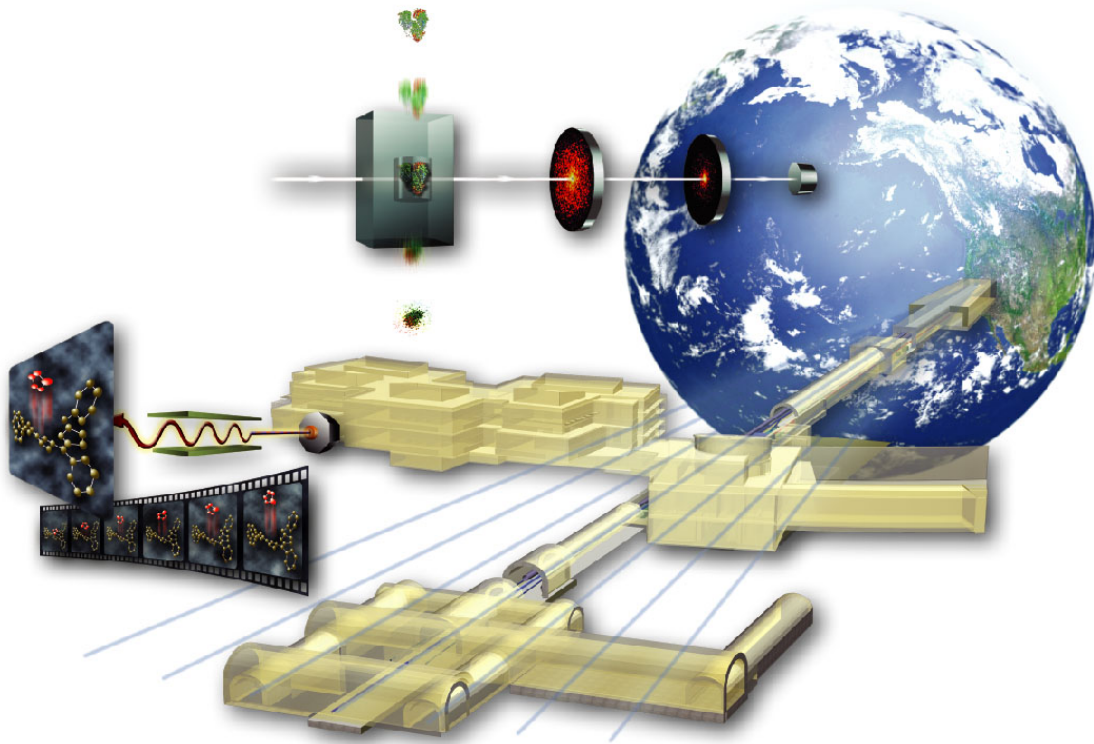


# Monthly Report July 2006



# CONTENTS

---

PROJECT OVERVIEW AND ASSESSMENT	3
TECHNICAL AND PROGRAMMATIC PROGRESS	
<u>LCLS Project Office &amp; Support</u>	
WBS 1.1, 2.1    Project Planning, Management & Administration	4
<u>Electron Beam Systems</u>	
WBS 1.1.3, 1.X.3 Global Controls	6
WBS 1.2, 2.2    Injector	7
WBS 1.3, 2.3    Linac	8
WBS 1.4, 2.4    Undulator	9
<u>Photon Beam Systems</u>	
WBS 1.5, 2.5    X-Ray Transport & Diagnostics	10
WBS 1.6, 2.6    X-Ray Endstations	12
<u>Conventional Facilities</u>	
WBS 1.9, 2.9    Conventional Facilities	13
COST PERFORMANCE REPORT	
-Cost/Schedule Variance Narrative	14
-Change Control Activity	
-Milestone Performance	
GLOSSARY	19

