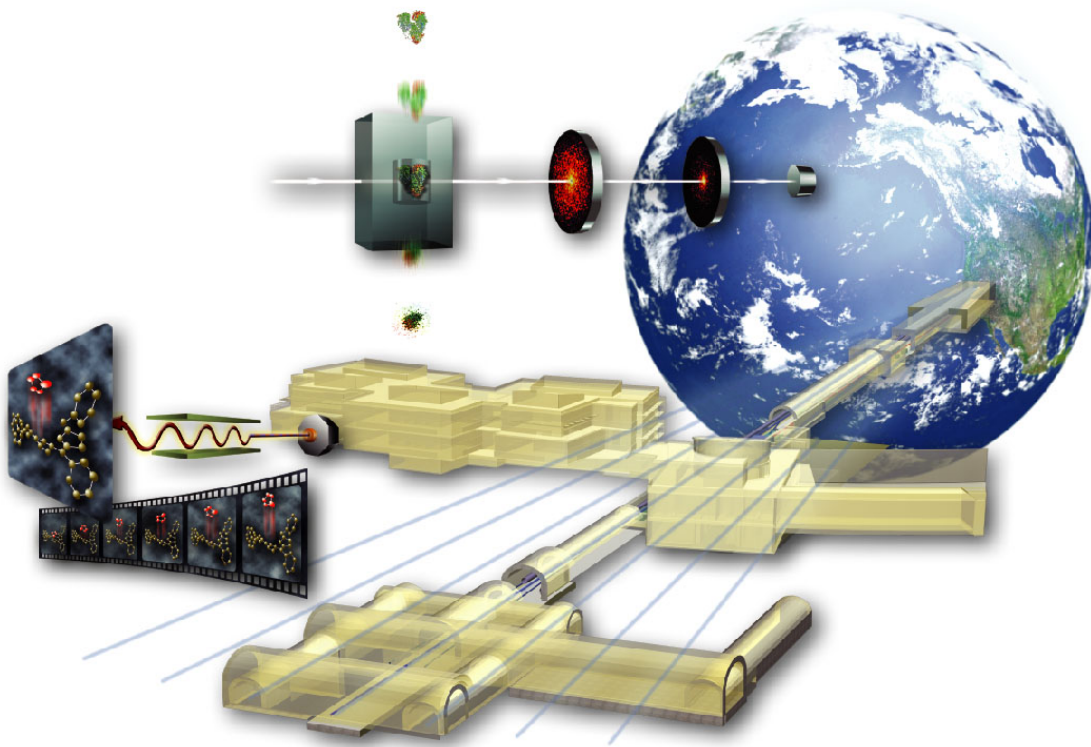


# Monthly Report

## March 2006



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## Project Overview and Assessment

### Highlights:

- The LCLS Project conducted two Earned-Value Management System (EVMS) reviews in March:
  1. LCLS Project Office (Surveillance) Review, Mar1-2, 2006. The purpose of the review was to evaluate and assess the LCLS EVM System to ensure that it meets DOE Order 413.3, Program Management for the Acquisition of Capital Assets and the 32 criteria from ANSI/EIA Standard 748 for Earned Value Management Systems. The review committee drew from external experts in EVM from other DOE labs (BNL, LANL, LLNL, ORNL) with experience in EVMS.
  2. OECM EVMS Validation Review, Mar 27-31, 2006. The purpose of the review was to certify that the LCLS EVMS was in compliance with the ANSI/EIA Standard 748. The review was conducted by Defense Contract Management Agency (DCMA) which charged an independent committee to assess the LCLS EVMS. (See assessment below)
- Progress continued on the construction of the Sector 20 Injector Facility (S20) and the Magnetic Measurement Facility (MMF). The projects are 90% and 95% complete, respectively. Beneficial occupancy of the MMF was met on March 29, 2006, slightly ahead of schedule.
- LCLS has begun to identify candidates for strengthening its senior staff in the Project Office. These are;
  - Procurements, LCLS has brought on Mr. Barry Miller, formerly of ORNL and the SNS project to assist the Project Office.
  - Civil Construction, LCLS has a requisition in place and is beginning to actively recruit for this position.
  - Engineering, LCLS has a requisition in place and is beginning to actively recruit for this position.

### Assessment and Issues:

- The March 2006 Cost Performance Reports (CPR) is the 25<sup>th</sup> month of reporting earned-value on the LCLS TPC. For this month the LCLS cost and schedule indices are 1.01 and 0.93, respectively. Total obligations to date (actual costs + open commitments) are \$88,884K.
- The OECM EVMS validation review conducted by DCMA identified Corrective Action Requests in order to validate the LCLS EVMS. A Corrective Action Plan (CAP) has been generated and the plan for executing the CAP is underway.

