	S-822	Close Yoke and Start Magnet Test in SX5	0 days	Sep 30 '03	Sep 30 '03
CMS1	ML1	HB-023	End Installation and Test of HB in UX5	0 days	May 31 '04	May 31 '04
CMS1	ML1	HE-015	End Installation and Test of HE in UX5	0 days	Jul 31 '04	Jul 31 '04
CMS1	ML1	E-819	End Inst., Testing, & Debug. of EB (barrel) in UX5	0 days	Oct 31 '04	Oct 31 '04
CMS1	ML1	M-019	End Install. of ME (Endcap) Stations in YE in UX5	0 days	Mar 31 '05	Mar 31 '05
CMS1	ML1	T-814	End Installation and Test of Tracker in UX5	0 days	Jun 30 '05	Jun 30 '05
CMS1	ML1	HF-025	End Installation and Test of HF in UX5	0 days	Jun 30 '05	Jun 30 '05
CMS1	ML1		Project Completion (30Sep05)	0 days	Sep 30 '05	Sep 30 '05
			Muon System (WBS 1.1)	**0 days**	**NA**	**Dec 02 '98**
MUON	ML2	M-089	Mechanical Engineering Design Review	-14 days	Dec 31 '98	Dec 02 '98
MUON	ML2	M-010	Begin Mass Production of CSC Parts (panels)	21 days	Apr 30 '99	May 31 '99
MUON	ML2	M-011	Begin Assembly of Cathode Strip Chambers at FNAL	173 days	Oct 31 '99	Jul 14 '00
MUON	ML2	M-012	Pre-Production ASIC's Ready	184 days	Nov 30 '99	Aug 01 '00
MUON	ML2	M-013	Begin Mass Production of Electronics Boards	80 days	Aug 31 '00	Jan 04 '01
MUON	ML2	M-014	Begin Mounting Electronics and Testing at UCLA/UF	97 days	Sep 30 '00	Feb 20 '01
MUON	ML2	M-015	Begin CSC Assembly-PNPSI, Petersburg & IHEP/Beijing	43 days	Jan 31 '01	Mar 31 '01
MUON	ML2	M-016	50% of the Chambers Installed	0 days	Jul 31 '03	Jul 31 '03
MUON	ML2	M-017	All Large Chambers Assembled and Tested	0 days	Oct 31 '03	Oct 31 '03
MUON	ML2	M-018	All Chambers Installed	0 days	Mar 31 '04	Mar 31 '04
			HCAL System (WBS 1.2)	**0 days**	**NA**	**Oct 02 '98**
HCAL	ML2	HB-058	HB: PP1 Absorber Delivered to CERN	-21 days	Oct 31 '98	Oct 02 '98
HCAL	ML2	HB-001	HB: Mechanical Engineering Design Review	-19 days	Nov 30 '98	Nov 03 '98
HCAL	ML2	HB-052	HB: PP#2 Absorber Delivered to CERN	-9 days	Apr 28 '99	Apr 15 '99
HCAL	ML2	HO-001	HO Engineering Design Review	-4 days	Jun 08 '99	Jun 02 '99
HCAL	ML2	HE-001	HE Mechanical Engineering Design Review	-78 days	Sep 30 '99	Jun 12 '99
HCAL	ML2	HF-005	HF Engineering Design Review Complete	99 days	Oct 31 '00	Mar 31 '01
HCAL	ML2	HB-010	HB-1 Absorber Delivered to CERN	0 days	Nov 30 '00	Nov 30 '00
HCAL	ML2	HF-028	HF: Define Fiber Diameter	0 days	Jan 31 '01	Jan 31 '01
