

# Project Manager's Quarterly Progress Report – 3<sup>rd</sup> Quarter FY 2002

## U.S. Large Hadron Collider Construction Project

### 1. PROJECT IDENTIFIERS

Reporting Period: Through **June 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  
DOE/NSF Associate Program Manager: M. Goldberg, (703) 306-1894, mgoldber@nsf.gov  
Operations Office: Chicago Operations Office/Fermi Area Office  
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 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://usecms.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. CMS & ATLAS Detectors	DOE/NSF Review	June 3-6, 2002
U.S. LHC Accelerator Project	DOE Review	June 10-11, 2002
U.S. LHC Program/Project	Joint Oversight Group Meeting	June 13, 2002
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

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	65%	65%	100%
U.S. CMS	76%	69%	91%
U.S. LHC Accelerator	85%	78%	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	139,612	24,138	90,471	49,141	49%
US CMS	167,250	145,182	22,068	100,580	44,602	49%
US Accelerator	110,000	102,582	7,418	79,716	23,710	31%

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	91,420	90,471	89,616	-949	855	163,750	163,750	0
U.S. CMS	111,067	100,580	88,613	-10,487	11,967	167,250	167,250	0
U.S. LHC Accelerator	86,807	79,716	81,477	-7,091	-1,761	110,000	110,000	0
CERN Invoices	36,009	36,009	36,009	0	0	90,000	90,000	0
U.S. LHC Total	325,303	306,776	295,715	-18,527	11,061	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 1.04, 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 and others will be submitted next quarter, including some addressing development of a new cost estimate and additional engineering for the cryo-genic feedbox fabrication. 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 possible for additional electromagnetic calorimeter chip (FPPA) submissions to address design issues on this critical path item. U.S. ATLAS contingency is presently at 48% of remaining costs, considered sufficient to bring the present scope in successfully. The U.S. ATLAS project continues to carefully manage contingency. 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 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 now 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. The U.S. LHC Project Office is working with the appropriate laboratory project offices and the DOE Program to define scope, costs and impacts, and specific options to address this.

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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. Cable and wedge production for interaction region quadrupoles is complete, and a Brookhaven D3 dipole engineering design review was completed. U.S. CMS Silicon Tracker sensor module production has begun. U.S. ATLAS electromagnetic Liquid Argon Calorimeter barrel feedthrough production has been completed ahead of schedule. Additional technical Project highlights are given in the report.

## **ISSUES**

**LHC Cost & Schedule**-In June '02, CERN Council accepted the recommendations of the External Review Committee concerning identified weaknesses in cost awareness, control and reporting, and contract management. The CERN Director committed to preparing an Action Plan to implement recommendations for September '02. 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. CERN presented a Medium Term Plan to Council, incorporating results of internal Task Forces, to provide for: shut-down of PS/SPS in '05; Accelerator Sector re-structuring from January '03; re-deployment of staff to LHC, and implementation of Earned Value management, including manpower. In addition to reallocation of 500 MCHF to LHC, Council agreed to unblock the remaining 33 MCHF of '02 funds held back pending clarification of LHC funding issues. LHC is CERN's all-out priority until it starts in '07.

**ATLAS and CMS Resources**– At the April '02 Resource Review Board (RRB) meetings, the collaborations were asked to continue 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). They were asked to reach agreement with funding agencies as to availability of additional construction funds by June '02 and to then prepare financial plans taking all available funding into account. The U.S. position that no additional construction funds are foreseen given the funding cap established in the International Agreement, was again communicated to the CERN Directorate. Preliminary indications are that ~80% of the shortfalls can be covered for each detector, including U.S. contributions within the funding cap, necessitating further savings and staging plans. The collaborations are considering staging trigger and data acquisition components as well as a variety of system-specific items, compatible with the initial planned lower luminosity LHC machine.

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**5. NARRATIVE SUMMARY**

**5.1 U.S. ATLAS CONSTRUCTION PROJECT**

**ATLAS International-** ATLAS detector construction is going well with subsystem components and modules being delivered to CERN. Pre-assembly and integration activities have started. Critical path items remain the barrel toroid, LAr barrel and second endcap, and the second Transition Radiation Tracker endcap, with recent improvements in each case. ATLAS will profit from the revised LHC machine start-up date to optimise its installation plans. Ongoing system construction schedules will not be slowed down but systems can reinstall the minimal 4 months float as contingency (except the last barrel toroid coil where the float is only 2 months). Below are additional international ATLAS highlights:

- Point 1 civil construction has progressed well, with major contracts for experimental area large infrastructure items on schedule.
- Central solenoid is the first major detector element to be tested and ready for installation; first barrel toroid cryostat vacuum vessel has arrived at CERN.
- Transition radiation tracker straw production has been completed in Russia.
- Seventy-five percent of all Tile Calorimeter barrel modules have been finished, equipped with optics and delivered to CERN; all Tile Calorimeter electronics are in procurement, and eighty percent of the Photo Multiplier Tubes have been delivered and tested with good results.

**U.S.ATLAS-** As of June 30, 2002 the project is 69% complete, reflecting the most recent update of cost and schedule estimates for the remaining work to complete the baseline scope. Forecast dates above have been revised to reflect the latest schedule estimates. A full DOE/NSF review was conducted on June 3-4, 2002, at Fermilab which concluded that significant technical progress has continued, and schedule status is reasonable.