## Project Office and Support

### WBS 1.1, 2.1 Project Planning, Management and Administration

#### Highlights:

- The Project continued to test a web based system (SharePoint) that can be used to deposit requirements documentation (SOWs, Specifications (ESDs), and Drawings) and track documents used for Purchase Orders in February. Full use of the system will require significant effort to gather the needed data and enter it into the system, but will help with configuration control and record keeping.
- LCLS Environmental, Safety & Health Status – March 2006
  - **Safety** – The project has worked 208 days without a recordable injury incident through the end of March.
  - **Safety Training Compliance** - In response to LCLS Project Director's directive for line managers to bring safety training into better compliance course completion has improved from 87% to 96%. The project goal is 100% compliance.
  - **Project Safety Reviews** - Project ESH group made presentations to one review committee in March, the Stanford University Scientific Policy Committee, Sub Committee for Environment, Safety and Health (ESHAC). The focus of the ESHAC review related to the LCLS project was the construction safety program. The committee was satisfied with the project's diligence in setting up the program and results achieved to date.
  - **Oversight Walkthroughs** continue at the Sector 20, Magnetic Measurement Facility (MMF) and other related construction sites. This month LCLS management Safe Performance Observation training was initiated. Several managers have completed their first field inspections.
  - **Turner Construction Co. Construction Safety Program** was revised to include further tunneling safety details. This revision has been accepted by the LCLS and incorporated into the Turner bid packages.
  - **Turner Crisis Management Plan** was reviewed by LCLS and formally accepted. Turner observed the SLAC emergency exercise and will develop a briefing for SLAC Management on the elements of their own Crisis Management Plan, including a hazards/risk assessment.
  - **Tunnel Rescue** - The LCLS has contracted with the University of Nevada Fire Science Academy at Reno to conduct the training. Equipment required for tunnel rescue operations is being procured by LCLS. Coordination meetings were held this month with University of Nevada, Reno Fire Science Academy and the Palo Alto Fire Department to establish compatible training dates. Training will begin as soon as the tunnel rescue equipment has arrived.

○ **Incidents and Opportunities for Improvement identified during March**

- **MMF Fire** – March 10, 2006 a fire occurred in the MMF facility when an electrician welding a grounding cable. A spark from the welding process ignited the elbow of a fiberglass insulation cover adjacent to the work. The fire was immediately extinguished. There was only minor damage to nearby insulation. The SLAC Fire Marshal was notified of the incident. The Fire Department responded, inspected the condition of the facility and declared that work could resume. A Job Safety Analysis had been written for the work performed; however, in retrospect a welding blanket should have been used to cover the components adjacent to the work.
- **K10 Transformer Installation Defect** - March 22, 2006, an installation defect was discovered during checkouts prerequisite to energizing the secondary side of the K10B substation. AMS, the electrical subcontractor to XL Construction Co., failed to connect the 12 KVA cables on the secondary side of the primary switchgear during installation in the Fall of 2005. The K10B system is the transformer feeding the newly constructed Sector 20 Laser/Injector housing structure. Because SLAC procedures were followed no person was in harms way.
  1. Proper LOTO procedures were followed.
  2. CEF procedures for meggering contractor installed electrical systems was followed indicating a safe situation.
  3. ESO was notified in a timely manner.
  4. No person was exposed or was at risk throughout this operation.
  5. Investigation and recommendations to prevent a recurrence is under development.
  6. The question regarding the subcontractor's quality control and how this condition was not detected continues to be evaluated.

Although this incident was determined to be QA issue, a thorough ESH investigation was conducted to assure that no individuals were at risk as the result of the contractor oversight.

- **LCLS Procurement Status – March 2006;**
  - LCLS procurement activity in March was quite heavy, mainly due to issues surrounding the Jacobs and Turner subcontracts. LCLS Procurement devoted significant attention and support to Turner preparations for bidding.
  - Issues related to the Job Requisition for a Procurement/Subcontract Administrator have been settled with the hiring of Mr. Scott Zadel in late

March. Ms. Araceli (Sally) Zapata also joined the procurement group on a part time basis to provide expediting support.

- A/E Design – Subcontract Modifications No. 12, 13, & 14 were written and returned to SLAC for execution late March. The modifications will be fully executed by SLAC and returned to Jacobs in early April.
- CM/GC – Weekly OAC meetings are very productive. Negotiations to clarify and incorporate RFP Addendum 3 into the subcontract were successfully concluded with a contract modification to follow.
- S20/K10B/MMF – The K10B substation and MMF are now complete. All construction on S20 is nearly complete and one modification for \$50,000 must be processed by SLAC. The MMF and S20 commissioning have both been awarded to Engineering Economics Inc.
- MMF Electrical Feeder Upgrade – Work is in-process (with rain delays) and a requisition is needed to cover COR-PO Mod.
- FFTB Equipment and Block Removal – IFB issued and a supplier was selected in March. PO placement is in process.
- Research Yard Cleanup - APP approved with planned start of May 1 and complete by May 31. A job walk was performed in late March and Bids are due on April 12. The current start date is expected to be June 1.
- Linac BC1 Chicane Dipole Magnets – Subcontract awarded. Design review is scheduled for April 7, due July 7.
- BC1 Tweaker Quadrupole Magnets – Subcontract awarded. The design review is scheduled for April 10 and the due date is June 30.
- BC2 Chicane Dipole Magnets – RFP Addendum issued with 1 month extension provided. Bids were received on March 20 and a technical evaluation is in-process.
- LTU Quadrupole Magnets - RFP Addendum issued with 1 month extension provided. Bids were received on March 20 and a technical evaluation is in-process.
- Injector Quadrupole Magnets – Subcontract awarded. Quantity 14 received on March 8, quantity 8 due on April 18, and quantity 1 due at the end of April.
- CMM - due date has slipped. Currently due in the port of Oakland by May 12. The install is scheduled to begin May 22 and the building is currently ready for the installation.