HCAL	ML2	HB-038	Complete Front-end Electronics Production	337 days	Jun 30 '01	Oct 31 '02
HCAL	ML2	HB-014	HB+1 Absorber Delivered to CERN	0 days	Dec 31 '01	Dec 31 '01
HCAL	ML2	HO-003	HO Optics Installation on YB Completed	0 days	Jun 30 '03	Jun 30 '03
HCAL	ML2	HB-021	HB: End Installation in Solenoid in UX5	75 days	Dec 01 '03	Mar 31 '04
HCAL	ML2	HO-007	HO End Installation and Tests in UX5	0 days	Apr 30 '05	Apr 30 '05
			Trides System (WBS 1.3)	**0 days**	**NA**	**Nov 03 '98**
TRIG	ML2	D-801	Complete Initial Muon, Calorimeter, & Global Trigger Desig	-19 days	Nov 30 '98	Nov 03 '98
DAQ	ML2	D-805	Readout Unit Prototype 2 (Design of)	0 days	May 19 '99	May 19 '99
DAQ	ML2	D-806	Event Builder Prototype 1 Complete	-19 days	May 31 '99	May 04 '99
TRIG	ML2	D-802	Complete Phase 1 Prototype Design	-20 days	Nov 30 '99	Nov 02 '99
DAQ	ML2	D-807	Readout Unit Prototype 2 Complete	-20 days	Nov 30 '99	Nov 02 '99
DAQ	ML2	D-808	Filter Unit Prototype 1 Complete	-20 days	Nov 30 '99	Nov 02 '99
DAQ	ML2	D-809	Vertical DAQ Clean Prototype Complete	-20 days	Nov 30 '99	Nov 02 '99
DAQ	ML2	D-810	High Level Trigger Prototype 1 Complete	-20 days	Nov 30 '99	Nov 02 '99
DAQ	ML2	D-811	Full DAQ Prototype Tests Complete	44 days	May 01 '00	Jun 30 '00
DAQ	ML2	D-813	Technologies Choice Preparation: scal 1 IN DAQ	21 days	Nov 01 '00	Nov 30 '00
			ECAL system (WBS 1.4)	**0 days**	**NA**	**Jun 01 '98**
ECAL	ML2	E-801	Choice of Avalanche Photodiodes	-21 days	Jun 30 '98	Jun 01 '98
ECAL	ML2	E-804	500 Electronics Channels Test	580 days	Dec 31 '99	Dec 31 '01
ECAL	ML2	E-806	Module 0 (400 channels) Prototype Complete	332 days	Dec 31 '99	Apr 30 '01
ECAL	ML2	E-808	Supermodule 1 Completed	435 days	Jun 30 '00	Mar 31 '02
ECAL	ML2	E-811	Supermodule 1 Calibration and Testing Complete	140 days	Aug 31 '01	Mar 31 '02
ECAL	ML2	E-813	Half-Barrel (18 Supermodules) Calibrated	0 days	Sep 30 '02	Sep 30 '02
ECAL	ML2	E-817	Full-Barrel (36 Supermodules) Completed	0 days	Jun 30 '04	Jun 30 '04
			FPIX System (WBS 1.5)	**0 days**	**NA**	**Dec 01 '98**
FPIX	ML2	T-812	Define construction milestones up to 2005	581 days	Jul 01 '98	Jun 30 '01
FPIX	ML2	T-801	Final Full Size Sensor - Submission	0 days	Jan 31 '01	Jan 31 '01
FPIX	ML2	T-802	Final Full Size Readout Chip - Submission	0 days	Feb 20 '01	Feb 20 '01