- Silicon Strips: Testing of electronics chips continues on schedule with yields remaining very close to the 26% in the frame contract. 45% of the chips have been tested.
- Transition Radiation Tracker: With the decision to keep the glass wire-joint, both wire-joint stations have been reactivated and production resumed. With two techs producing joints there should no problem meeting the module completion date.
- Liquid Argon Electromagnetic Calorimeter: All signal feedthroughs have been installed, while the HV FTs installation at CERN is in process.
- Tile Hadron Calorimeter: All standard submodule construction has been completed at all three U.S. sites. 58 of 64 modules have been fully assembled and 48 have been shipped to CERN.
- Muon: 129 out of 240 Base Monitored Drift Tube chambers are produced and 104 have been outfitted with gas systems and Faraday cages. Tube and base chamber production have been on or better than schedule at all three sites.

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- Trigger/DAQ : Work on the Level 2 Trigger is progressing. U.C.-Irvine has begun to make significant contributions to parts of the Data Collection software. Work continues to integrate the offline and level 2 selection frameworks.

**5.2 U.S. CMS CONSTRUCTION PROJECT**

**CMS International-** Technical progress in detector sub-systems is good, with a major sub-system (Hadron Calorimeter) progressing towards testing and commissioning. CMS schedule revision to match the new LHC schedule is nearly finalized. The solenoid coil delivery is on the critical path, with the surface magnet test fixed. It remains mandatory to maintain schedules with their planned contingencies to ensure that the latest CMS schedule leads to a plausible installation and commissioning schedule. An extended surface period is planned to allow more risks to be addressed before equipment is placed underground. Below are additional international CMS highlights:

- Main cavern excavation is almost complete, to be followed by an additional year of “concreting” and a further year to install services.
- Assembly of solenoid conductor is going well, with 8 out of 21 conductor lengths produced and 19 expected to be complete in 2002.
- An Engineering Design Review for the beam pipe went well, with the Pixel installation method verified.
- An external technical review of the Electromagnetic calorimeter (ECAL) front-end preamplifiers (FPPA) has led to understanding of a noise problem; a fall-back solution for the FPPA has also been developed that may reduce production costs.

**U.S. CMS-** As of June 30, 2002, the overall U.S. CMS Construction Project was 69% complete vs. the scheduled 76% complete. A DOE/NSF review was conducted at Fermilab on June 5-6, 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 where testing is needed to finalize design, including electromagnetic calorimeter electronics now on the critical path. Currently FY03 planned commitments indicate adequate contingency will be available for the current set of US deliverables. Below are a few highlights of the U.S. CMS Construction Project.

- Endcap Muon (EMU): CSC panel production is ~95% complete and on cost and schedule. Chamber production at Fermilab is ~70% complete, and also near cost and schedule. CSC testing at the US FAST sites (UCLA and U-Florida, managed by UC-Riverside) is underway. Final CSC's are to be shipped to CERN in the fall of 2002, with installation on the Endcap iron in late 2002.
- 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.

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- Silicon Tracker: Fermilab robotic silicon gantry is fully qualified for production; silicon tracker sensor modules are currently being produced for CERN test beam study.

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**5.3 U.S LHC ACCELERATOR CONSTRUCTION PROJECT**

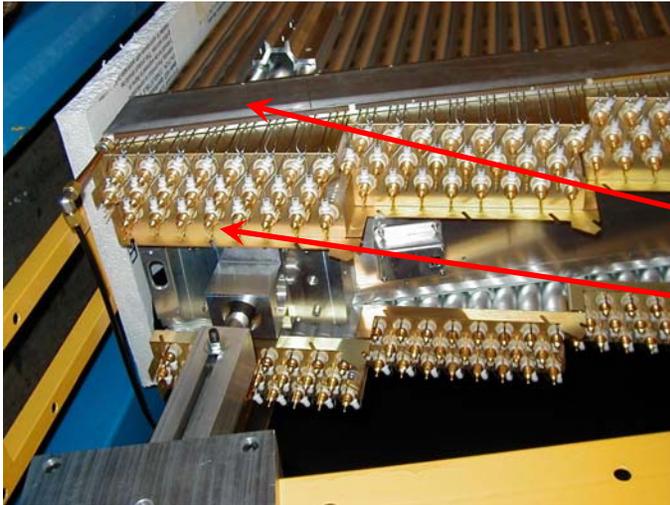
**LHC Accelerator-** The CERN Director presented to CERN Council a management plan in response to the international External Review of CERN and the LHC Project. The plan reschedules LHC start to '07 (accounting for forecasted superconducting cable delay) and refocuses Lab-wide resources on the LHC Project. It also calls for: re-organizing the CERN Accelerator Sector, reviewing policies to optimize balance and cost of internal vs. external (contracted) human resources, and strengthening of financial monitoring, controls and accountability (including introduction of "Earned Value" concept). The LHC project continues good progress in many areas:

- The U.S. firm Wah Chung will receive an award from CERN for their supply of Ni-Ti alloy.
- First new 18 kW, 4.5 K helium refrigerator has been commissioned with the other three on the way; first cold compressor unit, a revolutionary design supplying large mass flow at 1.9 K, has also been commissioned.
- All dipole contracts have been signed, as well the cryoline contract with Air Liquide, at 125 MCHF the largest single contract ever signed by CERN.
- The LHC magnet test string in its final configuration of 107-m long, has been assembled, cooled down and powered.

