

Project Manager's Quarterly Progress Report – 2nd Quarter FY 2003

U.S. Large Hadron Collider Construction Project

1. PROJECT IDENTIFIERS

Reporting Period: Through March 31, 2003
Program Sponsors: DOE High Energy Physics Division/NSF Physics Division
DOE/NSF Program Manager: Moishe Pripstein, (301) 903-4115, moishe.pripstein@science.doe.gov
DOE/NSF Associate Program Manager: M. Goldberg, (703) 306-1894, mgoldber@nsf.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://wwwlhc.cern.ch/> U.S. LHC Accelerator - <http://www-td.fnal.gov/LHC/USLHC.html>
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. LHC Program/Project	Joint Oversight Group Meeting	February 24, 2003
U.S. LHC Accelerator Project	DOE Review	February 25-26, 2003
U.S. CMS Detector Project	DOE/NSF Review	May 19-21, 2003
U.S. ATLAS Detector Project	DOE/NSF Review	May 21-23, 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	71%	71%	100%
U.S. CMS	83%	76%	92%
U.S. LHC Accelerator	88%	84%	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	145,567	18,183	103,442	42,125	43%
US CMS	167,250	149,492	17,758	113,461	36,031	49%
US Accelerator	110,000	105,878	4,122	88,531	17,347	24%

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	103,818	103,442	103,131	-376	311	163,750	163,750	0
U.S. CMS	123,890	113,461	103,534	-10,429	9,927	167,250	167,250	0
U.S. LHC Accelerator	93,217	88,531	91,255	-4,686	-2,724	110,000	110,000	0
CERN Invoices	48,619	48,619	48,619	0	0	90,000	90,000	0
U.S. LHC Total	369,544	354,053	346,539	-15,491	7,514	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 1.03, which is slightly favorable. The current Estimate At Completion for the U.S. LHC Accelerator project indicates that contingency is marginal and continues to be monitored closely. A contract was awarded for production of the final Accelerator component, the cryo-genic feedboxes. Strong technical proposals were received, and the costs for feedbox fabrication was in the range expected.

U.S. CMS contingency remains at ~50% of remaining costs and is considered sufficient to bring the present scope in successfully. Given favorable financial performance, recent contingency usage has enabled adding scope in the Endcap Muon system and contributing to common CMS needs (superconducting cable for CMS magnet and EDIA for a common CMS low voltage system). As a result of very good recent performance and progress, and through close coordination with ATLAS, U.S. ATLAS has applied available contingency toward items essential for a working detector. Future contingency usage is anticipated for LAr calorimeter power supply production, installation activities, or further contributions to common ATLAS needs (e.g. technical coordination and other areas). Contingency is currently ~40% of the costs to go and should be adequate to complete the baseline scope.

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 0.95, indicating no major slippages in schedule. The total U.S. LHC Construction Project is seventy-six percent complete based on earned value. The CERN schedule calls for first beams in April 2007. A period of beam commissioning will be followed by start of the LHC Physics Program in the latter half of 2007.

U.S. LHC Accelerator Project milestones for deliverables have been updated based on current U.S. production schedules and the LHC installation schedule, with float between expected U.S. delivery dates and CERN installation requirements. U.S. CMS fully anticipates delivering its commitments to CMS on or before the relevant milestone dates in the current approved schedule for the construction and installation phases of CMS. U.S. CMS plans to begin pre-commissioning its deliverables on the surface prior to the final installation phase in the underground experimental hall. U.S. ATLAS has updated the baseline schedule and float for each subsystem to reflect ATLAS required delivery dates. Installation in the ATLAS underground cavern has started as the first elements have been installed (shielding interface between the LHC machine and ATLAS detector). The current detector schedules support an LHC pilot run in April 2007 with first physics scheduled for August 2007.

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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 LHC accelerator interaction region Q2 quadrupole assembly successfully completed testing at Fermilab and production of the second Q2 was completed. The Fermilab Muon Cathode Strip Chamber (CSC) factory completed construction of all 148 CSC's with excellent cost and schedule performance. U.S. ATLAS Transition Radiation Tracker mechanical module construction has been completed by the Indiana/Duke/Hampton University team, and delivery to CERN has begun. Additional technical Project highlights are given in the report.

