

Project Manager's Quarterly Progress Report – 4th Quarter FY 2002

U.S. Large Hadron Collider Construction Project

1. PROJECT IDENTIFIERS

Reporting Period: Through **September 30 2002**
Program Sponsors: DOE High Energy Physics Division/NSF Physics Division
DOE/NSF Program Manager: Aesook Byon-Wagner, (301) 903-5475, aesook.byon@science.doe.gov
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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 Construction 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://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/>

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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. ATLAS	Quarterly Status Meeting	October 1, 2002
U.S. CMS	Quarterly Status Meeting	October 1, 2002
U.S. LHC Accelerator	Quarterly Status Meeting	October 2, 2002
U.S. CMS & ATLAS Detectors	DOE/NSF Review	December 12-13, 2002
U.S. LHC Accelerator Project	DOE Review	February 11-12, 2003
U.S. LHC Program/Project	Joint Oversight Group Meeting	February 24, 2003

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	73%	71%	98%
U.S. CMS	79%	71%	90%
U.S. LHC Accelerator	84%	79%	95%

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	139,962	23,788	99,171	40,791	58%
US CMS	167,250	145,791	21,289	104,071	41,720	51%
US Accelerator	110,000	105,687	4,313	83,895	21,792	20%

Table 3.3, Cost & Schedule Performance (in thousands of dollars) Indices

	Cumulative Costs to Date					Costs at Completion		
	Budgeted Cost		Actual Cost	Variance		Budgeted	Revised Estimate	Variance
	Work Scheduled	Work Performed		Schedule	Cost			
U.S. ATLAS	101,684	99,171	93,820	-2,513	5,351	163,750	163,750	0
U.S. CMS	115,947	104,071	95,096	-11,876	8,975	167,250	167,250	0
U.S. LHC Accelerator	88,506	83,895	84,655	-4,611	-7,60	110,000	110,000	0
CERN Invoices	36,009	36,009	36,009	0	0	90,000	90,000	0
U.S. LHC Total	342,146	323,146	309,580	-19,000	14,379	531,000	531,000	0

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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. The cumulative Cost Performance Index (CPI) for the total U.S. LHC Construction Project (U.S. ATLAS, U.S. CMS, and U.S. LHC Accelerator) is 1.05, which is slightly favorable. Each project maintains an adequate level of contingency. The current Estimate At Completion for the U.S. LHC Accelerator project indicates that contingency is marginal and needs to be monitored closely.

The U.S. LHC Accelerator project office continues to aggressively manage remaining contingency and work with all 3 Laboratories to identify potential risks and strategies for mitigation. Four baseline change requests were approved this quarter, including one addressing additional engineering for the cryo-genic feedbox fabrication. The fabrication cost will be updated after placing the fabrication contract with the cryogenic system integrator. U.S. CMS contingency, at ~50% of remaining costs, is considered sufficient to bring the present scope in successfully. Recent contingency usage has been primarily to maintain schedule and address production costs. Future contingency use is also possible for additional electromagnetic calorimeter chip (FPPA) submissions to address design issues on this critical path item. U.S. ATLAS contingency is presently over 50% of remaining costs, and considered sufficient to bring the present scope in successfully. The U.S. ATLAS project continues to carefully manage contingency. Last quarter, a risk assessment and bottoms-up contingency analysis was completed below level 3, confirming realistic contingency estimates.

Schedule – Schedule performance is measured by milestone completion and by earned value. The total U.S. LHC Construction Project schedule overall is slightly behind plans with a cumulative Schedule Performance Index (SPI) of 0.94, indicating no major slippages in schedule. The total U.S. LHC Construction Project is seventy-three percent complete based on earned value. A CERN schedule delay of one year has been announced, calling for first beams in April '07. A period of beam commissioning will be followed by start of the LHC Physics Program in the latter half of '07. U.S. LHC Accelerator Project milestones for deliverables have been updated and approved to reflect the previous CERN LHC installation schedule. The updates define adequate float between expected U.S. delivery dates (based on the U.S. production schedules) and CERN installation requirements. A delay in the LHC machine schedule is not expected to have adverse impact on the U.S. LHC Accelerator Construction Project schedule.

It is clear that the completion of a small percentage (~3%) of the U.S. ATLAS and U.S. CMS Construction Project scope or "deliverables" will be delayed beyond September '05 (JOG Project Completion milestone). This scope is intimately tied to the CERN LHC start-up schedule, and concerns final detector installation and high technology commodity procurement items. To address this, the U.S. LHC Project Office is working with the appropriate laboratory project offices and the DOE Program to finalize a Baseline Change Proposal for review by a DOE ESAAB equivalent and ultimate approval by the DOE Director of the Office of Science.

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Technical - Good technical progress continues across the project, and 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 expect to provide additional items to CERN, within the approved funding, should cost performance be favorable. Important milestones continue to be met. The first two U.S. production LHC quadrupoles have been assembled with a CERN-provided correction element into the first complete Q2 magnet cryo-assembly. Fabrication of U.S. ATLAS silicon strip pixel support structures is proceeding well. U.S. CMS Cathode Strip Chamber production is ~70% complete, near cost and schedule. Additional technical Project highlights are given in the report.

ISSUES

LHC Cost & Schedule-In September '02, CERN management released an Action Plan to address the recommendations of the External Review Committee concerning cost awareness, control and reporting; managerial structure; human resources policy; contract management, independent audits, annual reviews and other areas. CERN management will prepare a proposal for revising the 1996 LHC financial framework for December '02, including LHC Project cost-to-completion, resources for non-LHC programs, and a new long-term financial framework and Organization staffing plan. An updated Medium-Term plan (2004-2007), base upon these decisions, will be prepared and presented in June 2003. In December '02, the results of the newly implemented Annual LHC Cost and Schedule Review (scheduled for October '02) will also be presented, including recommendations on contingency usage. This review is modeled on DOE Office of Science project reviews.