8.3 U.S. LHC Accelerator Construction Project Milestones

Table 8.3 Level 2 U.S. LHC Accelerator Baseline Milestones through FY2001

WBS Identifiers	Milestone Description	Baseline Date	Forecast(F) or Actual(A)
Int Region	Begin 1st inner triplet quadrupole model magnet	1 Jul 97	1 Jul 97 (A)
Int Region	Complete inner triplet quadrupole model magnet program phase 1	1 Dec 99	28 Sep 99 (A)
Int Region	Complete inner triplet quadrupole model magnet program phase 2	1 Mar 00	17 Mar 00 (A)
Int Region	Place purchase order for HTS power leads	1 Feb 00	**30 Aug 00 (A)**
Int Region	Begin absorber fabrication	1 Nov 00	**30 Oct 00 (F)**
Int Region	Complete inner triplet quadrupole prototype magnet program	1 Oct 01	1 Oct 01 (F)
Int Region	Begin interaction region beam separation dipole production assembly	**1 Oct 00**	**25 Jul 00 (A)**
Int Region	Begin inner triplet feedbox fabrication	1 Mar 01	1 Mar 01 (F)
RF Region	Begin assembly of 1st dipole model magnet	1 Sep 99	10 Jun 99 (A)
RF Region	Complete dipole model magnet program	1 Aug 00	**8 Nov 00 (F)**
RF Region	Begin RF region beam separation dipole production assembly	**1 Jan 02**	8 Oct 01 (F)
SC Cable	All cable production support equipment delivered to CERN	1 Sep 99	28 May 99 (A)
SC Cable	Complete SC testing facility upgrades	1 Jun 99	30 Sep 99 (A)



9. 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.

10. 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 to the Level 2 cost and schedule baseline.
U.S. CMS	Changes to the Level 2 cost and schedule baseline.
U.S. LHC Accelerator	Changes to the Level 2 cost and schedule baseline.

Project Manager's Quarterly Progress Report – 4th Quarter FY 2000
U.S. Large Hadron Collider Construction Project

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

U.S. CMS Construction Project

	FY 1998				FY 1999				FY 2000				
	DOE				DOE				DOE				Grand
Institution	Grant	Contract	NSF	Total	Grant	Contract	NSF	Total	Grant	Contract	NSF	Total	Total
FNAL	0	5,517	0	5,517	0	10,817	40	10,857	0	5,981	0	5,981	22,355
Fairfield	0	29	0	29	0	0	0	0	0	10	0	10	39
Maryland	90	65	0	155	0	132	131	263	0	250	0	250	668
Boston U.	0	32	0	32	31	111	0	142	0	132	0	132	306
Florida State	60	54	0	114	71	118	0	189	80	54	0	134	437
U. of Minnesota	60	95	0	155	161	452	0	613	141	202	0	343	1,111
U. of Iowa	77	62	0	139	20	5	0	25	0	453	0	453	617
U. of Rochester	127	1,159	0	1,286	262	485	0	747	441	253	0	694	2,727
Notre Dame	0	52	0	52	0	44	184	228	0	14	193	207	487
Purdue	38	135	0	173	49	166	0	215	0	175	0	175	563
U. of Miss.	46	100	0	146	68	91	0	159	69	108	0	236	541
U. of Florida	44	95	0	139	184	412	0	596	333	853	0	1,186	1,921
Ohio State U.	140	64	0	204	275	212	0	487	196	732	0	928	1,619
Carnegie Mellon	0	113	0	113	0	291	0	291	0	312	0	312	716
Rice	138	19	0	157	102	56	0	158	132	16	0	148	463
U. of Wisconsin	533	1,052	0	1,585	471	3,598	0	4,069	459	3,197	0	3,656	9,310
U.C. Davis	34	100	0	134	0	78	0	78	263	502	0	765	977
UCLA	150	87	0	237	249	173	0	422	244	391	0	635	1,294
U.C. Riverside	20	10	0	30	0	164	0	164	0	70	0	70	264
John Hopkins	0	29	0	29	0	0	70	70	0	0	40	40	139
Northwestern	0	59	0	59	5	26	0	31	0	114	0	114	204
Rutgers	0	13	0	13	0	0	34	34	0	2	140	142	189
Princeton	0	256	0	256	0	626	0	626	0	667	0	667	1,549
Caltech	0	148	0	148	0	458	0	458	0	367	0	367	973
U.C. San Diego	11	0	0	11	11	90	24	125	36	0	0	36	172
Northeastern	0	0	0	0	0	0	3,370	3,370	0	0	1,741	1,741	5,111
U. Ill.-Chicago	0	0	0	0	0	0	124	124	0	0	309	309	433
U. of Nebraska	0	0	0	0	0	0	24	24	0	0	2	2	26
MIT	0	37	0	37	15	67	0	82	0	78	0	78	197
Iowa State	0	0	0	0	0	0	19	19	0	356	0	356	375
Subtotal	1,568	9,382	0	10,950	1,974	18,672	4,020	24,666	2,394	15,289	2,425	20,167	55,783
Reserve	0	0	0	0	0	3,401	1,524	4,925	0	0	0	0	0
Total	1,568	9,382	0	10,950	1,974	22,073	5,544	29,591	2,394	15,289	2,425	20,167	55,783