ISSUES

LHC Construction Completion—The CERN Council and CERN management have actively worked to solve the LHC fiscal difficulties by revising CERN's programs, priorities and structure and seeking additional resources where possible. Internal audits, task forces, external review and expert panels have all been employed to understand in detail the costs, resources, manpower needs and technical issues involved in LHC completion. LHC Project management and tracking is tighter and more transparent, cost estimates are now considered to comprise a useful baseline, and tools such as Earned Value Management systems are also now in use to assist in identifying and managing cost and schedule variances. Technical progress on major machine components and civil construction has been good, and meeting the schedule to start commissioning in April '07 is considered possible, but challenging. CERN should know whether this schedule can be met with greater confidence by the end of 2003 and when full production rates are reached for the dipoles.

ATLAS and CMS Resources— Both collaborations have presented updated financial plans to the detector Resource Review Boards (RRBs) in April, 2003. The updated plans address funding shortfalls previously identified, and the collaborations have had some success identifying funds and actions to significantly reduce those shortfalls. Additionally, costs of sub-detectors have been updated to cover the shortfalls through reducing redundancy, using existing contingencies, or further detector staging. In cases of detector staging, acceptability of physics impact is considered for initial physics running. The funding profiles present cash flow problems in some areas, which the collaborations are working with the funding agencies and RRBs to solve or minimize. There may be potential impact on overall detector installation schedules if the cash-flow situation cannot be successfully managed. The collaborations continue the process of firming up commitments internationally from those funding agencies that can provide additional resources (U.S. LHC construction funds are capped), a process likely to continue over the final years to completion. If successful, this process could allow the collaborations to gradually improve the expected performance and capability of the initial detectors to more fully exploit physics opportunities.

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5. NARRATIVE SUMMARY

5.1 U.S. ATLAS CONSTRUCTION PROJECT

ATLAS International.- The LHC Committee (LHCC) met in March 2003 to monitor the critical ATLAS construction issues. Schedule concerns remain in some areas of the electromagnetic calorimeter, barrel toroid and inner detector subsystems and a revised schedule and milestones are under review. A follow-up to the September 2002 LHCC ATLAS Installation Review was also completed. The Technical Coordination has made good progress toward a viable installation plan, which the committee believes is sound. There are no major changes in the overall financial outlook for ATLAS, and detector planning, construction and integration continues in accordance with the completion strategy agreed to with the Resource Review Board.

- For the toroid magnet system, seven out of eight barrel coil casings and six of eight barrel cryostat vacuum vessels are delivered to CERN; fifteen of sixteen barrel conductor windings are ready and both endcap toroid vacuum vessels have been completed and vacuum tested.
- Pixel sensor production is launched and ~25% have been produced—extensive beam tests have confirmed specifications are met.
- The first detector elements (shielding interface between LHC machine and ATLAS detector) have been installed in the UX15 underground experiment cavern.

U.S. ATLAS- As of March 31, 2003 the project is 76% complete out of 76% planned, reflecting the most recent update of cost and schedule estimates (Estimate-To-Complete '03) for the remaining work to complete the baseline scope. A DOE/NSF review of the construction project was conducted on December 12, 2002 at Fermilab. There are no major technical issues- all U.S. ATLAS subsystems are now in production and detector components are being successfully delivered to CERN. Cost and Schedule performance is very good. Contingency planning, prioritization and allocation strategies are focused on ensuring that adequate contingency levels can be maintained through project completion. Below are a few highlights of the U.S. ATLAS construction project:

- Silicon: Pixel mechanics and electronics are progressing well. Disk sector tubes are now in production and all components of the global support frame have been delivered to LBNL. U.S. ATLAS has received 87% of the Silicon Strip System chips needed for the full detector.
- Transition Radiation Tracker (TRT): TRT module mechanical construction is complete; wire joint production, wire stringing and final testing at Indiana, Duke and Hampton continues..
- Liquid Argon Electromagnetic (EM) Calorimeter: Calorimeter components are rapidly collecting at CERN with much progress on the installation.
- Tile Hadron Calorimeter: At CERN, ANL engineers helped with successful pre-assembly of an Extended Barrel (EB) Tile calorimeter; U.S. has delivered 64 instrumented EB modules.
- Muon: Construction of the Monitored Drift Tube (MDT) base chambers continues on schedule. Panels and wire stringing continued for the Cathode Strip Chambers with all panels for the large chambers now complete. Effort continues on the integration of MDT chambers.

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5.2 U.S. CMS CONSTRUCTION PROJECT-

CMS International- The LHC Committee (LHCC) met in March 2003 to monitor the critical CMS construction issues. The Electromagnetic calorimeter construction schedule, and magnet coil and Silicon Tracker production are critical path concerns. Coil production delays are being successfully reduced by speeding up production, and the Tracker falls within the shadow of these reduced delays. A follow-up to the September 2002 LHCC CMS Installation Review was also completed, and the committee acknowledged CMS for providing useful and detailed responses to prior concerns. There are no major changes in the overall financial outlook for CMS, as the collaboration maintains its planning efforts to bring in a working detector on schedule with all available funds directed toward reducing the existing shortfall.

- Growth of large electromagnetic calorimeter (ECAL) lead-tungstate crystal ingots is now very successful & reproducible—18,000 out of 62,000 barrel crystals have been delivered.
- A new ECAL front-end electronics chip design was submitted in Feb. '03 as an alternative to an original design that failed specs; the new design for this critical path item shows promise as a cheaper, better performing option with a decision expected in mid-2003.
- CMS is engaging several potential new collaborators with proposals in process involving Brazil, Ireland and New Zealand.

U.S. CMS- As of March 31, 2003, the overall U.S. CMS Construction Project was 76% complete vs. the scheduled 83% complete. A DOE/NSF review of the U.S. CMS construction project was conducted at Fermilab on December 13, 2002. Technical progress is excellent, and the U.S. CMS construction project is on budget. There are no major schedule slippages, but delays exist in production of some subsystem electronics, particularly the electromagnetic calorimeter electronics, now on the critical path for all of CMS. Additional areas monitored are the HCAL readout box integration effort and the Silicon Tracker parts flow into the 'factories' at Fermilab and UC-Santa Barbara.

- Endcap Muon (EMU): Cathode Strip Chamber (CSC) panel production is complete on cost and ahead of schedule. Chamber production at Fermilab is ~99% complete, and also near cost and schedule. CSC testing at the US FAST sites (UCLA and U-Florida, managed by UC-Riverside) is well underway, with over 70 of 148 CSC's already delivered to CERN.
- Hadron Calorimeter (HCAL): both HCAL half barrels (HB-1 and HB+1) have been delivered to CERN, and have been reassembled at SX-5 and fitted with optical megatiles. 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 being delivered to CERN on a regular basis. The stuffing of the HF calorimeter with optical fiber is well advanced and the HF readout box is in the prototype phase.
- 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 silicon tracker schedule has been vetted, and production parts are scheduled to arrive at Fermilab next quarter.

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5.3 U.S LHC ACCELERATOR CONSTRUCTION PROJECT

LHC Accelerator- LHC machine construction is reported to be on schedule to deliver first beam in April 2007, though this schedule is challenging. Overall LHC cost estimates have been stable. Industrial production of superconducting dipoles is underway and ramping up. The schedule for remaining LHC civil engineering is also stable. Accelerator physicists are actively developing and reviewing strategies for commissioning first beam, achieving first collisions, and bringing the machine up to initial luminosity performance levels. Additional LHC Project highlights follow:

- Superconducting cable production is reaching the nominal rate after commissioning of a new cabling machine.
- collared coils for nearly ninety dipoles complete, with over forty dipole cold masses delivered, over thirty-five dipoles assembled and over twenty dipoles cold tested. Aside from problems with two early magnets, field quality and level of all tested magnets has been good.
- Infrastructure installation in the LHC tunnel has started and the vehicle for transporting magnets is in place underground.
- LHC accelerator production progress can be tracked on the “LHC Dashboard” at, <http://lhc-new-homepage.web.cern.ch/lhc-new-homepage/DashBoard/index.asp>

U.S. LHC Accelerator- As of March 31, 2003, the overall project was 84% percent complete versus the scheduled plan of 88% percent complete. A DOE review was conducted February 25-26, 2003 at Fermilab. Overall technical progress remains good, with the last remaining major item, the cryogenic feedboxes, now in production. Contingency continues to 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] Inner triplet quadrupole magnet production is progressing well. The first Q2 quadrupole completed cold testing. Both magnets comprising the Q2 exceeded operating field without quenching, reaching a field 12% above this with zero and one quench respectively. The second Q2 was completed and is ready to be tested. Cold masses 5-8 are also complete and are ready for assembly into the third and fourth Q2 magnets; however, late delivery of correction coils from CERN has delayed the start of assembly.
- [BNL] The first and second D1 dipole magnets arrived at CERN. All nine D2 magnets have been cryostatted. Testing has begun on the fifth D2 magnet. The first of three D4 cold masses is complete, and five of six D3 magnets have been collared. Superconducting cable testing reached over 75% of the planned rate this quarter, the highest of any quarter to-date, thanks to the increased delivery rate from CERN.
- [LBNL] The complete bid package for the cryogenic feedboxes was awarded on 27 March, and fabrication has begun. Assembly of the TAN and TAS beam absorbers is well along. All TAS alignment and range of motion testing is complete and bake-out has begun. The

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only remaining major subassembly, the electron beam welding of the TAN beam tubes, is under way at the vendor.

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Above- Pre-assembly of the first ATLAS Extended Barrel Tile Calorimeter at CERN, using U.S. produced calorimeter modules. ANL, Michigan State, University of Illinois Urbana-Champaign, Northern Illinois and University of Chicago work on this sub-



Above- At Fermilab, the U.S. LHC Magnet assembly bay. Two Q2 quadrupole vacuum vessels and Q2 prototype (red) are being stored on the left. Q2 magnet assemblies are in the center.



Left- A 1,000 ft² clean room at University of California Santa Barbara is fully dedicated to CMS Silicon Tracker module production. The space houses a wire-bonding machine (inset right), automated module assembly gantry, precision measuring machine and other apparatus needed to construct 30-50% of the 6,000 U.S. produced silicon modules.

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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].

Table 5.1, Status of DOE Contracts (in \$000)

Contract Item	Company (U.S. Supplier)	Contract Price	w/ options & escalation
Nb-Ti Alloy Bars; Ni Sheets	Wah Chang	44,300	55,382
Polyamide Insulation Film	Kaneka High Tech Materials	5,425	6,510
Superconducting Cable	Outokumpu-Advanced Superconductor	16,447	20,985
LHC BPMS Button Feedthroughs	Ceramaseal	898	1,003
Cryogenic Temperature Sensor	Lakeshore		
Cryogenic He Mass Flowmeters	(tbd-contract in process)	1,200	1,200
(tbd-contract in process)	(tbd-contract in process)	(tbd)	3,134
Totals		68,270	88,214