ATLAS and CMS Resources- The collaborations are actively searching for further savings and new collaborators to cover funding shortfalls identified for detector construction completion (resulting from cost overruns, improved cost estimates, exchange rate problems, earlier civil construction delays, and some funding agencies not meeting commitments). It appears that ~80% of the CMS shortfall and ~70% of the ATLAS shortfall can be covered, including U.S. contributions within the funding cap, necessitating further savings and staging plans. The U.S. position that no additional construction funds are foreseen given the funding cap established in the International Agreement, has been clearly communicated to the CERN Directorate. On-going negotiations with other funding agencies continue to be positive, but some of these are yet to be finalized. The collaborations continue to consider staging trigger and data acquisition components as well as a variety of system-specific items, compatible with the initial planned lower luminosity LHC machine. The validity of detector construction MoU's has been extended to December '07 (from December '05), to accommodate the current CERN LHC and detector completion schedules.

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5. NARRATIVE SUMMARY

5.1 U.S. ATLAS CONSTRUCTION PROJECT

ATLAS International.- The July 2002 Large Hadron Collider Committee (LHCC) Comprehensive Review of ATLAS concluded that it is realistic to expect an initial working detector for first LHC operation and the physics run in 2007, and that the ATLAS plan to cover costs to complete is reasonable. The LHCC observed that many subsystems have little schedule contingency, and this will continue to be monitored. Much progress was noted in construction, as well as in the integration of services, status of important contracts, and installation of a site management team at Point 1. Project highlights follow:

- First ATLAS Installation Review took place in September, looking at installation schedules, required resources and potential risks; supported conclusion that detector can be ready by '07.
- Production of the 8 Barrel Toroid coils is progressing well in industry; coil casings, windings, super-insulation, vacuum vessels, cold mass supports and other parts are being delivered to CERN, where integration is performed.
- 1st wheel assembly of the Electromagnetic Barrel Calorimeter is complete; this is an important milestone and a collaboration of Annecy, Saclay, CERN, Orsay, Paris, Milano and BNL.
- A successful, combined test-beam run of Pixel-Tile Calorimeter-Muon Chamber trigger and DAQ was completed, with test expectations met and invaluable experience gained.

U.S. ATLAS- As of September 30, 2002 the project is 75% complete, reflecting the most recent update of cost and schedule estimates for completing baseline scope. Excellent technical progress and satisfactory cost status continues. Minor schedule variances are being tracked.

- Silicon Strips: Pixel support structure fabrication proceeding well; sensors for pixels are in production; strip module production approval has been given, with 4 modules completed.
- Transition Radiation Tracker: Wire stringing with glass wire joints moved into full production; system testing plans now better optimize and match module completion with electronics availability.
- Liquid Argon Electromagnetic Calorimeter: Pedestals and warm cables installed on Liquid Argon Barrel Cryostat; associated electronics now ready for an engineering run; also Front End Board electronics components appear to be in good shape.
- Tile Hadron Calorimeter: 64 of 65 extended barrel modules have been fully assembled and 54 have been tested and shipped to CERN.
- Muon: 149 out of 240 Base Monitored Drift Tube chambers have been completed and 117 have been outfitted with gas systems; tube and base chamber production have been on or better than schedule at all three sites.
- Trigger/DAQ: Supervisor Region of Interest Builder Preliminary Design Review conducted.

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5.2 U.S. CMS CONSTRUCTION PROJECT-

CMS International- The October 2002 Large Hadron Collider Committee (LHCC) Comprehensive Review of CMS concluded that CMS management structure is adequate and efficient, and that the overall CMS plan to bring the detector to completion, including installation, integration and commissioning is under control. No major concerns were expressed. The LHCC considers it realistic to expect an initial working detector for first LHC operation and the physics run in 2007, and that the CMS plan to cover costs to complete is reasonable. Project highlights follow:

- First CMS Installation Review took place in September, looking at installation schedules, required resources and potential risks; supported conclusion that detector can be ready by '07.
- Solenoid magnet construction, a time-critical item, is proceeding satisfactorily.
- Tracker pixel vertex detector converging toward final design with no critical items; group ready to move from DMILL to 0.25 micron technology for pixel electronics production; front-end hybrid electronics are critical, and work on resolving technical issues is proceeding.
- Electromagnetic Calorimeter (ECAL) barrel crystal production is progressing well, with 25% of crystals expected by end of '02; endcap crystals and ECAL electronics are critical items which CMS management is addressing.
- Muon drift tube chamber production is underway, and 60 are expected to be assembled by the end of '02; resistive plate chamber production, testing, quality assurance/ quality control efforts are progressing; cathode strip chamber is making very good progress.

U.S. CMS- As of September 30, 2002, the overall U.S. CMS Project was 71% complete vs. the scheduled 79% complete. Technical progress remains excellent, and the project is on budget. There are no major schedule slippages, but delays exist in production of some subsystem electronics where testing is needed to finalize design, including electromagnetic calorimeter electronics now on the critical path. Below are a few highlights of the U.S. CMS Project:

- Endcap Muon (EMU): Cathode Strip Chamber (CSC) production at Fermilab is ~70% complete, near cost and schedule. CSC testing at the US FAST sites (UCLA and U-Florida, managed by UC-Riverside) is underway, and tested CSC's are being shipped to CERN.
- Hadron Calorimeter (HCAL): both the HB-1 and HB+1 barrels have been delivered to CERN. HB-1 has been fitted with optical megatiles and reassembled at SX-5. Fermilab is now producing production optical decoder units (ODUs) for the HCAL readout boxes; the HCAL HPD's, Hadron Forward (HF) calorimeter fiber, and HF Photo Multiplier Tube's are all beginning to be delivered to CERN. The stuffing of the HF calorimeter with optical fiber has begun.
- Silicon Tracker: Fermilab robotic silicon gantry is fully qualified for production; silicon tracker sensor modules are currently being produced for CERN test beam study. The overall

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silicon tracker schedule has been vetted, and production parts are scheduled to arrive at Fermilab's SiDet facility in January 2003.