**U.S. LHC Accelerator-** As of June 30, 2002, the overall project was 78% percent complete versus the scheduled plan of 85% percent complete. A DOE quarterly status meeting was conducted April 17, 2002 at LBNL, and a DOE review conducted June 10-11, 2002 at Fermilab. 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 are being assembled together with a CERN-provided correction coil into the first complete Q2 cold mass. The third and fourth quadrupoles are complete, and the fifth has been collared. Coil winding for the sixth is nearly complete. The first cryostat vacuum vessel was received from the vendor.
- [BNL] All of the five D1 magnets have been tested. Seven of the nine D2 magnets have been completed. The first two 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 continues at about 60% of the planned rate, limited by the rate of delivery of samples from CERN.
- [LBNL] Assembly has begun on the TAN and TAS beam absorbers. Most of the parts and pieces are on hand at LBNL, with the only remaining major subassembly being the electron beam welding of the beam tube assemblies. The Production Readiness Review of the cryogenic feedbox was held. There is an intensive effort on producing, checking and approving drawing packages for the eight feedboxes. A final review of the RFP is planned.

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**Left- U.S. ATLAS Muon Monitored Drift Tube Chamber Status: Engineering for chamber layout complete. Production ~ 50 % complete - finish July 2004. All 3 U. S. sites are in 3<sup>rd</sup> of 5 series production. Production installation of chamber Gas system & Faraday Cages ~ 30 % complete.**

**Gas System**

**Faraday Cage**

**Right- Fermilab U.S. LHC Magnet production floor. Six of eighteen Interaction Region quadrupoles are completed or in production. Shown here are the first two quadrupoles just before the sleeve that connects them into a single cold mass assembly is welded. To the right is the third quadrupole on the warm magnetic field measurement stand.**



**Left- U.S. CMS Silicon Tracker Outer Barrel (TOB) "rod" prototype, with silicon modules installed. The Rod is placed in a test box with temperature control. The modules and Rod prototype are currently being produced by Fermilab SiDet center for CERN Test Beam study.**

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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	1,719	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**

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

Fiscal Year	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	Total
<b>Machine Funding Profiles (DOE)</b>											
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
<b>Detector Funding Profiles (DOE and NSF)</b>											
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
U.S. ATLAS	119,448	89,616	2,968	92,584	26,864
U.S. CMS	122,792	88,613	16,215	104,828	17,964
U.S. LHC Accelerator	92,250	81,477	0	81,477	10,773
CERN Direct Purchases	35,660	36,009	0	36,009	-349‡
Total	370,150	295,715	19,183	314,898	55,252

\* 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 saturated available funding in FY 2002. The balance will be carried over into the beginning of FY 2003.

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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	18,725	268	18,993
1.2	Transition Radiation Tracker	9,435	500	9,935
1.3	Liquid Argon Calorimeter	43,784	564	44,348
1.4	Tile Calorimeter	9,511	422	9,933
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	1300	0	1,300
	Contingency	25,892	-1,754	24,138
	<b>U.S. ATLAS Total Project Cost Baseline</b>	<b>163,750</b>	<b>0</b>	<b>163,750</b>

**U.S. CMS Cost Baseline**

<u>WBS</u>	<u>Description</u>	<u>Previous</u>	<u>Change</u>	<u>Current</u>
1.1	Endcap Muon	38,529	618	39,147
1.2	Hadron Calorimeter	39,760	1,227	40,987
1.3	Trigger and Data Acquisition	12,338	58	12,396
1.4	Electromagnetic Calorimeter	12,080	339	12,419
1.5	Forward Pixels	6,820	433	7,253
1.6	Common Projects	23,000	0	23,000
1.7	Project Office	6,529	138	6,667
1.8	Silicon	3,353	- 40	3,313
	Contingency	24,841	-2,773	22,068
	<b>U.S. CMS Total Project Cost Baseline</b>	<b>167,250</b>	<b>0</b>	<b>167,250</b>

**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	56,074	214	56,288
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	13,695	32	13,727
	Contingency	7,664	-246	7,418
	<b>U.S. LHC Accelerator Total Project Cost Baseline</b>	<b>110,000</b>	<b>0</b>	<b>110,000</b>