TOTAL Cumulative Payments from DOE to CERN, as of 4/17/03: \$ 48,619k

6. FINANCIAL/COST STATUS AND PLANS (as of March 31, 2003)

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

Fiscal Year	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	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	0.00	0.00	110
CERN Direct	0.00	0.00	0.00	8.09	8.29	8.08	11.20	13.40	23.20	17.74	0.00	0.00	90
Machine Total	2.00	6.67	14.00	23.49	33.21	27.24	21.30	22.10	29.33	20.66	0.00	0.00	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	8.99	5.49	3.24	1.88	163.75
DOE	1.70	3.71	10.05	9.00	16.49	14.48	10.51	17.42	8.99	5.49	3.24	1.88	102.95
NSF	0.00	0.00	0.00	16.63	11.94	12.29	12.65	7.29	0.00	0.00	0.00	0.00	60.80
US CMS	2.30	4.61	10.95	38.03	24.26	21.25	21.40	22.91	10.48	5.56	4.20	1.30	167.25
DOE	2.30	4.61	10.95	32.51	20.30	17.15	17.19	20.48	10.48	5.56	4.20	1.30	147.03
NSF	0.00	0.00	0.00	5.52	3.96	4.10	4.21	2.43	0.00	0.00	0.00	0.00	20.22
Detectors Total	4.00	8.32	21.00	63.66	52.69	48.02	44.56	47.62	19.47	11.05	7.44	3.18	

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

U.S. LHC Construction Project	A = Funds Allocated	B = Estimate Actual Costs	C = Open Comittments	D= B+C Total	A-D =Funds Available
U.S. ATLAS	144,158	103,131	3,516	106,647	37,511
U.S. CMS	145,706	103,534	20,225	123,759	21,947
U.S. LHC Accelerator	100,950	91,255	0	91,255	9,695
CERN Direct Purchases	49,060	48,619	0	48,619	441
Total	370,150	346,539	23,741	370,280	69,594

* The funding profile for the U.S. LHC Construction Project is extended through FY07, with no change in total funding, to address the impact of the CERN LHC schedule on U.S. project completion. This change was approved by the DOE Director, Office of Science through a U.S. LHC Project baseline change proposal.

† 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.

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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	2,377	21,370
1.2	Transition Radiation Tracker	9,935	1,451	11,386
1.3	Liquid Argon Calorimeter	44,348	- 179	44,169
1.4	Tile Calorimeter	10,283	480	10,763
1.5	Muon Spectrometer	26,386	626	27,012
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	850	2,150
	Contingency	23,788	-5,605	18,183
	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	39,555	231	39,786
1.2	Hadron Calorimeter	42,347	- 237	42,110
1.3	Trigger and Data Acquisition	12,440	2,189	14,629
1.4	Electromagnetic Calorimeter	12,492	-1,746	10,746
1.5	Forward Pixels	7,381	- 15	7,366
1.6	Common Projects	23,000	349	23,349
1.7	Project Office	6,800	247	7,047
1.8	Silicon	3,374	8	3,382
	Contingency	19,861	-1,026	18,835
	U.S. CMS Total Project Cost Baseline	167,250	0	167,250

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	59,893	0	59,893
1.2	Radio Frequency Straight Section	15,983	137	16,120
1.3	Superconducting Wire and Cable	13,225	10	13,235
1.4	Accelerator Physics	3,359	0	3,359
1.5	Project Management	13,271	0	13,271
	Contingency	4,269	-147	4,122
	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