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5.3 U.S LHC ACCELERATOR CONSTRUCTION PROJECT

LHC Accelerator- The CERN Council has accepted the External Review Committee's June '02 recommendations concerning CERN management and LHC project completion. In September '02, CERN published an Action Plan addressing the recommendations on those issues, including: focusing resources on LHC completion, implementing tools for transparency, proper monitoring and control of CERN processes, and securing program savings and adequate loans to meet cash-flow needs as large-scale industrial production commences. The LHC Project continues to make progress in many areas:

- 17 complete LHC dipole cold masses have been delivered to CERN, with 90 dipoles in process at the vendors and 44 completed cold masses expected by the end of '02; of the 17 tested 14 have been accepted, well within acceptable range for performance and field quality.
- A complete LHC cell has been tested after cool-down to 1.9 K, followed by pressure and leak checks; dipole circuits reached nominal current of 11860 amps, corresponding to 8.335 Tesla.
- The LHC Project awarded Russia's Budker Institute of Nuclear Physics for its high-quality production of 360 dipole magnets and 185 quadrupole magnets for LHC proton transfer lines.

U.S. LHC Accelerator- As of September 30, 2002, the overall project was 79% percent complete versus the scheduled plan of 84% percent complete. Overall technical progress remains good, and management is finalizing plans to move the last remaining major item, the cryogenic feedboxes, into production. Contingency will be reduced to address engineering change requests and remains a concern that is being closely monitored. The schedule of deliverables is slightly behind plans, but well in advance of CERN requirements. Project highlights are listed below:

- [Fermilab] There is good progress with inner triplet quadrupole magnet production. The first two production quadrupoles were assembled together with a CERN-provided correction coil into the first complete Q2 cryoassembly, which is being prepared for test. The third and fourth quadrupoles are complete and are being assembled into the second Q2 cold mass. The fifth is complete, and the sixth nearly so. Coil winding for the sixth is 75% complete. Four of nine Q1 and five of nine Q2 cryostat vacuum vessels have been received from the vendor.
- [BNL] All of the five D1 magnets have been tested. Eight of the nine D2 magnets have been completed. The first three D2 magnets have been cold tested. All coils for the D4 magnets and five coils for the D3 magnets have been wound. Superconducting cable testing dropped to about 40% of the planned rate this quarter, due to a reduction in the rate of delivery of samples from CERN.
- [LBNL] Assembly of the TAN and TAS beam absorbers is well along, and testing started with verification of the range of motion of the TAN support jacks. The only remaining major subassembly to be made is the electron beam welding of the beam tubes. There is an intensive effort on producing, checking and approving drawing packages for the eight

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cryogenic feedboxes. A final review of the Request for Proposals for feedbox fabrication is planned for October, prior to its release in November.

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Left- Hampton University Clean Room operation is in full production for the U.S. ATLAS Transition Radiation Tracker.



Above- Fermilab U.S. LHC Magnet test stand. The first Q2 quadrupole has been completed and placed on the test stand. The outer vacuum vessel is painted orange. The silver extensions are a return can (right) and feedcan (left).



Left- Several of the first twenty complete U.S. CMS Cathode Strip Chambers successfully sent to CERN by University of Florida and University of California, Los Angeles. Chambers are shown still in shipping crates, designed to house chambers with gas connected during testing and storage in the former ISR tunnel at CERN.

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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	27,351	38,667	48,431
Niobium Sheets	Wah Chang	3,894	5,633	6,951
Polyamide Insulation Film	Kaneka High Tech Materials	1719	5,425	6,510
Superconducting Cable	Outokumpu-Advanced Superconductor	2,461	16,447	20,985
LHC BPMS Button Feedthroughs	Ceramaseal	109	898	1,003
Cryogenic Temperature Sensor	Lakeshore	475		
Cryogenic He Mass Flowmeters	(tbd-contract in process)	0	1,200	1,200
(tbd-contract in process)	(tbd-contract in process)	0	(tbd)	3,134
Totals		36,009	68,270	88,214

6. FINANCIAL/COST STATUS AND PLANS (as of September 30,2002)

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	24.92	19.16	10.10	8.70	6.13	2.92	110
CERN Direct	0.00	0.00	0.00	8.09	8.29	8.08	11.20	13.40	23.20	17.74	90
Machine Total	2.00	6.67	14.00	23.49	33.21	27.24	21.30	22.10	29.33	20.66	200
Detector Funding Profiles (DOE and NSF)											
US ATLAS	1.70	3.71	10.05	25.63	28.43	26.77	23.16	24.71	14.69	4.90	163.75
DOE	1.70	3.71	10.05	9.00	16.49	14.48	10.51	17.42	14.69	4.90	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	4.61	10.95	38.03	24.26	21.25	21.40	22.91	15.98	5.56	167.25
DOE	2.30	4.61	10.95	32.51	20.30	17.15	17.19	20.48	15.98	5.56	147.03
NSF	0.00	0.00	0.00	5.52	3.96	4.10	4.21	2.43	0.00	0.00	20.22
Detectors Total	4.00	8.32	21.00	63.66	52.69	48.02	44.56	47.62	30.67	10.46	331.00

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

	A = Funds Allocated	B = Estimate Actual	C = Open	D= B+C	A-D = Funds
	Allocated	Costs	Comittments	Total	Available
U.S. LHC Construction					
U.S. ATLAS	119,448	93,820	2,569	96,389	23,059
U.S. CMS	122,792	95,096	15,300	110,396	12,396
U.S. LHC Accelerator	92,250	84,655	0	84,655	7,595
CERN Direct Purchases	35,660	36,009	0	36,009	-349‡
Total	370,150	309,580	17,869	327,449	42,701

* 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.

‡ CERN requests for payments have saturated available funding in FY02. Balance will be carried over into FY03.