#### **Assessment and Issues:**

- None



## Electron Beam Systems

### WBS 1.1, 1.x.2 Controls System

#### Highlights:

- Work continues on drafting detailed drawings for both the LCLS Injector Personnel Protection System (PPS) and Laser Safety System (LSS). The LSS drawings are being checked for completeness. A system-wide review date is under discussion. The PPS drawings are nearly complete.
- Major accomplishments for the Vacuum system during this month:
  - Ordered ion pump power supplies
  - Finished entries to the cable database for long haul cables
  - Scheduled and started preparing for the final design review
  - Finished writing the ESD
- Developed plans for a change in direction for injector commissioning application needs. We will be making heavy use of MATLAB for this cycle as well as the SLC applications.
- A Preliminary Design Review for the Cable plant was presented to the Electrical Safety Committee. Action items were returned for Cable plant Group to clear. A similar review with The Fire Safety Committee was provided and cleared.

#### Assessments and Issues:

- The Controls schedule for the 2006 installation in the Injector and Linac remains very tight. A plan to meet the schedule is being worked, and good progress is being made. The Controls Manager is monitoring this very closely.
- A requisition was placed for Phase I of cable plant installation through the LCLS Purchasing group in the amount of \$130K. Potential Electrical Contractor bidders were escorted by LCLS Purchasing to Sec 20 for a site visit. The installation of the cable plant is critical path for installation and commissioning of the drive laser. There has been good progress on defining the cabling and placing the installation order recently. Weekly meetings will continue to identify and address problems.
- There are ongoing discussions with the XTOD management concerning major re-configuration of FEE, including a possible split vacuum chamber and additional collimator for offset mirrors; two diagnostic stations; more pop-up cameras; and more focus on alignment systems.





## **WBS 1.2, 2.2 Injector System**

### **Highlights:**

- Drive laser milestone 2 (Completion of the standard parts) – was achieved. Test reports were submitted to SLAC by the laser vendor THALES. THALES is now working on the compression and temporal shaping – UV conversion.
- The final design review of the UV launch system was held and committee recommendations were implemented. The in-vacuum launch mirror went out for bid.
- Two accelerator structures were successfully machined and were staged for brazing the new dual feed input couplers.
- All S-Band waveguide for the injector has been submitted to SLAC's machine shops in preparation for the August 2006 shutdown.
- Brazing started on gun subassemblies. The gun solenoid bucking coil design was completed and drawings were checked. The decision to test the gun in the ASTA bunker was made, and work begun on the plan to bring S-band RF into the bunker.
- The lab-wide downtime planning meeting for the 2006 downtime activities started. LCLS submitted the detailed installation schedule for the 2006 installation work.

### **Assessments and Issues:**

- The Injector Cable plant installation plans were completed and the contract for the installation was placed. The work threatens to force a delay in the Laser system installation and commissioning schedule by at least one month. Workarounds are being investigated to minimize the impact.
- Wire scanner component delivery is late, delaying assembly start. While it is not yet critical path, the deliveries and assembly will be monitored closely.
- SLAC has informed that the K10 substation will be down for the month of October. The substation supplies power to Sector 20, 21 and the K10B sub which powers the Injector vault and alcove. Welding power, utility outlets and lighting would be off for this part of the 2006 installation period. An alternative schedule for the K10 substation work that minimizes impact to the LCLS installation is being explored.

## **WBS 1.3, 2.3 Linac System**

### **Highlights:**

- XL4 Klystron testing began. X-band structure supports were completed; waveguides are being fabricated in KLY department. X-Band installation drawings were completed. The final design review of the LCLS X-Band modulator modification was held.
- Component locations were finalized for the BC1-Out region (downstream of compressor chicane.) The MAD-deck was revised to the as-designed component locations. A preliminary design review was held on BC1-out. Action items were assigned to team members including optics layout, data processing modeling and wakefield effects studies from the annular mirror. Transmission characteristics of the ceramic gap need to be evaluated and detectors must also be selected. A bunch length monitor ESD is in development.
- All BPM design variants are in fabrication except the BC1 chicane BPM. The 2 jaw collimator design continued. OTR11 (BC1) design was started. Design and engineering staff was re-allocated to focus on BC1 diagnostics integration. Orders were placed for an additional 10 MDC profile monitor actuators.
- The lab-wide downtime planning meeting for the 2006 downtime activities started. LCLS submitted the detailed installation schedule for the 2006 installation work.

### **Assessment and Issues:**

- The BC1-out region design is at risk for the downtime installation. Appropriate resources must be maintained for BC1 diagnostics section designs and bunch length monitor development to meet installation schedule. This is being actively monitored. Additional SLAC effort has been put on this project, and weekly team meetings with controls group continue.