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**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	Subsystem	Schedule Designator	Description	Baseline Schedule	Forecast (F) / Actual (A) Date	
<b>Silicon (1.1)</b>	SIL L2/1	Start Full Silicon Strip Electronics Production	06-Jul-01	15-Jul-01 (A)	<b>Tile Cal</b>	Tile L2/1	Start Submodule Procurement	01-Sep-97	01-Sep-97 (A)	
	SIL L2/2	Start Full Strip Module Production	12-Apr-02	<b>31-Jul-02 (F)</b>	<b>(1.4)</b>	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-May-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 <sup>st</sup> IBM Prototype Submitted	26-Jul-01	12-Nov-01 (A)		Tile L2/6	Module Construction Complete	30-Sept-02	30-Sep-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	02-Dec-02 (F)	
	SIL L2/9	Pixels Disk System at CERN	20-Jan-05	20-Jan-05 (F)		<b>Muon (1.5)</b>	Muon L2/1	Start MDT Chambers Lines 1 and 3	17-Jul-00	15-Sep-00 (A)
<b>TRT (1.2)</b>	TRT L2/1	Final Design Complete	31-Dec-98	07-Dec-98 (A)			Muon L2/2	Start CSC Chamber Production	01-Sep-01	01-Oct-01 (A)
<b>Mechanical</b>	TRT L2/2	Module Production Complete (CUM 102)	31-Dec-03	31-Dec-03 (F)			Muon L2/3	MDT Electronics ASD PRR	01-Apr-02	01-Sep-02 (F)
	TRT L2/3	Barrel Construction Complete	10-Mar-04	10-Mar-04 (F)	Muon L2/4		Final Design of Global Alignment Devices Complete	01-Aug-02	<b>01-Mar-03 (F)</b>	
	TRT L2/4	Select Final Elec Design	15-Jun-01	30-Aug-00 (A)	Muon L2/5		CSC IC Production Complete	31-Oct-02	31-Oct-02 (F)	
<b>Electrical</b>	TRT L2/5	Start Production of ASICS	09-Jul-02	09-Jul-02 (F)	Muon L2/6		Kinematic Mount Design Complete	30-Jan-01	30-Jan-01 (A)	
	TRT L2/6	Installation Complete	04-Jan-05	04-Jan-05 (F)	Muon L2/7		MDT Chambers (U.S.) Production Complete	14-Sep-04	14-Sep-04 (F)	
	LAr Cal (1.3)	LAr L2/1	24-Jul-98	05-Aug-98 (A)	Muon L2/8		Kinematic Mount Production Complete	22-Sep-03	22-Sep-03 (F)	
	LAr L2/2	Barrel Feedthroughs Final Design Review	30-Sep-98	02-Oct-98 (A)	Muon L2/9		CSC ROD Production Complete	05-Nov-03	05-Nov-03 (F)	
	LAr L2/3	Start Electronics Production (Preamps)	30-Jun-00	30-Jun-00 (A)	Muon L2/10	MDT Elec.'s Mezzanine Production Complete	26-Sep-03	26-Sep-03 (F)		
	LAr L2/6	Level 1 Trigger Final Design Complete	30-Mar-02	30-May-02 (A)	Muon L2/12	Global Alignment System Final Delivery	30-Sep-04	30-Sep-04 (F)		
	LAr L2/7	ROD Final Design Complete	12-Dec-02	12-Dec-02 (F)	<b>Trigger/DAQ (1.6)</b>	TDAQ L2/1	Select Final LVL2 Architecture	31-Dec-99	31-Mar-00 (A)	
	LAr L2/8	Motherboard System Production Complete	30-Sep-02	30-Sep-02 (F)		TDAQ L2/2	LVL2 Trigger Design Complete	31-Dec-02	31-Dec-02 (F)	
	LAr L2/9	Cryostat Arrives at CERN	15-May-01	02-Jul-01 (A)		TDAQ L2/3	LVL2 Trigger Prototype Complete	30-Sep-02	30-Sep-02 (F)	
	LAr L2/10	Barrel Feedthroughs Production Complete	01-Jun-02	25-Mar-02 (A)		TDAQ L2/4	Start Production	08-Jan-03	08-Jan-03 (F)	
						TDAQ L2/5	Start Installation & Commissioning	05-Mar-03	05-Mar-03 (F)	
						TDAQ L2/6	Production Complete	30-Jul-05	30-Jul-05 (F)	

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<b>Subsystem</b>	<b>Schedule Designator</b>	<b>Description</b>	<b>Baseline Schedule</b>	<b>Forecast (F) / Actual (A) Date</b>	<b>Subsystem</b>	<b>Schedule Designator</b>	<b>Description</b>	<b>Baseline Schedule</b>	<b>Forecast (F) / Actual (A) Date</b>
<b>Silicon (1.1)</b>	SIL L2/1	Start Full Silicon Strip Electronics Production	06-Jul-01	15-Jul-01 (A)	<b>Tile Cal</b>	Tile L2/1	Start Submodule Procurement	01-Sep-97	01-Sep-97 (A)
						TDAQ L2/7	LVL2Installation&Commissioning Complete	30-Sep-05	30-Sep-05 (F)

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



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**U.S. Large Hadron Collider Construction Project**