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

U.S. ATLAS Cost Baseline

<u>WBS</u>	<u>Description</u>	<u>Previous</u>	<u>Change</u>	<u>Current</u>
1.1	Silicon System	18,993	0	18,993
1.2	Transition Radiation Tracker	9,935	0	9,935
1.3	Liquid Argon Calorimeter	44,348	0	44,348
1.4	Tile Calorimeter	9,933	350	10,283
1.5	Muon Spectrometer	26,386	0	26,386
1.6	Trigger/Data Acquisition System	10,973	0	10,973
1.7	Common Projects	9,179	0	9,179
1.8	Education	286	0	286
1.9	Project Management	8,279	0	8,279
1.10	Technical Coordination	1,300	0	1,300
	Contingency	24,138	- 350	23,788
	U.S. ATLAS Total Project Cost Baseline	163,750	0	163,750

U.S. CMS Cost Baseline

<u>WBS</u>	<u>Description</u>	<u>Previous</u>	<u>Change</u>	<u>Current</u>
1.1	Endcap Muon	39,147	112	39,259
1.2	Hadron Calorimeter	40,987	90	41,077
1.3	Trigger and Data Acquisition	12,396	12	12,408
1.4	Electromagnetic Calorimeter	12,419	244	12,663
1.5	Forward Pixels	7,253	15	7,268
1.6	Common Projects	23,000	0	23,000
1.7	Project Office	6,667	126	6,793
1.8	Silicon	3,313	10	3,323
	Contingency	22,068	- 609	21,459
	U.S. CMS Total Project Cost Baseline	167,250	0	167,251

U.S. LHC Accelerator Cost Baseline

<u>WBS</u>	<u>Description</u>	<u>Previous</u>	<u>Change</u>	<u>Current</u>
1.1	Interaction Region Components	56,288	3,562	59,850
1.2	Radio Frequency Straight Section	15,983	0	15,983
1.3	Superconducting Wire and Cable	13,225	0	13,225
1.4	Accelerator Physics	3,359	0	3,359
1.5	Project Management	13,727	- 457	13,270
	Contingency	7,418	-3,105	4,313
	U.S. LHC Accelerator Total Project Cost Baseline	110,000	0	110,000

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8. SCHEDULE STATUS AND PLANS

8.1 U.S. ATLAS Construction Project Milestones

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	Subsystem	Schedule Designator	Description	Baseline Schedule	Forecast (F) / Actual (A) Date	
Silicon (1.1)	SIL L2/1	Start Full Silicon Strip Electronics Production	06-Jul-01	15-Jul-01 (A)	Tile Cal	Tile L2/1	Start Submodule Procurement	01-Sep-97	01-Sep-97 (A)	
	SIL L2/2	Start Full Strip Module Production	12-Apr-02	05-Aug-02 (A)		(1.4)	Tile L2/2	Technology Choice for F/E Electronics	15-Nov-97	15-Nov-97 (A)
	SIL L2/3	ROD Design Complete	17-Apr-02	15-Dec-02 (F)			Tile L2/3	Start Module Construction	01-May-99	20-Sep-99 (A)
	SIL L2/4	Complete Shipment of Silicon Strip Module Production	17-Oct-03	17-Oct-03 (F)			Tile L2/4	Start Production of Motherboards	01-Apr-01	30-Mar-01 (A)
	SIL L2/5	ROD Production/Testing Complete	13-Mar-03	13-Mar-03 (F)	Tile L2/5		All Electronic Components Delivered to CERN	01-Oct-02	01-Oct-02 (F)	
	SIL L2/6	Pixels 1 st IBM Prototype Submitted	26-Jul-01	12-Nov-01 (A)	Tile L2/6	Module Construction Complete	30-Sept-02	30-Oct-02 (F)		
	SIL L2/7	Pixels Start IBM Production	12-Jun-03	12-Jun-03 (F)	Tile L2/7	All Modules Delivered to CERN	02-Dec-02	31-Jan-03 (F)		
	SIL L2/8	Pixels Start IBM Outer Bare Module Prod	29-Jan-04	29-Jan-04 (F)	Muon (1.5)	Muon L2/1	Start MDT Chambers Lines 1 and 3	17-Jul-00	15-Sep-00 (A)	
SIL L2/9	Pixels Disk System at CERN	20-Jan-05	20-Jan-05 (F)	Muon L2/2		Start CSC Chamber Production	01-Sep-01	01-Oct-01 (A)		
TRT (1.2)	TRT L2/1	Final Design Complete	31-Dec-98	07-Dec-98 (A)		Muon L2/3	MDT Electronics ASD PRR	01-Apr-02	30-Aug-02 (A)	
						Muon L2/4	Global Alignment Device Final Design Complete	01-Aug-02	01-Mar-03 (F)	
Mechanical I	TRT L2/2	Module Production Complete (CUM 102)	31-Dec-03	31-Dec-03 (F)	Muon L2/5	CSC IC Production Complete	31-Oct-02	30-Apr-03 (F)		
					Muon L2/6	Kinematic Mount Design Complete	30-Jan-01	30-Jan-01 (A)		
Electrical	TRT L2/3	Barrel Construction Complete	10-Mar-04	10-Mar-04 (F)	Muon L2/7	MDT Chambers (U.S.) Production Complete	14-Sep-04	14-Sep-04 (F)		
	TRT L2/4	Select Final Elec Design	15-Jun-01	30-Aug-00 (A)	Muon L2/8	Kinematic Mount Production Complete	22-Sep-03	22-Sep-03 (F)		
	TRT L2/5	Start Production of ASICS	09-Jul-02	15-Nov-02 (F)	Muon L2/9	CSC ROD Production Complete	05-Nov-03	05-Nov-03 (F)		
LAr Cal (1.3)	TRT L2/6	Installation Complete	04-Jan-05	04-Jan-05 (F)	Muon L2/10	MDT Elec. 's Mezzanine Production Complete	26-Sep-03	26-Sep-03 (F)		
	LAr L2/1	Cryostat Contract Award	24-Jul-98	05-Aug-98 (A)	Muon L2/12	Global Alignment System Final Delivery	30-Sep-04	30-Sep-04 (F)		
	LAr L2/2	Barrel Feedthroughs Final Design Review	30-Sep-98	02-Oct-98 (A)	Trigger/DAQ	TDAQ L2/1	Select Final LVL2 Architecture	31-Dec-99	31-Mar-00 (A)	
	LAr L2/3	Start Electronics Production (Preamps)	30-Jun-00	30-Jun-00 (A)		TDAQ L2/2	LVL2 Trigger Design Complete	31-Dec-02	31-Dec-02 (F)	
	LAr L2/4	FCAL Mechanical Design Complete	14-Dec-98	15-Dec-99 (A)		TDAQ L2/3	LVL2 Trigger Prototype Complete	30-Sep-02	30-Mar-03 (F)	
	LAr L2/6	Level 1 Trigger Final Design Complete	30-Mar-02	30-May-02 (A)		TDAQ L2/4	Start Production	08-Jan-03	08-Jan-03 (F)	
	LAr L2/7	ROD Final Design Complete	12-Dec-02	12-Dec-02 (F)		TDAQ L2/5	Start Installation & Commissioning	05-Mar-03	05-Mar-03 (F)	
	LAr L2/8	Motherboard System Production Complete	30-Sep-02	30-Sep-02 (A)		TDAQ L2/6	Production Complete	30-Jul-05	30-Jul-05 (F)	
	LAr L2/9	Cryostat Arrives at CERN	15-May-01	02-Jul-01 (A)		TDAQ L2/7	LVL2 Installation & Commissioning Complete	30-Sep-05	30-Sep-05 (F)	
	LAr L2/10	Barrel Feedthroughs Production Complete	01-Jun-02	25-Mar-02 (A)						
LAr L2/11	FCAL-C Delivered to EC	15-Jan-03	15-Jan-03 (F)							