---

## Project Overview and Assessment

### Highlights:

- LCLS has updated its cost estimate for the Project Management, Injector, Linac XTOD and XES scopes of work. All revised cost estimates have been reviewed and approved by the LCLS Change Control Board. In August, LCLS will update the basis of estimate for Undulator, Controls and Conventional Facilities.
- LCLS has hired a candidate for the Associate Project Director for Civil Construction, Mr. Jess Albino. Jess will be a member of the LCLS Project Office and be responsible for the direction of the LCLS Conventional Facilities staff. LCLS is actively recruiting for the Associate Project Director of Engineering and anticipates selecting a candidate no later than September.
- Both phases of the FFTB cleanout have been completed safely and on schedule. This effort clears the way in SLAC's Research Yard for the excavation of the LCLS Beam Transport Hall which will begin in September under the direction of Turner Construction.
- LCLS staff presented the civil construction design to SLAC's ES&H Coordinating Committee (ESHCC) in a one-day review on July 14. The purpose of this review was to evaluate SLAC's design calculation and assumptions for radiation shielding and construction safety with an emphasis on oversight and monitoring methods. The committee noted several 'commendable actions' and one 'area of concern' (adequate construction safety training for SLAC staff). LCLS will evaluate its training requirements to ensure that they adequately meet the needs of the LCLS construction site.

### Assessment and Issues:

- The July 2006 Cost Performance Reports (CPR) is the 29<sup>th</sup> month of reporting earned-value on the LCLS TPC. For this month the LCLS cost and schedule indices are 0.95 and 0.93, respectively. Total obligations to date (actual costs + open commitments) are \$110,869K.
- LCLS allocated ~\$19M of contingency this month (see Change Request Log). Change requests were approved to reflect updated Estimate To Complete (ETC) for Linac, XTOD and XES and the awarded subcontractor amounts for the LCLS civil construction. The result of these approved performance baseline changes reduced the contingency on ETC from 32% to below 20%. The LCLS Project Office is working to identify additional sources of contingency funds from other areas of the project.

## Project Office and Support

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

#### Highlights:

- LCLS Information Technology – July 2006.
  - The LCLS webcam "LCLS Bird 1" is now functional on top of SLAC's Building 121. It is capable of serving up streaming video of activities in the Research Yard. The camera will allow remote users to view LCLS construction without having to go near hazardous areas. The website can be viewed at; <http://www-ssrl.slac.stanford.edu/lcls/webcam.shtml>
  - The master beamline design optics file has been updated to include trackability. Project programmers have worked with physicists and engineers to develop a draft data report that easily displays comparisons of different versions of the optics files.
  - Inventory Database – The Injector/Linac installation team is using an inventory database built by project programmers to manage components (e.g., barcodes, serial numbers, drawing numbers, locations) and the storing of their associated QA documents.
  
- LCLS Environmental, Safety & Health Status – July 2006.
  - Safety – Through the end of July the project has worked 76 days without a recordable injury incident. Prior to an injury reported in May of this year the project had worked 235 days without a recordable injury incident. The LCLS project recordable incident rate is currently 0.63<sup>1</sup>. This compares favorably to general industry rates of 6.8 and that of the Department of Energy which is 2.1 for similar work.
  - Fire Hazards Analysis – SLAC released the final draft of the Fire Hazards Analysis (FHA) for internal and DOE review and comments in late June. The FHA was approved and issued on schedule, the second week of July.
  - DOE OR Construction Safety Review – The DOE/SSO invited construction safety subject matter experts (SMEs) from the DOE OR office to provide assistance in overseeing affected SLAC programs and associated policy and procedures. Two OR SMEs well versed in construction and industrial hygiene safety provided the oversight assistance. The visit lasted approximately 6 hours and consisted of several hours of presentation by SSO, LCLS and CEF. The presentations were supplemented by field visits to LCLS construction activities in the RSY and installation activities at S20.
  - Contracted work – Current contracted work consists of demolition activities at the SLC Gas Pad, B102A/B and B113, and underground

---

<sup>1</sup> The number of injuries sustained by an average work crew of 100 individuals over a year.