## **WBS 1.4, 2.4 Undulator System**

### **Highlights:**

- Undulator Magnets
  - The 1<sup>st</sup> article undulator from Hi-Tech manufacturing has arrived at ANL. The 1<sup>st</sup> article from Metalex manufacturing is also complete and scheduled to be shipped to ANL the first week of April.
  - Following a simple correction with one magnet in the 1<sup>st</sup> article it was measured and found to be within the specifications required of the assembly vendor. Further testing will be done to fully characterize and tune the 1<sup>st</sup> article.
- Single Undulator Test Setup
  - A complete undulator cell is being built up in the ANL magnet measurement laboratory. The supports are installed; the girder is in place on the cam movers, a dummy undulator is installed on the translation stages and entire assembly accurately surveyed. Other items such as the vacuum chamber, quadrupole magnet, and diagnostics will be added as they become available. We will use this system to verify all fit and function.
- RF Beam Position Monitor
  - Work continues on the RF BPM. Measurements in the lab show sensitivity to better than 2 microns. The 1<sup>st</sup> brazed assembly will be installed onto the injector test stand in April and test further with beam.
- Vacuum Chamber
  - A number of small test chambers have been constructed, coated with aluminum, and measured for surface roughness. These measurements were given to SLAC physicists, who found that the flat sections of the chambers were well within specifications while the curved sections were not. Improvements are planned by performing the aluminum coating last. A vendor has been identified for this new process and samples using this new technique are planned.
- Metrology
  - The group is preparing to move equipment into the Magnet Measurement Facility during the month of April.
  - MMF equipment: Calibration and testing of the CMM at Brown & Sharpe was completed. The CMM was shipped with an expected delivery date at SLAC of mid-May. Preparations were made for the acceptance test for Kugler bench.

- Prototype undulator testing continued with work on undulator measurement system, software development for automatic shimming. Several complete tuning sequences were gone through.
- It was shown that the gap shims are not acting in a repeatable manner. ANL will put threaded inserts in the aluminum base plates to solve this problem.

#### **Assessments and Issues:**

- The RF bpm testing and production continues to be close to the critical path and could easily slow down the assembly of the undulator systems in the magnet measurement facility. This issue continues to be closely monitored.
- Although an assembly plan for the undulator system was worked out quite some time ago it was clear that with a little more effort a more integrated and comprehensive assembly process of the undulator system in the magnet measurement facility should be created. Work is progressing on this with the goal of having a solid, integrated assembly plan by the end of April.
- A recent flood in SLAC's Sector 10 metrology lab limits the group's ability to continue with the development of the ADS. A new location for these tests needs to be found.

## Photon Beam Systems

### WBS 1.5, 2.5 X-ray Transport, Optics & Diagnostics (XTOD)

#### Highlights:

- Management and Safety – Recent changes to the XTOD Front-End enclosure (FEE) layout may have an impact on the overall design strategy. These changes include: 1) Extending the FEL offset mirror region an additional ~2 meters upstream, allowing the low energy mirror to deflect the beam sideways enough to allow separate PPS stoppers for each line; 2) Reducing the apertures of the fixed mask / slit from 80 mm x 40 mm to approximately 45 mm x 15 mm. 3) Deleting the valves holding the gas attenuator and gas detector windows that allowed the windows to be removed from the beam line. The 3mm apertures in the 10 to 12 windows will probably be pre-aligned on the bench, and then surveyed into place. This saves <1.5 meters in the FEE. 3) Inclusion of more pop-up cameras in the FEE to help locate and guide the FEL through the fixed apertures. 4) Inclusion of ~1 meter of space upstream of the gas detectors to accommodate a K measurement system. 5) Redefining the diagnostics requirements.

Work continues to further define the new layout and requirements for the pop-up detectors and diagnostics. The information will then be formalized in Physics Requirements Documents (PRDs) that detail the new beam line layout and other instrumentation falling into the XTOD WBS. Once the requirements have been established, the cost and schedule estimates can be prepared and resources committed. A BCR is likely to address any additional changes.

- Tunnel - The X-Ray Vacuum Transport System (tunnel vacuum) Seismic Safety Review document was reviewed by SLAC's Earthquake Safety Citizens Committee. Initial committee comments are that the system is straightforward enough to NOT require a presentation before the Citizens' Committee. A follow-up check was performed by a committee member who responded by March 27th. The reviewer made 4 comments that are being integrated into the design package.
- Attenuator – The gas attenuator prototype assembly has been completed except for some of the control systems. The photograph on the following page shows the prototype with its 2.5 meter long inner section (left), the 1st stage pumped by 2 scroll pumps (center), the 2nd stage pumped by a large turbopump, and the 3rd stage pumped by a small turbopump (right). The system was run manually at inner pressures up to 80 Torr.



LCLS XTOD Gas Attenuator Prototype

- TTF Damage Experiment – The thermal stress test is scheduled to run the week of April 10 in the B131 excimer laser facility. Samples of SiC and B4C will be exposed to single and multiple pulses of laser light with energy depositions similar to LCLS.