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Subsystem	Schedule Designator	Description	Baseline Schedule	Forecast (F) / Actual (A) Date	Subsystem	Schedule Designator	Description	Baseline Schedule	Forecast (F) / Actual (A) Date
	LAr L2/12	FCAL-A Delivered to EC	04-Nov-03	04-Nov-03 (F)					

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8.2 U.S. CMS Construction Project Milestones

DOE/NSF Project Manager and U.S. CMS Project Management Group (PMG) Chair milestones (below) are under Change Control as described in the US CMS Project Management Plan. Any 3 month change from the previously approved date in these milestone requires the approval of the DOE/NSF Project Manager and PMG Chair.

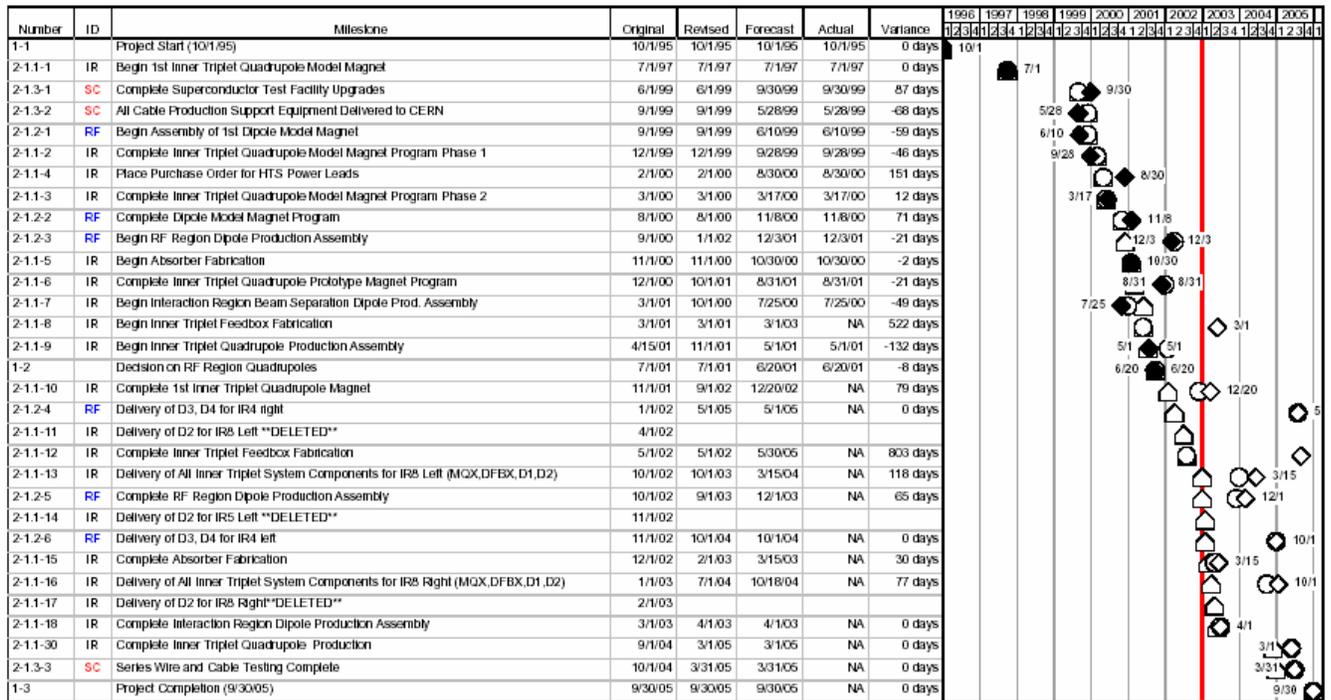
	System	Level?	CMS ID	Milestone	v33	Start	Variance	'99	'00	'01	'02	'03	'04	'05	'06	'07
1				☐ US CMS Agency PM / FNAL Dep Dir (APM/DD) Milestones	NA	Jan 31 '99	0 days									
2	HCAL	ML3*	HB-024	HB: Start Optics Production	Jan 31 '99	Jan 31 '99	0 days	●								
3	MUON	ML2*	ME-011	Begin Assembly of Cathode Strip Chambers at FNAL	Jul 14 '00	Jul 14 '00	0 days		●							
4	HCAL	ML3*	HB-026	HB-1 Optical Assemblies 100% Complete	Sep 15 '00	Sep 15 '00	0 days		●							
5	HCAL	ML2*	HB-010	HB-1 Absorber Delivered to CERN	Nov 30 '00	Nov 30 '00	0 days		●							
6	MUON	ML2*	ME-013	Begin Mass Production of Electronics Boards	Mar 31 '01	Mar 31 '01	0 days		●							
7	HCAL	ML2*	HB-014	HB+1 Absorber Delivered to CERN	Sep 30 '01	Sep 30 '01	0 days		●							
8	HCAL	ML1*	HB-016	HB-1 End Module Assembly in SX5	Oct 30 '01	Oct 30 '01	0 days		●							
9	SiTTrkr	ML2*	TS-027	Begin Sensor Module Construction (for M200)	Oct 31 '01	Oct 31 '01	0 days		●							
10	HCAL	ML3*	HG-039	HF: Start PMT Procurement	Nov 30 '01	Nov 30 '01	0 days		●							
11	HCAL	ML3*	HG-1004	Start HPD Procurement	Nov 30 '01	Nov 30 '01	0 days		●							
12	MUON	ML2*	ME-014	Begin Mounting Electronics and Testing at UCLA/UF	Dec 6 '01	Dec 6 '01	0 days		●							
13	CP	ML3*	SY-039	End Assembly of YE+3	Dec 10 '01	Dec 10 '01	0 days		●							
14	HCAL	ML3*	HB-029	HB+1 Optical Assemblies 100% Complete	Dec 31 '01	Dec 31 '01	0 days		●							
15	HCAL	ML2*	HG-1009	HF: PMT Tests 100% Complete	Oct 1 '02	Apr 30 '03	140 days				●					
16	HCAL	ML3*	HG-1012	QIE ASIC Production Run Complete	Dec 31 '02	Dec 31 '02	0 days				●					
17	HCAL	ML1*	HB-017	End Assembly of HB+ (Barrel) in SX5	Jan 15 '03	Jan 15 '03	0 days				●					
18	MUON	ML3*	ME-061	70 ME23/2 CSC's Delivered from UC/UF to CERN	Mar 31 '03	Mar 31 '03	0 days				●					
19	HCAL	ML2*	HG-002	HCAL Front-End Electronics Production Complete	Mar 31 '03	Mar 31 '03	0 days				●					
20	ECAL	ML-US*	4.3.8.11m	All Lasers (3) Delivered & Installed at CERN	Jun 30 '03	Jun 30 '03	0 days				●					
21	HCAL	ML2*	HG-1016	HCAL HPD Tests 100% Complete	Aug 29 '03	Aug 29 '03	0 days				●					
22	ECAL	ML3*	EB-027	EB Front-End Electronics Production Launched	Oct 15 '03	Oct 15 '03	0 days				●					