**U.S. ATLAS Major Project Milestones (Level 2)- cont'd**

ID	Subsystem ID	Milestone	ETC 02 Baseline	Forecast	Actual	2001				2002				2003				2004				2005		
						4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3			
33	TDAQ L2/2	LVL2 Trigger Design Complete	Tue 12/31/02	Tue 12/31/02	NA									◆										
34	TDAQ L2/4	Start Production	Wed 1/8/03	Wed 1/8/03	NA									◆										
35	LAr L2/11	FCAL-C Delivered to EC	Wed 1/15/03	Wed 1/15/03	NA									◆										
36	TDAQ L2/5	Start Installation & Commissioning	Wed 3/5/03	Wed 3/5/03	NA									◆										
37	Sil L2/5	ROD Production/Testing Complete	Thu 3/13/03	Thu 3/13/03	NA									◆										
38	Sil L2/7	Pixels 'Start IBM Production'	Thu 6/12/03	Thu 6/12/03	NA									◆										
39	Muon L2/8	Kinematic Mount Production Complete	Mon 9/22/03	Mon 9/22/03	NA									◆										
40	Muon L2/10	MDT Elec.'s Mezz Production Complete	Fri 9/26/03	Fri 9/26/03	NA									◆										
41	Sil L2/4	Compl Shipment of Silicon Strip Modules Prod	Fri 10/17/03	Fri 10/17/03	NA									◆										
42	LAr L2/12	FCAL-A Delivered to EC	Tue 11/4/03	Tue 11/4/03	NA									◆										
43	Muon L2/9	CSC ROD Production Complete	Wed 11/5/03	Wed 11/5/03	NA									◆										
44	TRT L2/2	Module Production Complete (CUM 102)	Wed 12/31/03	Wed 12/31/03	NA									◆										
45	Sil L2/8	Pixels 'Start IBM Outer Bare Module Prod'	Thu 1/29/04	Thu 1/29/04	NA									◆										
46	TRT L2/3	Barrel Construction Complete	Wed 3/10/04	Wed 3/10/04	NA									◆										
47	Muon L2/7	MDT Chambers (U.S.) Prod Compl (Qty. 240)	Tue 9/14/04	Tue 9/14/04	NA									◆										
48	Muon L2/12	Global Align System Final Delivery	Thu 9/30/04	Thu 9/30/04	NA									◆										
49	TRT L2/6	Installation Complete	Tue 1/4/05	Tue 1/4/05	NA									◆										
50	Sil L2/9	Pixels 'Disk System at CERN'	Thu 1/20/05	Thu 1/20/05	NA									◆										
51	TDAQ L2/6	Production Complete	Sat 7/30/05	Sat 7/30/05	NA									◆										
52	TDAQ L2/7	Installation & Commissioning Complete	Fri 9/30/05	Fri 9/30/05	NA									◆										

## Project Manager's Quarterly Progress Report – 3<sup>rd</sup> Quarter FY 2002

### U.S. Large Hadron Collider Construction Project

#### 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	v27	v31	Start	Variance	'98	'99	'00	'01	'02	'03	'04	'05	'06
☐ US CMS APM-DD Milestones				NA	NA	Jan 31 '99	0 days									
HCAL	ML3*	HB-024	HB: Start Optics Production	Jan 31 '99	Jan 31 '99	Jan 31 '99	0 days		●							
MUON	ML2*	M-011	Begin Assembly of Cathode Strip Chambers at 1	Oct 31 '99	Jul 14 '00	Jul 14 '00	0 days			●						
HCAL	ML3*	HB-026	HB-1 Optical Assemblies 100% Complete	Jul 31 '00	Sep 30 '00	Sep 30 '00	0 days				●					
HCAL	ML2*	HB-010	HB-1 Absorber Delivered to CERN	Nov 30 '00	Nov 30 '00	Nov 30 '00	0 days				●					
MUON	ML2*	M-013	Begin Mass Production of Electronics Boards	Aug 31 '00	Mar 31 '01	Mar 31 '01	0 days					●				
HCAL	ML2*	HB-014	HB+1 Absorber Delivered to CERN	Dec 31 '01	Sep 30 '01	Sep 30 '01	0 days					●				
HCAL	ML3*	HL-039	HF: Start PMT Procurement	Oct 31 '01	Oct 31 '01	Oct 31 '01	0 days					●				
HCAL	ML1*	HB-016	HB-1 End Module Assembly in SX5	NA	Oct 31 '01	Oct 31 '01	0 days						●			
CP	ML3*	S-059	End Assembly of YE+3	Oct 31 '01	Oct 31 '01	Nov 30 '01	22 days						●			
SiTrkr	ML2*	T-027	Begin Sensor Module Construction (for M200)	NA	Oct 31 '01	Apr 1 '02	97 days							●		
MUON	ML2*	M-014	Begin Mounting Electronics and Testing at UC1	Sep 30 '00	Nov 30 '01	Nov 30 '01	0 days							●		
HCAL	ML3*	HB-029	HB+1 Optical Assemblies 100% Complete	Dec 31 '01	Dec 31 '01	Mar 31 '02	61 days							●		
HCAL	ML3*	HL-005	Start HPD Procurement	Oct 31 '99	Jan 31 '02	Jan 31 '02	0 days									
SiTrkr	ML2*	T-1070	25% of Rods Complete	NA	Jul 31 '02	Mar 1 '04	390 days									
HCAL	ML2*	HL-011	HF: PMT Tests 100% Complete	NA	Sep 30 '02	Sep 30 '02	0 days									
ECAL	ML-US	4.3.8.11m	Second Laser Installed & Delivered	NA	Oct 1 '02	Oct 1 '02	0 days									
ECAL	ML3*	E-027	ECAL Front-End Electronics Production Launch	Apr 30 '00	Oct 31 '02	Oct 31 '02	0 days									
HCAL	ML1*	HB-017	End Assembly of HB+ (Barrel) in SX5	Jul 31 '02	Oct 31 '02	Oct 31 '02	0 days									
FPIX	ML2*	T-1002	Final Full Size ROC Submission(0.25micron)	NA	Dec 31 '02	Dec 31 '02	0 days									
HCAL	ML3*	HL-014	QIE ASIC Production Run Complete	NA	Dec 31 '02	Dec 31 '02	0 days									
HCAL	ML2*	HL-002	HCAL Front-End Electronics Production Compl	Jun 30 '01	Mar 31 '03	Mar 31 '03	0 days									
HCAL	ML2*	HL-018	HCAL HPD Tests 100% Complete	NA	Aug 31 '03	Aug 31 '03	0 days									
MUON	ML2*	M-017	All 148 ME23/2 CSC's Delivered from UC/UF to	Oct 31 '03	Sep 30 '03	Sep 30 '03	0 days									
SiTrkr	ML2*	T-1077	Delivery of TOB to the Tracker	NA	Apr 30 '04	Apr 15 '05	239 days									
FPIX	ML2*	T-1015	First Butterfly Ready	NA	Mar 31 '04	Mar 31 '04	0 days									
ECAL	ML3*	E-045	All APDs Delivered	Feb 28 '04	Apr 30 '04	Apr 30 '04	0 days									
DAQ	ML2*	D-1014	Start of Readout and EVB Commissioning	NA	Jul 31 '04	Jul 31 '04	0 days									
ECAL	ML3*	E-046	ECAL Front-End Electronics Production Compl	May 31 '04	Sep 30 '04	Sep 30 '04	0 days									
CP	ML1*	G-1010	UX Ready (Start Lowering Magnet Parts)	NA	Sep 30 '04	Sep 30 '04	0 days									
ECAL	ML-US	4.6.1.8m	FPPA Delivery Complete	NA	Oct 1 '04	Oct 1 '04	0 days									
ECAL	ML-US	4.6.3.9m	Optical Link Delivery Complete	NA	Oct 1 '04	Oct 1 '04	0 days									
TRIG	ML3*	D-1350	CSC: MPC Prod Test Complete	NA	Nov 30 '04	Nov 30 '04	0 days									
FPIX	ML2*	T-1020	Ship Pixel Tracker Endcaps to SX5	NA	Sep 30 '05	Sep 30 '05	0 days									
MUON	ML1*	M-1083	End UX Inst/Cabling/Test on ME Stations on Y	Mar 31 '05	Nov 30 '05	Nov 30 '05	0 days									
HCAL	ML1*	HB-023	End Cabling and Test of HB in UX5	May 31 '04	Nov 30 '05	Nov 30 '05	0 days									
HCAL	ML1*	HE-015	End Cabling and Test of HE-1 in UX5	Jul 31 '04	Nov 30 '05	Nov 30 '05	0 days									
HCAL	ML1*	HF-025	HF: Installation and Testing in UX5 Complete	Jun 30 '05	Nov 30 '05	Nov 30 '05	0 days									
TRIG	ML2*	D-1008	Finish Trigger Installation	NA	Nov 30 '05	Nov 30 '05	0 days									
DAQ	ML2*	D-1023	DAQ.0: 25% Performance Installed	NA	Jan 31 '06	Jan 31 '06	0 days									