**Issues:**

- None

## **WBS 1.6, 2.6 X-Ray Endstation Systems (XES)**

### **Highlights:**

- PPS, MPS – The specifications and requirements of these systems have been defined. A refined schedule for these areas is not under development.
- Detectors – Software for detector simulations & analysis is under development. A workshop is being organized at SLAC on detector interfaces, DAQ & controls. The XES group is currently defining the LCLS users' needs for a streak camera and working to establish the specifications. The Cornell 2D detector project is on schedule.
- Atomic Physics Instrument – A comprehensive description of the AMO project scope has been drafted to identify the desired capabilities of the AMO experiments at the LCLS and produced a preliminary version of the project schedule with personnel resources. The high field photo-ionization experiment is becoming well defined, along with refocus optics requirements. Work remains to be done on defining the diagnostics suite, laser system and single particle diffraction experiment.
- Controls – A workshop is being organized for all beamline collaborators for the last week of April. The purpose of the workshop is to understand the user equipment and collect requirements for data acquisition, data analysis and data rates. The workshop will include staff from LUSI, Cornell, SSRL, and LCLS.

### **Assessment and Issues:**

- XES group is starting to develop a detailed schedule in all WBS areas. Modifications, detailing of our plans, resource and cost loading, and integration is expected to take at least through March and will then be presented as a BCR.
- The long-range staffing plan is continuing to be developed, particularly the necessary increase to a staffing level adequate for operating the LCLS.



## Conventional Facilities (CF)

### WBS 1.9, 2.9 Conventional Facilities (CF)

#### Highlights:

- Progress continued on the construction of the Sector 20 Injector Facility (S20) and the Magnetic Measurement Facility (MMF). The projects are 90% and 95% complete, respectively. Beneficial occupancy of the MMF was met on March 29, 2006, slightly ahead of schedule.
- A pre-bid job walk and conference was held at the SLAC site to orient potential bidders for Group #1. The Group #1 bidders included such trades as concrete, tunneling, earthwork, plumbing, electrical, HVAC, fire protection and site utilities. Group #1 sums to nearly 70% of the total estimated civil construction value.
- Jacobs Facilities submitted an addendum (Addendum #1) to its 100% design package. The addendum included SLAC-directed changes to modify the access tunnel to the Far Experimental Hall (FEH) and deletion of Service Building 8.1. The addendum was reviewed and approved by SLAC and then issued to Turner Construction for incorporation into the subcontractor bid process.
- A revised construction schedule was submitted by Turner Construction based on the 100% drawings and specifications for review and approval by LCLS. These revisions provide Turner with an opportunity to optimize the overall schedule and are not viewed as any substantial impact to the overall project schedule.
- The LCLS tunnel design was presented to the SLAC Earthquake Review Committee (ERC) and received approval.
- A job walk was held at the SLAC site for the demolition activities in SLAC Research Yard that precede the main construction effort.

#### Issues and Assessments

- Turner Construction submitted a revised cost estimate based upon the 100% drawing and specification package. The cost estimate was a 10% increase over the 60% cost estimate. A reconciliation meeting will be conducted between Jacobs Facilities and Turner to resolve the variances between the two estimates.
- Unusually wet weather conditions at SLAC have delayed the 12KV feeder installation to building #81 adjacent to the MMF. This may delay the installation of permanent power to the MMF. Should this occur a temporary generator will be provided as a work-around.



## LCLS Cost and Schedule Performance – March 2006

LCLS Cost/Schedule Status Report - Work Breakdown Structure										31-Mar-06
WBS	Cumulative to Date (\$K)							At Completion (\$K)		
	Budgeted Cost		Actual Cost Work Performed	Variance		Performance Indices		Budgeted	Management Estimate at Complete*	Variance
	Work Scheduled	Work Performed		Schedule	Cost	SPI	CPI			
1.1 Project Management	13,775	13,503	15,027	-272	-1,524	0.98	0.90	27,741	31,221	3,480
1.2 Injector	14,404	11,935	11,569	-2,469	366	0.83	1.03	20,591	22,029	1,438
1.3 Linac	7,440	5,627	4,769	-1,814	858	0.76	1.18	25,214	22,985	-2,229
1.4 Undulator	14,172	13,530	13,883	-641	-353	0.95	0.97	41,095	42,550	1,455
1.5 X-ray Transport	7,522	7,306	6,910	-215	397	0.97	1.06	24,149	26,355	2,206
1.6 X-ray Endstations	1,082	989	934	-93	55	0.91	1.06	14,220	15,477	1,257
1.9 Conventional Facilities	16,374	15,741	15,414	-633	327	0.96	1.02	107,689	114,850	7,161
<b>1 LCLS Total Base Cost</b>	<b>74,768</b>	<b>68,631</b>	<b>68,505</b>	<b>-6,137</b>	<b>126</b>	<b>0.92</b>	<b>1.00</b>	<b>260,698</b>	<b>275,467</b>	<b>14,769</b>
								<b>LCLS Total Estimated Cost</b>	<b>315,000</b>	<b>315,000</b>
								<b>Avail. Contingency</b>	<b>54,302</b>	<b>39,533</b>
								<b>% Contingency / ETC</b>	<b>28.3%</b>	<b>19.1%</b>
								<b>% Complete LCLS Base Cost</b>	<b>26.3%</b>	<b>24.9%</b>
2.1 LCLS Project Mgmt, Planning & Admn (OPC)	5,214	5,284	5,210	70	75	1.01	1.01	33,425	33,459	-34
2.2 Injector (OPC)	754	667	695	-87	-28	0.88	0.96	5,754	5,812	-57
2.3 Linac (OPC)	1	1	31	0	-30	1.00	0.04	2,545	2,575	-29
2.4 Undulator (OPC)	747	747	795	0	-48	1.00	0.94	4,623	4,672	-49
2.5 X-ray Transport (OPC)	489	489	427	0	62	1.00	1.14	4,930	4,878	52
2.6 X-ray Endstations (OPC)	410	419	175	9	244	1.02	2.39	5,246	5,007	239
2.9 Conventional Facilities (OPC)	0	0	0	0	0			621	621	0
<b>2 LCLS Total Other Project Cost</b>	<b>7,616</b>	<b>7,608</b>	<b>7,333</b>	<b>-8</b>	<b>275</b>	<b>1.00</b>	<b>1.04</b>	<b>57,145</b>	<b>57,023</b>	<b>122</b>
								<b>LCLS Other Project Cost</b>	<b>64,000</b>	<b>64,000</b>
								<b>Avail. Management Reserve</b>	<b>6,855</b>	<b>6,977</b>
								<b>% Management Reserve / ETC</b>	<b>13.8%</b>	<b>14.1%</b>
								<b>% Comp LCLS Other Project Cost</b>	<b>13.3%</b>	<b>13.3%</b>
<b>LCLS Total Project Cost</b>	<b>82,384</b>	<b>76,240</b>	<b>75,839</b>	<b>-6,144</b>	<b>401</b>	<b>0.93</b>	<b>1.01</b>	<b>379,000</b>	<b>379,000</b>	
								<b>% Complete LCLS TPC</b>	<b>24.0%</b>	<b>22.9%</b>