23	SiTTrkr	ML2*	TS-1070	25% of Rods Complete	Nov 30 '03	Nov 30 '03	0 days				●					
24	MUON	ML2*	ME-017	All 148 ME23/2 CSC's Delivered from UC/UF to CERN	Jan 31 '04	Jan 31 '04	0 days				●					
25	SiTTrkr	ML3*	TS-1073	50% of Rods Completed	Mar 31 '04	Mar 31 '04	0 days				●					
26	ECAL	ML3*	EB-045	All APDs Delivered	May 14 '04	May 14 '04	0 days				●					
27	FPIX	ML2*	TP-1002	Final Full Size ROC Submission (0.25micron)	May 31 '04	May 31 '04	0 days				●					
28	DAQ	ML2*	QR-1014	Start of Readout and EVB Commissioning	Jul 31 '04	Jul 31 '04	0 days				●					
29	CP	US*	US-CP.01	US CMS Common Project Commitment Complete	Sep 30 '04	Sep 30 '04	0 days				●					
30	ECAL	ML-US*	4.6.1.8m	FPPA Delivery Complete	Oct 1 '04	Oct 1 '04	0 days				●					
31	ECAL	ML-US*	4.6.3.9m	Optical Link Delivery Complete	Oct 1 '04	Oct 1 '04	0 days				●					
32	HCAL	ML3*	HG-1018	HCAL "Slice" Test II in SX5 Complete	Nov 30 '04	Nov 30 '04	0 days				●					
33	TRIG	ML3*	QT-1350	CSC: Muon Port Card Production Test Complete	Nov 30 '04	Nov 30 '04	0 days				●					
34	ECAL	ML3*	EB-046	ECAL Front-End Electronics Production Complete	Dec 15 '04	Dec 15 '04	0 days				●					
35	SiTTrkr	ML2*	TS-XXXX	TOB Complete	Apr 15 '05	Apr 15 '05	0 days				●					
36	CP	ML1*	IA-1010	UX Ready (Start Lowering Magnet Parts)	Apr 30 '05	Apr 30 '05	0 days				●					
37	PQ	US*	US-PO.01	US CMS Project Office Construction Support Complete	Sep 30 '05	Sep 30 '05	0 days				●					
38	TRIG	ML2*	QT-1008	Finish Trigger Installation	Nov 30 '05	Nov 30 '05	0 days				●					
39	HCAL	ML1*	HB-023	End Cabling and Test of HB in UX5	Dec 30 '05	Dec 30 '05	0 days				●					
40	DAQ	ML2*	QR-1023	DAQ0: 25% Performance Installed	Jan 31 '06	Jan 31 '06	0 days				●					
41	FPIX	ML2*	TP-1013	First Butterfly Ready	Mar 15 '06	Mar 15 '06	0 days				●					
42	HCAL	ML1*	HE-015	End Cabling and Test of HE-1 in UX5	Jun 30 '06	Jun 30 '06	0 days				●					
43	ECAL	ML1*	EG-019	End Inst., Test, & Debug. of EB (barrel) in UX5	Jun 30 '06	Jun 30 '06	0 days				●					
44	SiTTrkr	ML1*	TG-014	End Installation and Cabling of SiTTrkr in UX5	Jun 30 '06	Jun 30 '06	0 days				●					
45	MUON	ML1*	ME-1083	End UX inst/cabling/test of CSC stations on YE-	Jul 31 '06	Jul 31 '06	0 days				●					
46	HCAL	ML1*	HF-025	HF: Installation and Testing in UX5 Complete	Nov 9 '06	Nov 9 '06	0 days				●					
47	FPIX	ML2*	TP-1004	Pixel Tracker at SX5, Ready for Installation	Mar 30 '07	Mar 30 '07	0 days				●					
48																
49		Notes		MLx * Denotes Joint CMS & Agency PM/FNAL Dep Dir M	NA	Sep 30 '05	0 days									
50				Baseline Milestone Symbol (CMS v33 Schedule)	NA	Oct 1 '00	0 days	●								
51				Projected Milestone Symbol	NA	Oct 1 '00	0 days	●								
52				Achieved Milestone Symbol	NA	Oct 1 '00	0 days	●								

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8.3 U.S. LHC Accelerator Construction Project Milestones