ID	Subsystem ID	Milestone	ETC03 Baseline	Forecast	Actual	2001			2002			2003			2004			2005		
						1	2	3	4	1	2	3	4	1	2	3	4	1	2	3
1		Project Start (10/1/95)	Sun 10/1/95	Sun 10/1/95	Sun 10/1/95															
2	Tile L2/1	Start Submodule Procurement	Mon 9/1/97	Mon 9/1/97	Mon 9/1/97															
3	Tile L2/2	Technology Choice for F/E Electronics	Sat 11/15/97	Sat 11/15/97	Sat 11/15/97															
4	LAr L2/1	Cryostat Contract Award	Fri 7/24/98	Wed 8/5/98	Wed 8/5/98															
5	LAr L2/2	Barrel FTs Final Design Review	Wed 9/30/98	Fri 10/2/98	Fri 10/2/98															
6	TRT L2/1	Final Design Complete	Thu 12/31/98	Mon 12/7/99	Mon 12/7/99															
7	LAr L2/4	FCAL Mech Design Complete	Mon 12/14/98	Wed 12/15/99	Wed 12/15/99															
8	Tile L2/3	Start Module Construction	Sat 5/1/99	Mon 9/20/99	Mon 9/20/99															
9	TDAQ L2/1	Select Final LVL2 Architecture	Fri 12/31/99	Fri 3/31/00	Fri 3/31/00															
10	LAr L2/3	Start Elec.'s Production (Preamps)	Fri 6/30/00	Fri 6/30/00	Fri 6/30/00															
11	Muon L2/1	Start MDT Chambers Lines 1 & 3	Mon 7/17/00	Fri 9/15/00	Fri 9/15/00															
12	Muon L2/6	Kinematic Mount Design Complete	Tue 1/30/01	Tue 1/30/01	Tue 1/30/01	■														
13	Tile L2/4	Start Production of MBs	Sun 4/1/01	Fri 3/30/01	Fri 3/30/01	■														
14	LAr L2/9	Cryostat Arrives at CERN	Tue 5/15/01	Mon 7/2/01	Mon 7/2/01	■														
15	TRT L2/4	Select Final Elec Design	Fri 6/15/01	Wed 8/30/00	Wed 8/30/00	■														
16	Sil L2/1	Start Full Silicon Strip Elec Production	Fri 7/6/01	Sun 7/15/01	Sun 7/15/01	■														
17	Sil L2/6	Pixels '1st IBM Prototype Submitted'	Thu 7/26/01	Mon 11/12/01	Mon 11/12/01	■														
18	Muon L2/2	Start CSC Chamber Production	Sat 9/1/01	Mon 10/1/01	Mon 10/1/01	■														
19	LAr L2/6	Level 1 Trigger Final Design Complete	Sat 3/30/02	Thu 5/30/02	Fri 5/31/02	■														
20	Muon L2/3	MDT Electronics ASD PRR	Mon 4/1/02	Sun 9/1/02	Fri 8/30/02	■														
21	Sil L2/2	Start Full Strip Module Production	Fri 4/12/02	Mon 8/5/02	Mon 8/5/02	■														
22	LAr L2/10	Barrel FTs Production Complete	Sat 6/1/02	Mon 3/25/02	Mon 3/25/02	■														
23	LAr L2/8	MB System Production Complete	Mon 9/30/02	Mon 9/30/02	Mon 9/30/02	■														
24	Tile L2/6	Module Construction Complete	Mon 9/30/02	Wed 10/30/02	Wed 10/30/02	■														