- utility surveying around the PEP Ring Road area. Work is following prescribed safety practices and has progressed without incident.
- Injector System ARR and Conventional Facilities Reviews - The capture of completed and scheduled CF and Injector System reviews, including Citizen Committee review continues. A meeting was held with the SLAC Safety Oversight Committee (SOC) Chair to discuss his needs and LCLS scheduling. Subsequently the LCLS System Managers for EBS and CF were presented with a scheduling format for review with the SOC Chair that was developed by R. Hislop. It is incumbent upon the System Managers to develop, schedule and follow-up on their System reviews
  - Training Compliance - LCLS training compliance is 94% and exceeds the SLAC goal of 90%. STA's are currently 87% which is below the SLAC goal of 90%; deficiencies are being found and corrective action taken to meet or exceed the goal.
- LCLS Procurement Status – July 2006
    - LCLS procurement activity continued with heavy activity in July, mainly due to issues surrounding the Jacobs and Turner subcontracts and with Turner requiring significant oversight and support to iron out contractual issues and prepare for the start of construction. In light of increasing procurement activity, Jerry Jobe authorized temporary assistance from other SLAC resources on an as needed basis.
    - CM/GC – Turner Construction was Notified to Proceed (NTP) with Phase 2 (construction) of the LCLS. Awards were authorized for the Surveying, Earthwork, Tunneling, and Site Utilities subcontracts. Other issues settled in July were agreement on a new subcontract article regarding availability of funding, a new bid package certification form, and a new payment and performance bond form.
    - FFTB Excavation – Progress has been difficult on this procurement. SLAC is actively working to expedite slow progress with supplier, and complete this important project in August.
    - Linac BC1 Chicane Dipole Magnets – Subcontract awarded. Design review was completed on April 7, with a final review of drawings completed by SLAC. Significant progress was made in June and July with arrival at SLAC planned for late August.
    - Injector Laser Heater Chicane Dipole Magnets – Subcontract awarded. Delivery date is August 18.
    - LTU Quadrupole Magnets - RFP Addendum issued with 1 month extension. Award was made in May with a due date of Jan 12, 2007.
    - Injector Quadrupole Magnets – Subcontract awarded. All critical items have been received. One remaining item (non-critical) will ship in December.
    - Controls and Power Supply Racks – Awarded to IE Power. All but 2 were received in April with the remaining 2 delayed because of problems

getting heat-sinks from their supplier. The heat-sink problem was resolved in June resulting in delivery in October.

**Assessment and Issues:**

- An observation was made regarding the discrepancy between levels of PPE worn by the various workers in the S20 injector housing. The subs were, for the most part, in PPE prescribed by the LCLS ES&H Plan while most of the SLAC employees were not. This has been rectified by requiring installation work to follow the LCLS Project ES&H Plan.

## Electron Beam Systems

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

- The Controls group is in the process of updating its Estimate to Complete (ETC). The revised ETC will be submitted to the LCLS Change Control Board for approval in August.
- Sector 20 (S20) Laser Facility Controls –
  - The design and documentation of the S20 cable plant for phase II installation was completed. A bid package was prepared and submitted.
  - The S20 Laser Safety System (LSS) is expected to be certified in early September after the laser shutters are installed.
- Injector Accelerator Controls –
  - All Injector vacuum pump controllers and gauge controllers have arrived. High voltage connectors for vacuum pump cables have been ordered. The vacuum controls test stand hardware was assembled and the development of PLC ladder logic for the test stand was started.
  - All 3 racks for magnet power supply control are in the Building 24 High Bay area. The racks are almost fully loaded and are under going testing with production software.
  - All Profile monitor electronics boards have been received. The profile monitor chassis design is done, and production is on schedule. The cameras for the Profile Monitor system have been shipped by the vendor.
- The Design of the BPM digitizer board is complete, and the prototype #1 produced and is undergoing testing. Driver software development and performance tests are in progress.
- Two frequency multipliers from 2856MHz to 11.424GHZ have been completed and tested. The noise floor is below the -131dBc/Hz specification. A test setup for X-Band components has been assembled and development of the X-Band LLRF system components will begin next month.
- All three phasing cavities have been fabricated and tested. The PAD module being developed for the RF system will also be used to collect data from the phasing cavities.

### **Assessment and Issues:**

- The installation schedule for the 2006 down is very tight. The cable plant contract has not yet been placed. Controls component checkout at the end of the down is at risk.