\*Management Estimate at Complete includes the Budget at Complete, a weighted CPI and SPI, proposed Baseline Change Requests and known risk contingencies.

## **Cost and Schedule Narrative**

The LCLS cost and schedule estimate is consistent with a CD-4 milestone of March 31, 2009 and with a Total Estimated Cost (TEC) of \$315M and a Total Project Cost (TPC) of \$379M. All costs are in actual-year dollars and out-year costs are escalated using guidance provided by the Department of Energy's Office of Engineering and Construction Management (OECM).

The March 2006 Cost Performance Reports (CPR) is the 25<sup>th</sup> month of reporting earned-value on the LCLS TPC. For this month the LCLS cost and schedule indices are 1.01 and 0.93, respectively. Total obligations to date (actual costs + open commitments) are \$88,884K. Approved Baseline Change Requests (BCR's) are shown in the table below. The project critical path runs through the beneficial occupancy of the Central Lab Office Complex (CLOC) and has a total float of 111 working days with respect to CD-4. An updated schedule is under review which intentionally delays the award of the CLOC to mitigate cost risk related to civil construction. The LCLS Project Office is working closely with Turner to optimize the award of the CLOC while maintaining adequate float on the project critical path. Early beam commissioning is critical to achieving the CD-4 goals of the LCLS. The controlling path for the LCLS beam commissioning runs through the Undulator Facility Beneficial Occupancy followed by the installation of the undulators followed by FEL beam commissioning. The total commissioning period with respect to CD-4 is 213 working days. LCLS management will aggressively work to maintain or improve this beam commissioning period.

### **Significant Cost/Schedule Variances**

**Injector System: SPI = 0.83** – The major driver of the Injector schedule variance is the laser system. Thales milestone #3, the final acceptance test at Thales (scheduled for March 29) will occur around May 15 with a delivery date of May 30. SLAC is considering delaying the laser delivery date until mid-July to allow for completion of the Sector 20 cable installation. The delivery of the streak camera is another contributor to the schedule variance. The streak camera has arrived, and that variance will clear next month. The fabrication of the RF gun, another contributor to the schedule variance, is advancing. A detailed plan for the hot test of the gun is in hand which contains sufficient float prior to gun installation.

**Linac System: SPI = 0.76, CPI = 1.18** – In the Controls Systems for both Linac and Injector the procurement of hardware for the upcoming installation is now underway but behind schedule. There is a work-around to minimize the impact of hardware readiness for the '06 shutdown, but the schedule remains very tight. The Linac System is running under budget in the RF subsystem. This is due to design synergies with the design effort for Injector RF which could lead to true savings. The favorable CPI is also partly caused by no charges to LCLS yet for the SLAC-built X-band klystron which is under test.



All schedule variances are being addressed at this time, and as none of this planned work is on the project's critical path or shutdown schedules, these variances are seen as low risk. For the LCLS Other Project Costs (OPC), cost and schedule variances are negligible.