U.S. ATLAS Construction Project

	FY 1998				FY 1999				FY 2000				
	DOE				DOE				DOE				Grand
Institution	Grant	Contract	NSF	Total	Grant	Contract	NSF	Total	Grant	Contract	NSF	Total	Total
ANL	0	1,098	0	1,098	0	967	0	967	0	922	0	922	2,987
BNL	0	3,903	0	3,903	0	2,581	0	2,581	0	6,429	0	6,429	12,913
LBNL	0	633	0	633	0	715	0	715	0	420	0	420	1,768
SUNY/Albany	20	0	0	20	48	0	0	48	50	0	0	50	118
U. of Arizona	320	100	0	420	634	0	0	634	557	0	0	557	1,611
Boston U.	224	0	0	224	298	0	0	298	287	0	0	287	809
Brandeis U.	265	45	0	310	0	0	593	593	0	0	478	478	1,381
U.C.Irvine	193	0	0	193	0	0	93	93	0	0	0	0	286
U.C. SantaCruz	404	0	0	404	63	0	0	63	0	0	568	568	1,035
U. of Chicago	0	54	0	54	0	0	1,069	1,069	0	0	264	264	1,387
Duke U.	190	0	0	190	601	0	0	601	417	0	0	417	1,208
Hampton U.	0	0	0	0	0	0	538	538	0	0	293	293	831
Harvard	234	0	0	234	0	0	654	654	0	0	390	390	1,278
U. of Illinois	50	159	0	209	347	0	0	347	294	0	0	294	850
Indiana U.	190	0	0	190	765	0	0	765	460	0	0	460	1,415
MIT	50	0	0	50	105	0	0	105	177	0	0	177	332
Michigan State	0	35	0	35	0	0	178	178	0	0	293	293	506
Nevis/Columbia	0	675	0	675	0	0	2,680	2,680	0	0	1,422	1,422	4,777
U. of New Mex.	20	0	0	20	30	0	0	30	24	0	0	24	74
Northern Illinois	0	0	0	0	0	0	0	0	0	0	0	0	0
Ohio State U.	0	0	0	0	100	0	0	100	45	0	0	45	145
U. of Michigan	62	254	0	316	716	0	0	716	518	0	0	518	1,550
U. of Oklahoma	30	0	0	30	0	0	41	41	0	0	51	51	122
U. of Penn.	250	0	0	250	300	0	0	300	265	0	0	265	815
U. of Pittsburg	110	0	0	110	0	0	150	150	0	0	210	210	470
U. of Rochester	0	0	0	0	0	0	3,587	3,587	0	0	1,664	1,664	5,251
U.T. Arlington	50	82	0	132	0	0	474	474	0	0	230	230	836
S. Methodist	40	0	0	40	124	0	0	124	30	0	0	30	194
SUNY/Stony B.	27	0	0	27	0	0	1,045	1,045	0	0	1,037	1,037	2,109
Tufts University	50	0	0	50	20	0	0	20	20	0	0	20	90
U. Washington	0	0	0	0	0	0	240	240	0	0	318	318	558
U. of Wisconsin	230	0	0	230	429	0	0	429	665	0	0	665	1,324
Subtotal	3,009	7,038	0	10,047	4,580	4,263	11,342	20,185	3,809	7,771	7,218	18,798	49,030
Reserve	0	3	0	3	157	0	5,289	5,446	327	1,936	1,795	4,058	4,058
									0	2,602	2,928	5,530	
Total	3,009	7,041	0	10,050	4,737	4,263	16,631	25,631	4,136	12,309	11,941	28,386	53,088