## WBS 1.2, 2.2 Injector System

### **Highlights:**

- Sector 20 Laser Facility –
  - Phase One cable installation was completed and the ceiling was closed in preparation for laser installation. Laser tables and enclosures were installed. A temporary water system was installed to provide chilled water for laser installation and checkout.
  - The laser safety system was installed and temporary laser operation was granted for the duration of laser installation and checkout.
  - The drive laser arrived from THALES and their laser technicians installed the laser and confirmed operation.
- The RF gun solenoid was magnetically measured. No shimming was required to correct quadrupole field. A small measured quadrupole moment at the ends of the solenoid was likely due to small alignment errors. Further investigation will be performed on the second gun solenoid following measurements of the remaining magnets required for the 2006 downtime activities.
- Machining on the Spectrometer Bend, Gun Spectrometer Bend and Insertion/SAB Special Chambers are being fabricated at LBNL.
- Gallery waveguide installation design passed structural engineering review and Earthquake Safety review and installation was started. Lateral bracing of the waveguide hangers was added for earthquake safety.
- Mounting of calibrated BPM's in measured Injector quadrupoles started. The BPM serial number, orientation and which serialized quad it was installed in will be recorded and uploaded into the LCLS controls database.

### **Assessment and Issues:**

- To fit the installation activities into the fixed downtime, a two shift down is planned. Additional supervisory, coordination and engineering oversight manpower will be required to cover work on swing shifts. Work over the holidays will also be required.
- The Sector 20 Alcove commissioning is proceeding nicely, but not without some start-up issues;
  - The S20 fire alarm tripped twice during drive laser installation. The exact source of the alarm trip is still being understood.
  - The S20 Alcove HVAC system malfunctioned resulting in problems with laser stability due to temperature and humidity fluctuations. The HVAC system was repaired prior to completion of drive laser installation.



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

### **Highlights:**

- The Linac group has updated its Estimate to Complete (ETC) and presented it to the LCLS Change Control Board for approval. BCR LN-29 (excluding controls) provides the details of the updated ETC which resulted in an increase to the Linac base cost by ~\$429K.
- A modification required to the BC1 chamber to accommodate a change in the upstream quadrupole was performed in the MFD shops. The BC1 articulation actuator was received and tested.
- Scanditronics completed assembly of the BC1 chicane magnets and started shimming of the pole faces to bring them into tolerance for quadrupole and sextupole errors. The delivery of the quadrupoles is now late but does not yet impact installation.
- An engineer assignment matrix was established for L2, BC2, L3, LTU, E-Dump region integration as well as component and systems. This is in preparation of migrating design emphasis from 2006 downtime components to downstream work. Coordination will be established with Controls for identifying needed engineering teams.

### **Assessment and Issues:**

- Methods for reducing water induced vibration of critical components are being explored by Phil Cutino and Jim Turner with assistance from ILC and CEF engineering.
- A University of Michigan team requested beamline space downstream of BC1 to install an EO bunch length detector. Space will be provided but no additional work can be done to accommodate the detector as this might impact successful completion of the installation activities already planned for the 2006 shutdown.

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

### **Highlights:**

- Management and Safety – The Undulator group is in the process of updating its Estimate to Complete (ETC). The revised ETC will be submitted to the LCLS Change Control Board for approval in August.
- Undulator Production –
  - The two undulator assembly vendors, Hi-Tech and Metalex, have been approved to proceed with the assembly of undulators 3-16. At the end of July a total of 8 undulators (20%) have been completed.
  - The first production undulator has been sent to SLAC and is awaiting testing on the new magnet measurement bench. Shipping additional other completed undulators will wait until a full truck load is available.
- Undulator System Integration –
  - The Single Undulator Test (SUT), consisting of an integrated undulator system module from the floor up, is undergoing system tests and performance measurement. The SUT successfully tested all motion control and performance criteria against the physics requirements. An internal two day meeting evaluated the test results and generated action items to be resolved prior to the final design review.
  - A prototype RF beam position monitor (BPM) has been installed in the ANL injector test stand and undergone a series of beam tests. Although tests are not complete, a significant amount of information has been obtained and the design appears robust.
  - The RFP for the quadrupole/corrector magnets has been released. Bids are due on August 10<sup>th</sup>.
- Undulator Measurement and Installation –
  - The vibration and temperature sensors from the shipment of SN #2 undulator magnet were downloaded at ANL and show acceptable vibration and temperature during transit. The largest vibrations occurred during loading and unloading from the trailer.
  - Undulator Magnet shipments are being held until a large shipment is ready. The second undulator magnet will be needed at SLAC in August to support the commissioning of the measurement benches.
  - The first production undulator has been acceptance tested and pre-tuned ( $K_{\text{eff}}$  set) on the Dover measurement bench in SLAC's Magnetic Measurement Facility (MMF).
  - The three cranes in the MMF have been certified for use.