**Change Control Activity\***

**March 2006**

BCR #	WBS #	Signature Level	Approval Month	BCR Description	Originator	TEC Base Cost Estimate		
						Previous Estimate	Increase (Decrease)	New Estimate
LN-30	1.03.03	4	01-Mar-06	LINAC MAG SYST - Revised Est to Complete based on vendor quotes and IJ Mag System Experience	Schultz/Bong	27,912,072	(97,976)	27,814,095
IJ32	1.02.03.10	3	01-Mar-06	Visible Transport Optics Budget Reduction.	Schultz/Gilevich	27,435,090	(104,598)	27,330,492
IJ33	1.02.03.08 & 1.02.03.11	3	01-Mar-06	UV Launch, Conditioning & Diag Procurement LB Infrastructure & LB System Wide Items	Schultz/Gilevich	27,330,492	112,318	27,442,810
UN-43	2.04.05.02	4	01-Mar-06	Removal of remaining costs and work for WBS 2.04.05.02 and WBS 2.04.05.03	D. Schultz/S. Milton	27,442,810	-	27,442,810
CT-23	1.06	4	01-Mar-06	Revise the beamline controls, network and FEE MPS schedules and resources.	H. Shoae	27,442,810	79,784	27,522,594
CF-40	1.09	3	01-Mar-06	FFTB Removal & Equipment Preservation. Bid received 3/21/06 plus \$30 for change orders. Also BTH West to remove cut cables from BSY & Support Bldgs \$100k	Boyce/Saenz	27,522,594	317,239	27,839,833
CF-46	1.09	3	01-Mar-06	A&E Title 2 Design - DCNs	Saenz	27,839,833	168,192	28,008,025
Previous Month Total Base Cost Estimate						260,223,205		
Total Delta Base Cost Change			1-Mar-06				474,958	
Current Month Total Base Cost Estimate								260,698,163

**\*All changes to the baseline are approved by the LCLS Change Control Board as per the approval thresholds defined in the LCLS Project Management Plan. Copies of Baseline Change Requests (BCRs) are available through the LCLS Project Office.**



### DOE (Level 1 - 2) Milestones

System	Level?	Milestone	Baseline	Updated	Variance	2002		2003		2004		2005		2006		2007		2008		2009	
						Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr
		<b>Level 1 DOE (SC1) Milestones</b>	<b>8/29/08</b>	<b>3/31/09</b>	<b>140 days</b>																
DOE	ML1	CD0 - Approve Mission Need	6/17/01	6/17/01	0 days																
DOE	ML1	CD1 - Approve Preliminary Baseline Range	10/16/02	10/16/02	0 days																
DOE	ML1	CD2a - Approve Long-Lead Procurement Budget	7/30/04	7/30/04	0 days																
DOE	ML1	CD3a - Approve Start of Long Lead Procurement	10/29/04	10/29/04	0 days																
DOE	ML1	CD2b - Approve Performance Baseline	3/31/05	3/31/05	0 days																
DOE	ML1	CD3b - Approve Start of Construction	2/28/06	3/21/06	15 days																
DOE	ML1	CD4 - Approve Start of Operations	3/31/09	3/31/09	0 days																
		<b>Level 2 DOE (SSO) Milestones</b>	<b>8/29/08</b>	<b>11/10/08</b>	<b>51 days</b>																
PM	ML2	Prelim Safety Assessment (PSAD) Doc Complete	4/30/04	4/30/04	0 days																
PM	ML2	DOE External Independent Review (EIR) Complete	6/15/04	6/15/04	0 days																
PM	ML2	Fire Hazard Analysis Approved	6/30/05	8/31/05	44 days																
PM	ML2	Prelim Safety Assessment (PSAD) Doc Approved	2/28/06	1/26/06	-23 days																
UN	ML2	Delivery of Undulator 1st Articles to MMF	7/3/06	7/3/06	0 days																
CF	ML2	Sector 20/Alcove Beneficial Occupancy	7/21/06	7/21/06	0 days																
UN	ML2	MMF Qualified & Ready to Measure Prod Undulators	8/28/06	8/28/06	0 days																
CF	ML2	Research Yards Mods Beneficial Occupancy	10/20/06	10/20/06	0 days																
IJ	ML2	Start Injector Commissioning (Drive Laser)	11/20/06	11/20/06	0 days																
IJ	ML2	Injector Laser Commissioning Review Complete	1/16/07	1/16/07	0 days																
CF	ML2	Undulator Facility Beneficial Occupancy	6/4/07	6/4/07	0 days																
CF	ML2	Near Experimental Hall Beneficial Occupancy	6/18/07	6/18/07	0 days																
CF	ML2	Linac Facility Beneficial Occupancy	7/11/07	7/11/07	0 days																
IJ	ML2	Start Injector Commissioning (UV Beam to Cathode)	7/20/07	7/20/07	0 days																
CF	ML2	Far Experimental Hall Beneficial Occupancy	9/4/07	9/4/07	0 days																
IJ	ML2	Injector Accelerator Readiness Review (ARR) Comp	9/20/07	9/20/07	0 days																
CF	ML2	Front End Enclosure Beneficial Occupancy	10/5/07	10/5/07	0 days																
CF	ML2	X-Ray Transport Beneficial Occupancy	10/12/07	10/12/07	0 days																
CF	ML2	Beam Transport Hall Beneficial Occupancy	1/3/08	1/3/08	0 days																
XE	ML2	2-D Pixel Detector Production Start	1/3/08	1/3/08	0 days																
LN	ML2	Linac ARR (Li20-Li30) Complete	3/7/08	3/7/08	0 days																
PM	ML2	Final Safety Analysis Document (FSAD) Approved	3/31/08	3/31/08	0 days																
LN	ML2	Start Linac (Li20-Li30) Commissioning	5/8/08	5/8/08	0 days																
PM	ML2	LCLS ARR Complete (BTH thru FEH)	6/9/08	6/9/08	0 days																
LN	ML2	Start Linac-to-Undulator (LTU) Commissioning	6/12/08	6/12/08	0 days																
UN	ML2	Start Undulator Commissioning (1st Light)	8/18/08	8/18/08	0 days																
XE	ML2	Start XES Commissioning	8/18/08	8/18/08	0 days																
XTOD	ML2	Start XTOD Commissioning	8/18/08	8/18/08	0 days																
CF	ML2	Central Lab Office Ctr Beneficial Occupancy	11/10/08	11/10/08	0 days																