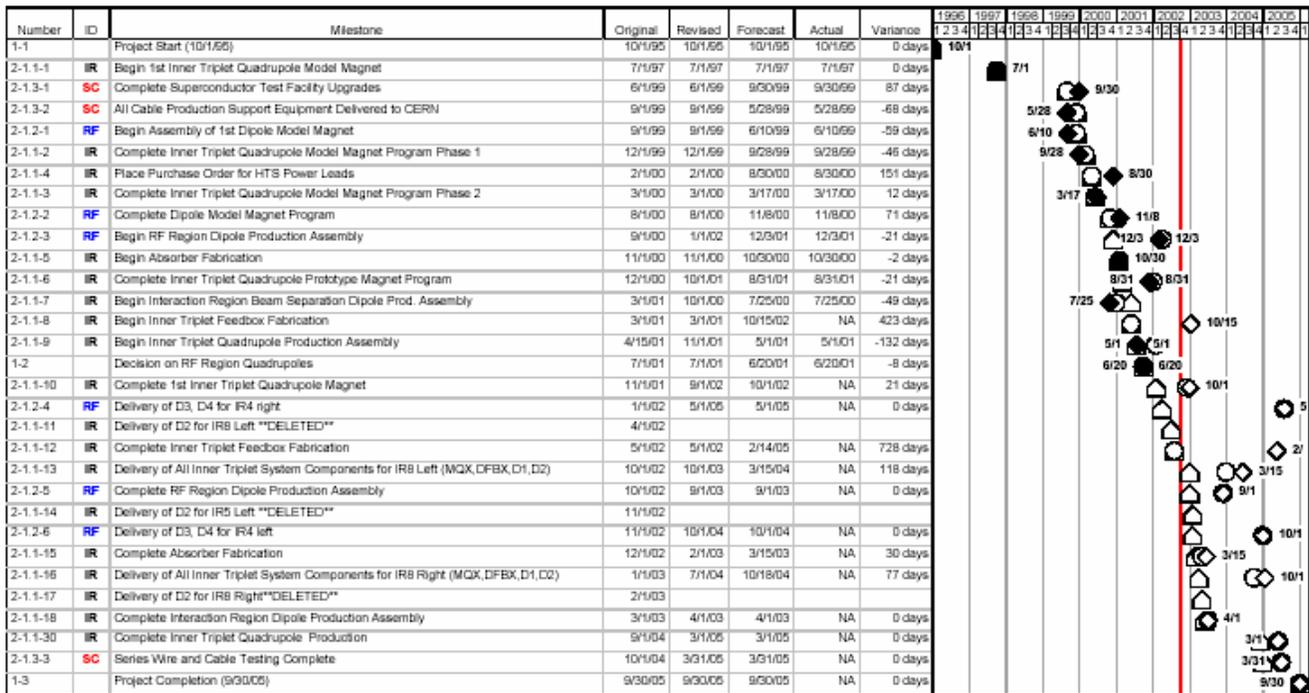
## Project Manager's Quarterly Progress Report – 3<sup>rd</sup> Quarter FY 2002