### **Assessments and Issues:**

- The undulator vacuum chamber primary design uses a 4-weld chamber design. A 42" section of the chamber is under fabrication and a full length prototype by the beginning of October. This item is a critical component of the LCLS and requires careful attention to its fabrication and assembly. The vacuum chamber fabrication schedule is also near the project's critical path.
- SLAC's MMF air temperature went out of specification twice this month. One incident was caused by an electrical issue and the second incident was caused by a faulty mixing valve. Both issues have been resolved and steps have been taken to avoid disruptions in the future.
- The MMF Setup continues to run behind schedule. The level 3 milestone on July 28<sup>th</sup> was not met, and the Level 2 milestone on August 28th may be in jeopardy. The issue has been escalated to SLAC's Metrology Department Manager and the LCLS Project Office is monitoring this closely.

## Photon Beam Systems

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

#### Highlights:

- Management and Safety – The XTOD group has updated its Estimate to Complete (ETC) and presented it to the LCLS Change Control Board for approval. BCR XT-10 (excluding controls) provides the details of the updated ETC which resulted in an increase to the XTOD base cost by ~\$1.2M. The primary driver of the increase was additional diagnostics (k-measurement system, pop-up cameras, etc.). ISM Safety notes were started for the Total Energy Measurement and Gas Detector systems.
- Slit / Fixed Mask / Fast Valve – Work on the Slit/Fixed Mask Preliminary Design Review was completed in June.
- Attenuator – The final phase of prototype gas attenuator testing will be resumed immediately after the delivery of one flow controller and one turbopump. The design of the attenuator differential pumping sections that integrate the gas detector has been advanced and alignment schemes for the attenuator aperture assembly have been developed. Fig. 1 illustrates the configuration of the support system for the upstream differential pumping section. The six gate valves on the attenuator differential pumping sections hold the six 3-mm apertures (holes) that hold back the gas yet allow unobstructed passage of the FEL beam through the attenuator and Gas Detectors.