Table 8.3 Level 1&2 U.S. LHC Accelerator Baseline Milestones through 2002

WBS Identifiers	Milestone Description	Baseline Date	Forecast(F) or Actual(A)
Project	Decision as to whether or not the US Project includes RF region quadrupoles	1 Jul 01	20 Jun 01 (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 (A)
Int Region	Complete inner triplet quadrupole prototype program	1 Oct 01	31 Aug 01 (A)
Int Region	Begin IR beam separation dipole production assembly	1 Oct 00	25 Jul 00 (A)
Int Region	Begin inner triplet feedbox fabrication	1 Mar 01	15 Oct 02 (F)
Int Region	Begin inner triplet quadrupole production assembly	1 Nov 01	1 May 01 (A)
Int Region	Complete 1 st inner triplet quadrupole magnet	1 Sep 02	1 Oct 02 (F)
Int Region	Complete inner triplet feedbox fabrication	1 May 02	14 Feb 05(F)
Int Region	Delivery of all inner triplet system components for IR8 left (MQX, DFBX, D1, D2)	1 Oct 03	15 Mar 04 (F)
Int Region	Complete absorber fabrication	1 Feb 03	15 Jul 03 (F)
Int Region	Complete interaction region beam separation dipole production assembly	1 Apr 03	1 Apr 03 (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 (A)
RF Region	Begin RF region dipole production assembly	1 Jan 02	3 Dec 01 (A)
RF Region	Complete RF region beam separation dipole production assembly	1 Sep 03	1 Sep 03 (F)
SC Cable	All cable prod. 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)



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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 Project 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 (IA) to the Accelerator Protocol. The IA was signed by the CERN and U.S. signatories in July 1998 and revised in May 2002 to update delivery dates to match CERN schedule and address a CERN-directed change on RF region lattice design impacting U.S. work (reference the U.S. LHC Accelerator Project Management Plan, Annex II).

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

Level 1, DOE/NSF Joint Oversight Group

Level 2, DOE/NSF Project Office

U.S. ATLAS

U.S. CMS

U.S. LHC Accelerator

Baseline Changes

No Changes this quarter

Changes to the Level 2 cost, scope and schedule baseline.

Changes to the Level 2 cost, scope and schedule baseline.

Changes to the Level 2 cost, scope and schedule baseline.

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APPENDIX A - FUNDING BY INSTITUTION (in thousands of dollars), U.S. CMS

U.S. CMS Construction Project

Institution	FY 1998				FY 1999				FY 2000				FY 2001				FY 2002				Grand Total
	DOE		NSF	Total	DOE		NSF	Total	DOE		NSF	Total	DOE		NSF	Total	DOE		NSF	Total	
	Grant	Contract			Grant	Contract			Grant	Contract			Grant	Contract			Grant	Contract			
FNAL	0	5,517	0	5,517	0	10,817	40	10,857	0	5,981	0	5,981	0	6,033	0	6,033	0	6,318	14	6,332	34,720
Fairfield	0	29	0	29	0	0	0	0	0	10	0	10	0	13	0	13	0	8	0	8	60
Maryland	90	65	0	155	0	132	131	263	0	250	0	250	0	189	0	189	0	1,361	0	1,361	2,218
Boston U.	0	32	0	32	31	111	0	142	0	132	0	132	0	88	0	88	0	222	1,130	1,352	1,746
Florida State	80	54	0	114	71	118	0	189	80	54	0	134	68	43	0	111	50	16	0	66	614
U. of Minnesota	60	95	0	155	161	452	0	613	141	202	0	343	153	401	0	554	85	305	0	390	2,055
U. of Iowa	77	62	0	139	20	5	0	25	0	453	0	453	0	843	0	843	0	48	0	48	1,508
U. of Rochester	127	1,159	0	1,286	262	485	0	747	441	253	0	694	464	143	0	607	358	182	0	520	3,854
Notre Dame	0	52	0	52	0	44	184	228	0	14	193	207	0	14	112	126	0	17	209	226	839
Purdue	38	135	0	173	49	168	0	215	0	175	0	175	0	89	0	89	0	377	0	377	1,029
U. of Miss.	46	100	0	146	68	91	0	159	69	108	0	236	0	235	0	235	34	109	0	143	919
U. of Florida	44	95	0	139	184	412	0	596	332	853	0	1,185	432	293	0	725	171	310	0	481	3,126
Ohio State U.	140	64	0	204	275	212	0	487	196	732	0	928	151	700	0	851	180	918	0	1,068	3,566
Carnegie Mellon	0	113	0	113	0	291	0	291	0	312	0	312	0	258	0	258	0	301	0	301	1,275
Rice	138	19	0	157	102	58	0	158	132	16	0	148	196	36	0	232	134	61	0	195	890
U. of Wisconsin	533	1,052	0	1,585	471	3,598	0	4,069	722	2,995	0	3,717	504	4,489	0	4,993	193	1,620	63	1,878	16,240
U.C. Davis	34	100	0	134	0	78	0	78	0	502	0	502	0	63	0	63	0	200	0	200	977
UCLA	150	87	0	237	249	173	0	422	244	391	0	635	347	546	42	935	264	496	43	823	3,052
U.C. Riverside	20	10	0	30	0	164	0	164	0	70	0	70	0	72	0	72	0	74	0	74	410
John Hopkins	0	29	0	29	0	0	70	70	0	40	0	40	0	0	5	5	0	0	7	7	151
Northwestern	0	59	0	59	5	28	0	31	0	114	0	114	0	39	0	39	0	33	0	33	276
Rutgers	0	13	0	13	0	0	34	34	0	2	140	142	0	0	101	101	0	0	127	127	417
Princeton	0	256	0	256	0	626	0	626	0	667	0	667	0	133	0	133	0	11	0	11	1,083
Caltech	0	148	0	148	0	458	0	458	0	367	0	367	0	452	0	452	0	116	0	116	1,541
U.C. San Diego	11	0	0	11	11	90	24	125	36	0	0	36	0	43	0	43	0	57	0	57	272
Northeastern	0	0	0	0	0	0	3,370	3,370	0	0	1,741	1,741	0	0	1,482	1,482	0	0	3,073	3,073	9,866
U. Ill.-Chicago	0	0	0	0	0	0	124	124	0	0	309	309	0	0	262	262	0	0	172	172	867
U. of Nebraska	0	0	0	0	0	0	24	24	0	0	2	2	0	0	100	100	0	7	0	7	133
MIT	0	37	0	37	15	67	0	82	0	78	0	78	0	87	0	87	0	58	0	58	342
Iowa State	0	0	0	0	0	0	19	19	0	356	0	356	0	29	0	29	0	177	0	177	581
Kansas State														66	0	66	0	28	0	28	94
LBL														554	0	554	0	543	0	543	1,097
Texas Tech														876	0	876	0	275	0	275	1,151
UC Santa Barbara														13	0	13	0	461	0	461	474
U. of Kansas														6	0	6	0	0	210	210	216
Florida Inst. Tech.																		60	0	60	60
Subtotal	1,568	9,382	0	10,950	1,974	18,672	4,020	24,666	2,393	15,087	2,425	19,964	2,315	16,840	2,110	21,265	1,489	14,740	5,055	21,284	98,129