### U.S. Large Hadron Collider Construction Project

#### 8.3 U.S. LHC Accelerator Construction Project Milestones

Table 8.3 Level 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	<b>17 Dec 02 (F)</b>
Int Region	Begin inner triplet quadrupole production assembly	1 Nov 01	1 May 01 (A)
Int Region	Complete 1 <sup>st</sup> inner triplet quadrupole magnet	1 Sep 02	1 Sep 02 (F)
Int Region	Complete inner triplet feedbox fabrication	1 May 02	<b>14 Feb 05 (F)</b>
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	31 Dec 01 (A)
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 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

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)**

<b>U.S. CMS Construction Project</b>																	
	<b>FY 1998</b>				<b>FY 1999</b>				<b>FY 2000</b>				<b>FY 2001</b>				
<b>Institution</b>	<b>DOE Grant</b>	<b>Contract</b>	<b>NSF</b>	<b>Total</b>	<b>DOE Grant</b>	<b>Contract</b>	<b>NSF</b>	<b>Total</b>	<b>DOE Grant</b>	<b>Contract</b>	<b>NSF</b>	<b>Total</b>	<b>DOE Grant</b>	<b>Contract</b>	<b>NSF</b>	<b>Total</b>	<b>Grand Total</b>
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	28,388
Fairfield	0	29	0	29	0	0	0	0	0	10	0	10	0	13	0	13	52
Maryland	90	65	0	155	0	132	131	263	0	250	0	250	0	189	0	189	857
Boston U.	0	32	0	32	31	111	0	142	0	132	0	132	0	88	0	88	394
Florida State	60	54	0	114	71	118	0	189	80	54	0	134	68	43	0	111	548
U. of Minnesota	60	95	0	155	161	452	0	613	141	202	0	343	153	401	0	554	1,665
U. of Iowa	77	62	0	139	20	5	0	25	0	453	0	453	0	843	0	843	1,460
U. of Rochester	127	1,159	0	1,286	262	485	0	747	441	253	0	694	464	143	0	607	3,334
Notre Dame	0	52	0	52	0	44	184	228	0	14	193	207	0	14	112	126	613
Purdue	38	135	0	173	49	166	0	215	0	175	0	175	0	89	0	89	652
U. of Miss.	46	100	0	146	68	91	0	159	69	108	0	236	0	235	0	235	776
U. of Florida	44	95	0	139	184	412	0	596	332	853	0	1,185	432	293	0	725	2,645
Ohio State U.	140	64	0	204	275	212	0	487	196	732	0	928	151	700	0	851	2,470
Carnegie Mellon	0	113	0	113	0	291	0	291	0	312	0	312	0	258	0	258	974
Rice	138	19	0	157	102	56	0	158	132	16	0	148	196	36	0	232	695
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	14,364
U.C. Davis	34	100	0	134	0	78	0	78	0	502	0	502	0	63	0	63	777
UCLA	150	87	0	237	249	173	0	422	244	391	0	635	347	546	42	935	2,229
U.C. Riverside	20	10	0	30	0	164	0	164	0	70	0	70	0	72	0	72	336
John Hopkins	0	29	0	29	0	0	70	70	0	0	40	40	0	0	5	5	144
Northwestern	0	59	0	59	5	26	0	31	0	114	0	114	0	39	0	39	243
Rutgers	0	13	0	13	0	0	34	34	0	2	140	142	0	0	101	101	290
Princeton	0	256	0	256	0	626	0	626	0	667	0	667	0	133	0	133	1,682
Caltech	0	148	0	148	0	458	0	458	0	367	0	367	0	452	0	452	1,425
U.C. San Diego	11	0	0	11	11	90	24	125	36	0	0	36	0	43	0	43	215
Northeastern	0	0	0	0	0	0	3,370	3,370	0	0	1,741	1,741	0	0	1,482	1,482	6,593
U. Ill.-Chicago	0	0	0	0	0	0	124	124	0	0	309	309	0	0	262	262	695
U. of Nebraska	0	0	0	0	0	0	24	24	0	0	2	2	0	0	100	100	126
MIT	0	37	0	37	15	67	0	82	0	78	0	78	0	87	0	87	284
Iowa State	0	0	0	0	0	0	19	19	0	356	0	356	0	29	0	29	404
Kansas State													0	66	0	66	66
LBL													0	554	0	554	554
Texas Tech													0	876	0	876	876
UC Santa Barbara													0	13	0	13	13
U. of Kansas													0	0	6	6	6
<b>Subtotal</b>	<b>1,568</b>	<b>9,382</b>	<b>0</b>	<b>10,950</b>	<b>1,974</b>	<b>18,672</b>	<b>4,020</b>	<b>24,666</b>	<b>2,393</b>	<b>15,087</b>	<b>2,425</b>	<b>19,964</b>	<b>2,315</b>	<b>16,840</b>	<b>2,110</b>	<b>21,265</b>	<b>75,330</b>