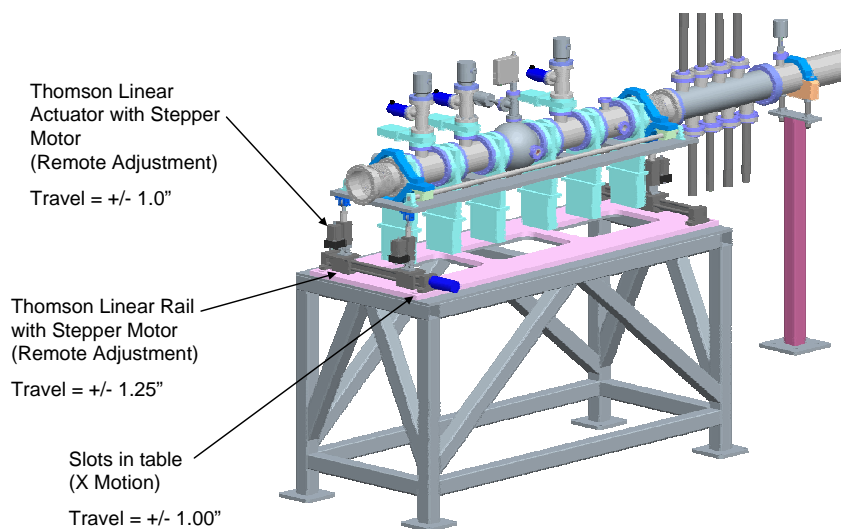


Fig. 1 Mechanical support of upstream attenuator differential pumping assembly

- Mirrors – Work on the development and characterization of B<sub>4</sub>C films to be used as reflective coatings for the Low Energy x-ray mirrors continues. B<sub>4</sub>C films of four different thicknesses within the range of interest for the mirror implementation (217, 395, 470, and 560 Å) were deposited on silicon wafer substrates. The film thicknesses were verified through EUV reflectance measurements performed at beamline 6.3.2 of the Advanced Light Source at LBNL, and subsequent fitting of the Kiessig fringes of the experimental data, as is shown below.
- Total Energy – The Physics Requirements Document for the Total Energy Measurement System has been signed and released. The Cu cooling block for the prototype has been design and is in fabrication. A conceptual design of the laser calibration system has been produced and safety analysis and documentation has begun. The System Concept Review for the Total Energy Measurement System is to be held the week of August 14.
- Tunnel – The draft Tunnel electrical drawings are complete and CAD entry has begun. The electrical drawings are the last design package needed to be completed for the tunnel Final Design Review (FDR). The work is on schedule to support a tunnel FDR during the week of August 28.
- Controls
  - The extra rack capacity needed in the FEE for the K Spectrometer, Total Energy measurement, and Direct Imager (Wide + Narrow FOV) cameras can be accommodated with 3 above-beam racks. The electronics for the Low-Energy beam line have been segregated to a separate rack within the FEE reduce the complexity of decommissioning the Low-Energy beam line when the second through-line is installed in the future.
  - The detailed controls design continues to mature for Total Energy Measurement. The design now includes provisions for temperature control, a calibration laser, and multiple moveable sensors. The data acquisition system has been changed from a large set of low-frequency to small set of high-frequency digitizers and the controls must be modified to reflect this change.
  - The FEE vacuum controls were revised to reflect accumulated changes over last several months, which included moving the Fast Shutter, combining the Total Energy and Direct Imager mechanical systems and adding bypass pumping to 3 gas-flow areas.

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

- None.

## **WBS 1.6, 2.6 X-Ray Endstation Systems**

### **Highlights:**

- The XES group has updated its Estimate to Complete (ETC) and presented it to the LCLS Change Control Board for approval. BCR XE-17 (excluding controls) provides the details of the updated ETC which resulted in an increase to the XES base cost by ~\$130K. As part of the ETC exercise, and update to the XES schedule was also provided, including an updated installation and commissioning plan.
- Specification of the Personnel Protection System in the Photon areas is now beginning. A scope estimate of the Beam Containment System (BCS) for these areas is underway.
- XES has added scope and a new WBS section for a k-parameter measurement spectrometer. This instrument will be used for the undulator diagnostics. This change was approved via the BCR process.
- The 3<sup>rd</sup> LCLS Detector Advisory Committee Meeting (LDAC) is scheduled for July 19-20 at SLAC. The Cornell and Brookhaven projects will be reviewed and streak camera needs for LCLS will be discussed. The agenda will be available on the LCLS website.

### **Assessment and Issues:**

- Start of the design effort on the Atomic Physics Station was delayed by lack of availability of personnel. This has been resolved and does not impact the schedule. The conceptual design engineering is now scheduled to start in July. Beam line and instrument layout in the hutches have been discussed with the LUSI group and its impact on the focusing optics.
- 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:

- Final scrubbing of the bids for Bid Group #1 was conducted between Turner Construction, Jacobs Engineering and SLAC in preparation for proposed award values. Some items were identified for further value engineering.
- A continued review of the Bid Group #2 subcontractor bids was provided by SLAC and TCCO. Bid Group #2 is the remainder of the construction subcontracts for the LCLS Beam Path.
- The FFTB Shielding removal project was completed safely and on schedule and a Notice To Proceed (NTP) was provided to the successful subcontractor for the FFTB Excavation project. SLAC/LCLS is directly managing the FFTB removal projects. Once finalized, SLAC's Research Yard will be ready for Turner Construction to begin the main construction effort.
- The demolition activities for the Research Yard (B113, B102 partial and the SLC Gas Pad) were completed safely and on schedule. This project was directly managed by SLAC/LCLS.

#### Issues and Assessments

- Notification to Proceed (NTP) with LCLS Phase II (construction) was provided to Turner Construction. The NTP Phase II, also included language approving the majority of Bid Group #1 subcontracts (less the fire protection bid package). Turner Construction is developing an alternative approach for the fire protection bid package.
  - With the approval of the Bid Group #1 subcontracts, BCR-54 has been approved to update the LCLS cost estimate to reflect the subcontract pricing. BCR-54 increases the base cost of the LCLS by ~\$18M. The increased cost reflects the delta between bid group #1 subcontract pricing and the LCLS base cost estimate. This BCR was approved by the LCLS Change Control Board (CCB) and the DOE Federal Project Director.
- A continuing effort is being made to Value Engineer the project without impacting the science. Initial recommendations do show some items that may be considered a reasonable approach in reducing cost. However, final cost savings can not be determined some design changes are provided by Jacobs Engineering.