As of 12/3/02

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APPENDIX B - FUNDING BY INSTITUTION (in thousands of dollars), U.S. ATLAS

U.S. ATLAS Construction Project

Institution	FY 1998				FY 1999				FY 2000				FY 2001				FY 2002				Grand Total
	DOE Grant	Contract	NSF	Total	DOE Grant	Contract	NSF	Total	DOE Grant	Contract	NSF	Total	DOE Grant	Contract	NSF	Total	DOE Grant	Contract	NSF	Total	
ANL	-	1,098	-	1,098	-	967	-	967	-	922	-	922	-	572	-	572	-	771	-	771	4,330
BNL	-	3,903	-	3,903	-	2,581	-	2,581	-	6,429	-	6,429	-	7,213	-	7,213	392	5,104	-	5,495	25,621
LBNL	-	633	-	633	-	715	-	715	-	420	-	420	-	1,775	-	1,775	-	2,049	-	2,049	5,592
SUNY/Albany	20	-	-	20	48	-	-	48	50	-	-	50	-	-	-	-	-	-	-	-	118
U. of Arizona	320	100	-	420	634	-	-	634	557	-	-	557	298	153	-	451	-	378	-	378	2,440
Boston U.	224	-	-	224	298	-	-	298	287	-	-	287	155	336	-	491	-	295	277	572	1,872
Brandeis U.	265	45	-	310	-	-	593	593	-	-	478	478	-	-	731	731	-	406	-	406	2,518
U.C. Irvine	193	-	-	193	-	-	93	93	-	-	-	-	-	-	266	266	-	-	-	-	562
U.C. Santa Cruz	404	-	-	404	63	-	-	63	-	-	568	568	-	-	2,702	2,702	-	442	-	442	4,179
U. of Chicago	-	54	-	54	-	-	1,069	1,069	-	-	264	264	-	-	723	723	-	159	-	159	2,269
Duke U.	190	-	-	190	601	-	-	601	417	-	-	417	501	158	-	659	-	375	-	375	2,242
Hampton U.	-	-	-	-	-	-	538	538	-	-	293	293	-	-	590	590	-	204	-	204	1,625
Harvard	234	-	-	234	-	-	654	654	-	-	390	390	-	-	3,882	3,882	-	953	-	953	6,113
U. of Illinois	50	159	-	209	347	-	-	347	294	-	-	294	76	-	-	76	99	-	-	99	1,025
Indiana U.	190	-	-	190	765	-	-	765	460	-	-	460	-	713	-	713	-	361	-	361	2,489
MIT	50	-	-	50	105	-	-	105	334	-	-	334	190	237	-	427	389	-	-	389	1,305
Michigan State	-	35	-	35	-	-	178	178	-	-	293	293	-	-	316	316	-	-	-	-	822
Nevis/Columbia	-	675	-	675	-	-	2,680	2,680	-	-	1,422	1,422	-	-	4,483	4,483	-	3,632	-	3,632	12,791
U. of New Mex.	20	-	-	20	30	-	-	30	24	-	-	24	-	127	-	127	-	57	-	57	258
Northern Illinois	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ohio State U.	-	-	-	-	100	-	-	100	45	-	-	45	-	-	-	-	157	-	-	-	302
U. of Michigan	62	254	-	316	716	-	-	716	518	-	-	518	681	-	-	681	230	-	-	157	2,948
U. of Oklahoma	30	-	-	30	-	-	41	41	-	-	51	51	-	-	49	49	-	202	-	202	373
U. of Penn.	250	-	-	250	300	-	-	300	265	-	-	265	679	-	-	679	-	850	-	850	2,344
U. of Pittsburgh	110	-	-	110	-	-	150	150	-	-	210	210	-	50	201	251	-	630	-	630	1,351
U. of Rochester	-	-	-	-	-	-	3,587	3,587	-	-	1,664	1,664	-	-	1,477	1,477	-	-	-	-	6,728
U.T. Arlington	50	82	-	132	-	-	474	474	-	-	230	230	-	-	584	584	-	-	-	-	1,420
S. Methodist	40	-	-	40	124	-	-	124	30	-	-	30	87	184	-	271	96	-	-	88	563
SUNY/Stony B.	27	-	-	27	-	-	1,045	1,045	-	-	1,037	1,037	-	-	426	426	-	89	-	89	2,624
Tufts University	50	-	-	50	20	-	-	20	20	-	-	20	-	-	-	-	11	-	-	11	101
U. Washington	-	-	-	-	-	-	240	240	-	-	318	318	-	-	1,377	1,377	-	737	-	737	2,672
U. of Wisconsin	230	-	-	230	429	-	-	429	665	-	-	665	1,112	-	-	1,112	377	-	-	377	2,813
Subtotal	3,009	7,038	-	10,047	4,580	4,263	11,342	20,185	3,966	7,771	7,218	18,955	3,779	11,518	17,807	33,104	1,752	9,014	9,343	20,108	102,399
Reserve	-	3	-	3	157	-	5,289	5,446	327	1,936	1,795	4,058	-	300	-	-	-	118	-	118	9,625
Total	3,009	7,041	-	10,050	4,737	4,263	16,631	25,631	4,293	12,309	11,941	28,543	3,779	11,818	17,807	33,104	1,752	9,132	9,343	20,226	117,554