25	Tile L2/7	All Modules Delivered to CERN	Fri 1/31/03	Fri 4/18/03	NA															
26	TRT L2/5	Start Production of ASICs	Mon 2/17/03	Tue 4/1/03	NA															
27	Tile L2/5	All Elec.'s Components Delivered to ATLAS	Sat 3/1/03	Sat 3/1/03	Sat 3/1/03															
28	TDAQ L2/2	LVL2 Trigger Design Complete	Mon 3/31/03	Mon 3/31/03	Mon 3/31/03															
29	TDAQ L2/3	LVL2 Trigger Prototype Complete	Wed 4/30/03	Wed 4/30/03	NA															
30	Sil L2/3	ROD Design Complete	Fri 5/30/03	Thu 5/15/03	NA															
31	Muon L2/5	CSC IC Production Complete	Thu 7/31/03	Thu 7/31/03	NA															
32	LAr L2/7	ROD Final Design Complete	Fri 8/15/03	Fri 8/15/03	NA															
33	Sil L2/7	Pixels 'Start IBM Production'	Thu 9/25/03	Thu 9/25/03	NA															
34	Sil L2/8	Pixels 'Start IBM Outer Bare Module Prod'	Fri 9/5/03	Fri 9/5/03	NA															
35	Muon L2/10	MDT Elec.'s Mezz Production Complete	Fri 10/31/03	Fri 10/31/03	NA															
36	LAr L2/11	FCAL-C Delivered to EC	Mon 12/1/03	Mon 12/1/03	NA															
37	Muon L2/4	Final Design of Global Align Devices	Mon 12/1/03	Mon 12/1/03	NA															
38	Sil L2/5	ROD Production/Testing Complete	Mon 3/1/04	Mon 3/1/04	NA															
39	TRT L2/2	Module Production Complete (CUM 102)	Thu 4/1/04	Thu 4/1/04	NA															
40	TDAQ L2/4	Start Production	Tue 6/1/04	Tue 6/1/04	NA															
41	Muon L2/7	MDT Chambers (U.S.) Prod Compl (Qty. 240)	Thu 7/1/04	Thu 7/1/04	NA															
42	LAr L2/12	FCAL-A Delivered to EC	Thu 7/15/04	Thu 7/15/04	NA															
43	TDAQ L2/5	Start Installation & Commissioning	Mon 9/6/04	Mon 9/6/04	NA															
44	Sil L2/4	Compl Shipment of Silicon Strip Modules Prod	Tue 9/14/04	Tue 9/14/04	NA															
45	Muon L2/8	Kinematic Mounts/Struts Production Complete	Mon 9/27/04	Mon 9/27/04	NA															
46	Muon L2/9	CSC ROD Production Complete	Thu 9/30/04	Thu 9/30/04	NA															
47	TRT L2/6	Installation Complete	Tue 1/4/05	Tue 1/4/05	NA															
48	TRT L2/3	Barrel Construction Complete	Mon 1/17/05	Mon 1/17/05	NA															
49	Sil L2/9	Pixels 'Disk System at CERN'	Fri 1/21/05	Fri 1/21/05	NA															
50	Muon L2/12	Global Align System Final Delivery	Tue 3/1/05	Tue 3/1/05	NA															
51	TDAQ L2/6	Production Complete	Mon 7/31/06	Mon 7/31/06	NA															
52	TDAQ L2/7	Installation & Commissioning Complete	Fri 9/29/06	Fri 9/29/06	NA															