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U.S. Large Hadron Collider Construction Project**

**APPENDIX B - FUNDING BY INSTITUTION (in thousands of dollars)**

U.S. ATLAS Construction Project																	
Institution	FY 1998				FY 1999				FY 2000				FY 2001				Grand Total
	DOE Grant	Contract	NSF	Total	DOE Grant	Contract	NSF	Total	DOE Grant	Contract	NSF	Total	DOE Grant	Contra	NSF	Total	
ANL	0	1,098	0	1,098	0	967	0	967	0	922	0	922	0	172	0	172	3,159
BNL	0	3,903	0	3,903	0	2,581	0	2,581	0	6,429	0	6,429	0	6,630	0	6,630	19,543
LBNL	0	633	0	633	0	715	0	715	0	420	0	420	0	1,575	0	1,575	3,343
SUNY/Albany	20	0	0	20	48	0	0	48	50	0	0	50	0	0	0	0	118
U. of Arizona	320	100	0	420	634	0	0	634	557	0	0	557	298	0	0	298	1,909
Boston U.	224	0	0	224	298	0	0	298	287	0	0	287	155	0	0	155	964
Brandeis U.	265	45	0	310	0	0	593	593	0	0	478	478	0	0	731	731	2,112
U.C.Irvine	193	0	0	193	0	0	93	93	0	0	0	0	0	0	266	266	552
U.C. Santa Cruz	404	0	0	404	63	0	0	63	0	0	568	568	0	0	2,702	2,702	3,107
U. of Chicago	0	54	0	54	0	0	1,069	1,069	0	0	264	264	0	0	723	723	2,110
Duke U.	190	0	0	190	601	0	0	601	417	0	0	417	501	0	0	501	1,709
Hampton U.	0	0	0	0	0	0	538	538	0	0	293	293	0	0	331	331	1,162
Harvard	234	0	0	234	0	0	654	654	0	0	390	390	0	0	3,882	3,882	5,070
U. of Illinois	50	159	0	209	347	0	0	347	294	0	0	294	76	0	0	76	926
Indiana U.	190	0	0	190	765	0	0	765	460	0	0	460	0	616	0	616	2,031
MIT	50	0	0	50	105	0	0	105	177	0	0	177	190	0	0	190	522
Michigan State	0	35	0	35	0	0	178	178	0	0	293	293	0	0	0	0	506
Nevis/Columbia	0	675	0	675	0	0	2,680	2,680	0	0	1,422	1,422	0	0	103	103	4,880
U. of New Mex.	20	0	0	20	30	0	0	30	24	0	0	24	0	80	0	80	154
Northern Illinois	0	0	0	0	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	0	0	0	0	145
U. of Michigan	62	254	0	316	716	0	0	716	518	0	0	518	681	0	0	681	2,231
U. of Oklahoma	30	0	0	30	0	0	41	41	0	0	51	51	0	0	49	0	171
U. of Penn.	250	0	0	250	300	0	0	300	265	0	0	265	679	0	0	679	1,494
U. of Pittsburg	110	0	0	110	0	0	150	150	0	0	210	210	0	50	0	50	520
U. of Rochester	0	0	0	0	0	0	3,587	3,587	0	0	1,664	1,664	0	0	0	0	5,251
U.T. Arlington	50	82	0	132	0	0	474	474	0	0	230	230	0	0	0	0	836
S. Methodist	40	0	0	40	124	0	0	124	30	0	0	30	87	0	0	87	281
SUNY/Stony B.	27	0	0	27	0	0	1,045	1,045	0	0	1,037	1,037	0	0	426	426	2,535
Tufts University	50	0	0	50	20	0	0	20	20	0	0	20	0	0	0	0	90
U. Washington	0	0	0	0	0	0	240	240	0	0	318	318	0	0	1,377	1,377	1,935
U. of Wisconsin	230	0	0	230	429	0	0	429	665	0	0	665	1,014	0	0	1,014	2,338
<b>Subtotal</b>	<b>3,009</b>	<b>7,038</b>	<b>0</b>	<b>10,047</b>	<b>4,580</b>	<b>4,263</b>	<b>11,342</b>	<b>20,185</b>	<b>3,809</b>	<b>7,771</b>	<b>7,218</b>	<b>18,798</b>	<b>3,920</b>	<b>9,123</b>	<b>10,590</b>	<b>22,625</b>	<b>71,704</b>
Reserve	0	3	0	3	157	0	5,289	5,446	327	1,936	1,795	4,058	0	300	0	300	9,807
<b>Total</b>	<b>3,009</b>	<b>7,041</b>	<b>0</b>	<b>10,050</b>	<b>4,737</b>	<b>4,263</b>	<b>16,631</b>	<b>25,631</b>	<b>4,136</b>	<b>12,309</b>	<b>11,941</b>	<b>28,386</b>	<b>3,920</b>	<b>9,423</b>	<b>10,590</b>	<b>22,925</b>	<b>81,511</b>