### Milestone Report

<b>Milestone ID/Name</b>	MS1_PM030 –CD3b - Approve Start of Construction
<b>Milestone Level</b>	ML1
Baseline Date	02/28/06
New Projected Date	03/21/06
Completed	Yes
Impacts:	Cost: No L1 Schedule: No Other: No
Comments (Reason for Change): This milestone is complete	

<b>Milestone ID/Name</b>	MSC_CF000, CRIT: Release RFP T3 Construct (RY-CLOC)
<b>Milestone Level</b>	ML3
Baseline Date	03/08/06
New Projected Date	03/08/06
Completed	Yes
Impacts:	Cost: No L1 Schedule: No Other: No
Comments (Reason for Change): This milestone is complete	

<b>Milestone ID/Name</b>	MSBO_010, Magnetic Msmt Facility(MMF) Beneficial Occupancy
<b>Milestone Level</b>	ML3
Baseline Date	04/03/06
New Projected Date	03/29/06
Completed	Yes
Impacts:	Cost: No L1 Schedule: No Other: No
Comments (Reason for Change): This milestone is complete	

<b>Milestone ID/Name</b>	MSBO_000, RF Hut Beneficial Occupancy
<b>Milestone Level</b>	ML3
Baseline Date	03/09/06
New Projected Date	03/09/06
Completed	Yes
Impacts:	Cost: No L1 Schedule: No Other: No
Comments (Reason for Change): This milestone is complete	

## LCLS Glossary

**Actual Cost of Work Performed (ACWP)** – Actual cost as reported through the LCLS cost accounting systems, plus any accruals, for a specific WBS#, subproject, or project.

**Actual Year Dollars (AY\$)** – Actual dollars in the year spent. Budgeted funds also reported in AY\$ to estimate of out-year expenditures and inflation. LCLS uses the escalation rate guidance as recommended by the Department of Energy for Energy Research projects.

**Budget Authority (BA)** – Cumulative budget currently allocated and authorized by the Department of Energy that may be committed and spent by LCLS for project-related activities.

**Budget at Completion (BAC)** – The total budgeted cost of the project at completion for a given subproject, or project. BAC is the budgeted cost of the project excluding contingency.

**Budgeted Cost of Work Performed (BCWP)** – Budgeted value of planned work for a specific WBS#, subproject, or project physically accomplished to date.

**Budgeted Cost of Work Scheduled (BCWS)** – Budgeted value of planned work time-phased to the schedule for a specific WBS#, subproject, or project.

**Commitments** – Budget allocated for approved work.

**Cost Performance Index (CPI)** – The ratio of the value of the work performed to actual cost;  $CPI = BCWP/ACWP$ . Values less than 1.0 represent “cost overrun” condition, and values greater than 1.0 represent “cost underrun” condition.

**Cost Variance (CV)** – Difference between the estimated value of the physical work performed and the actual cost expended for a specific WBS#, subproject, or project.  $CV = BCWP - ACWP$ . A negative result is unfavorable and indicates the potential for a cost overrun.

**Estimate to Complete (ETC)** – A realistic appraisal of the cost to complete the remaining scope of work.

**Management Estimate at Completion** – Forecast of the final cost for a specific WBS#, subproject, or project based on the current BAC plus management’s assessment of the cost to complete the remaining scope of work.

**Other Project Cost (OPC)** – LCLS “supporting” costs not directly contributing to the construction project. OPC costs generally include research and development and pre-operation (start-up) activities.

**Percent Complete** – The ratio of the work accomplished (earned-value) to the Budget at Completion for any WBS#, subproject, or project.  $\% \text{ Complete} = BCWP/BAC$ .

**Project Engineering and Design (PED)** – Funding used to support the engineering and design effort for the LCLS.

**Schedule Performance Index (SPI)** – The ratio of the value of work performed to work scheduled,  $SPI = BCWP/BCWS$ . Values less than 1.0 represent a “behind schedule” condition, and values greater than 1.0 represent “ahead of schedule” condition.





**Schedule Variance (SV)** – Difference between the value of the physical work performed and the value of the work planned (scheduled).  $SV = BCWP - BCWS$ . A negative result is unfavorable and indicates a behind schedule condition.

**Total Estimated Cost (TEC)** – The total capital budget authorized for the LCLS project for the construction phase of the project. TEC includes contingency but does not include OPC.

**Total Project Cost (TPC)** – The total capital budget authorized for the LCLS project, including TEC and OPC.

**WBS (Work Breakdown Structure)** – A method of hierarchically numbering tasks in a traditional outline numbering format. The WBS provides a basis for the LCLS work plan which is used to track all resources, schedules, and costs.