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8.2 U.S. CMS Construction Project Milestones

	System	Level?	CMS ID	Milestone	v33	Start	Variance	'99	'00	'01	'02	'03	'04	'05	'06	'07
1				☐ DOE/NSF Proj. Man./FNAL Dep. Dir. 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	SiTrkr	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	DAQ	ML1*	QR-014	Submit DAQ Technical Design Report (TDR)	Nov 30 '02	Dec 15 '02	10 days									
17	HCAL	ML3*	HG-1012	QIE ASIC Production Run Complete	Dec 31 '02	Mar 21 '03	54 days									
18	HCAL	ML1*	HB-017	End Assembly of HB+ (Barrel) in SX5	Jan 15 '03	Dec 15 '02	-11 days									
19	MUON	ML3*	ME-061	70 ME23/2 CSC's Delivered from UC/UF to CERN	Mar 31 '03	Apr 23 '03	17 days									
20	HCAL	ML2*	HG-002	HCAL Front-End Electronics Production Complete	Mar 31 '03	Jun 30 '03	65 days									
21	ECAL	ML-US*	4.3.8.11m	All Lasers (3) Delivered & Installed at CERN	Jun 30 '03	Jun 30 '03	0 days									
22	HCAL	ML2*	HG-1016	HCAL HPD Tests 100% Complete	Aug 29 '03	Aug 29 '03	0 days									
23	ECAL	ML3*	EB-027	EB Front-End Electronics Production Launched	Oct 15 '03	Oct 15 '03	0 days									
24	SiTrkr	ML2*	TS-1070	25% of Rods Complete	Nov 30 '03	Nov 30 '03	0 days									
25	MUON	ML2*	ME-017	All 148 ME23/2 CSC's Delivered from UC/UF to CERN	Jan 31 '04	Jan 31 '04	0 days									
26	SiTrkr	ML3*	TS-1073	50% of Rods Completed	Mar 31 '04	Mar 31 '04	0 days									
27	ECAL	ML3*	EB-045	All APDs Delivered	May 14 '04	May 14 '04	0 days									
28	FPIX	ML2*	TP-1002	Final Full Size ROC Submission (0.25micron)	May 31 '04	May 31 '04	0 days									
29	DAQ	ML2*	QR-1014	Start of Readout and EVB Commissioning	Jul 31 '04	Jul 31 '04	0 days									
30	CP	US*	US-CP.01	US CMS Common Project Commitment Complete	NA	Sep 30 '04	0 days									
31	ECAL	ML-US*	4.6.1.8m	FPPA Delivery Complete	Oct 1 '04	Oct 1 '04	0 days									
32	ECAL	ML-US*	4.6.3.9m	Optical Link Delivery Complete	Oct 1 '04	Oct 1 '04	0 days									
33	HCAL	ML3*	HG-1018	HCAL "Slice" Test II in SX5 Complete	Nov 30 '04	Nov 30 '04	0 days									
34	TRIG	ML3*	QT-1350	CSC: Muon Port Card Production Test Complete	Nov 30 '04	Nov 30 '04	0 days									
35	ECAL	ML3*	EB-046	ECAL Front-End Electronics Production Complete	Dec 15 '04	Dec 15 '04	0 days									
36	SiTrkr	ML2*	TS-XXXX	TOB Complete	Apr 15 '05	Apr 15 '05	0 days									
37	CP	ML1*	IA-1010	UX Ready (Start Lowering Magnet Parts)	Apr 30 '05	Apr 30 '05	0 days									
38	PO	US*	US-PO.01	US CMS Project Office Construction Support Complete	NA	Sep 30 '05	0 days									
39	TRIG	ML2*	QT-1008	Finish Trigger Installation	Nov 30 '05	Nov 30 '05	0 days									
40	HCAL	ML1*	HB-023	End Cabling and Test of HB in UX5	Dec 30 '05	Dec 30 '05	0 days									
41	DAQ	ML2*	QR-1023	DAQ.0: 25% Performance Installed	Jan 31 '06	Jan 31 '06	0 days									
42	FPIX	ML2*	TP-1015	First Butterfly Ready	Mar 15 '06	Mar 15 '06	0 days									
43	HCAL	ML1*	HE-015	End Cabling and Test of HE-1 in UX5	Jun 30 '06	Jun 30 '06	0 days									
44	ECAL	ML1*	EG-019	End Inst., Test, & Debug. of EB (barrel) in UX5	Jun 30 '06	Jun 30 '06	0 days									
45	SiTrkr	ML1*	TG-014	End Installation and Cabling of SiTrkr in UX5	Jun 30 '06	Jun 30 '06	0 days									
46	MUON	ML1*	ME-1083	End UX inst/cabling/test of CSC stations on YE.	Jul 31 '06	Jul 31 '06	0 days									
47	HCAL	ML1*	HF-025	HF: Installation and Testing in UX5 Complete	Nov 9 '06	Nov 9 '06	0 days									
48	FPIX	ML2*	TP-1004	Pixel Tracker at SX5, Ready for Installation	Mar 30 '07	Mar 30 '07	0 days									
49					NA	Sep 30 '05	0 days									
50		Notes		MLx* Denotes Joint CMS & Agency PM/FNAL Dep Dir Mh	NA	Sep 30 '05	0 days									
51				Baseline Milestone Symbol (CMS v33 Schedule)	NA	Oct 1 '00	0 days									
52				Projected Milestone Symbol	NA	Oct 1 '00	0 days									
53				Achieved Milestone Symbol	NA	Oct 1 '00	0 days									

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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 originally approved by the JOG in March 1998. Deliverables are listed in an Appendix to the U.S. ATLAS Construction Project Management Plan. The JOG approved a revision to the U.S. ATLAS Construction Project Management Plan in February 2003, incorporating changes to implement a two-phased project completion matched to CERN plans.

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 originally approved by the JOG in October 1998 and is referenced in the U.S. CMS Project Management Plan. The JOG approved a revision to the U.S. CMS Construction Project Management Plan in February 2003, incorporating changes to implement a two-phased project completion matched to CERN plans.

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 is an annex to the U.S. LHC Accelerator Project Management Plan. 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.

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

<u>Baseline Control Level</u>	<u>Baseline Changes</u>
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, scope and schedule baseline.
U.S. CMS	Changes to the Level 2 cost, scope and schedule baseline.
U.S. LHC Accelerator	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	127	0	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