## LCLS Cost and Schedule Performance – July 2006

LCLS Cost/Schedule Status Report - Work Breakdown Structure										31-Jul-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	16,618	16,428	18,623	-190	-2,195	0.99	0.88	24,958	27,164	2,206
1.2 Injector	16,406	15,810	16,760	-597	-950	0.96	0.94	20,795	21,650	855
1.3 Linac	8,900	7,912	7,388	-988	524	0.89	1.07	24,677	24,104	-573
1.4 Undulator	20,196	16,719	18,563	-3,477	-1,844	0.83	0.90	41,095	42,344	1,249
1.5 X-ray Transport	9,052	8,938	8,974	-114	-37	0.99	1.00	25,367	25,805	438
1.6 X-ray Endstations	1,734	1,239	1,176	-496	63	0.71	1.05	14,555	14,777	222
1.9 Conventional Facilities	19,835	18,741	19,548	-1,094	-807	0.94	0.96	125,793	126,776	983
<b>1 LCLS Total Base Cost</b>	<b>92,742</b>	<b>85,786</b>	<b>91,032</b>	<b>-6,956</b>	<b>-5,246</b>	<b>0.92</b>	<b>0.94</b>	<b>277,240</b>	<b>282,620</b>	<b>5,380</b>
							<b>LCLS Total Estimated Cost</b>	<b>315,000</b>	<b>315,000</b>	
							<b>Avail. Contingency</b>	<b>37,760</b>	<b>32,380</b>	
							<b>% Contingency / ETC</b>	<b>19.7%</b>	<b>16.5%</b>	
							<b>% Complete LCLS Base Cost</b>	<b>30.9%</b>	<b>30.4%</b>	
2.1 LCLS Project Mgmt, Planning & Admn (OPC)	6,057	6,041	5,918	-16	123	1.00	1.02	32,069	32,042	-27
2.2 Injector (OPC)	918	800	845	-118	-45	0.87	0.95	7,300	7,360	60
2.3 Linac (OPC)	1	1	31	0	-30	1.00	0.04	2,318	2,348	30
2.4 Undulator (OPC)	798	1,035	825	236	209	1.30	1.25	4,634	4,416	-218
2.5 X-ray Transport (OPC)	489	489	427	0	62	1.00	1.15	4,944	4,881	-62
2.6 X-ray Endstations (OPC)	635	626	252	-9	374	0.99	2.49	5,548	5,201	-347
2.9 Conventional Facilities (OPC)	8	0	0	0	0			621	621	0
<b>2 LCLS Total Other Project Cost</b>	<b>8,907</b>	<b>8,992</b>	<b>8,298</b>	<b>93</b>	<b>694</b>	<b>1.01</b>	<b>1.08</b>	<b>57,435</b>	<b>56,870</b>	<b>-566</b>
							<b>LCLS Other Project Cost</b>	<b>64,000</b>	<b>64,000</b>	
							<b>Avail. Management Reserve</b>	<b>6,565</b>	<b>7,130</b>	
							<b>% Management Reserve / ETC</b>	<b>13.6%</b>	<b>14.9%</b>	
							<b>% Comp LCLS Other Project Cost</b>	<b>15.7%</b>	<b>15.8%</b>	
<b>LCLS Total Project Cost</b>	<b>101,649</b>	<b>94,778</b>	<b>99,330</b>	<b>-6,863</b>	<b>-4,552</b>	<b>0.93</b>	<b>0.95</b>	<b>379,000</b>	<b>379,000</b>	
							<b>% Complete LCLS TPC</b>	<b>28.3%</b>	<b>27.9%</b>	

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



## **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 July 2006 Cost Performance Reports (CPR) is the 29<sup>th</sup> month of reporting earned-value on the LCLS TPC. For this month the LCLS cost and schedule indices are 0.95 and 0.93, respectively. Total obligations to date (actual costs + open commitments) are \$110,869K. 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. The LCLS schedule intentionally delays the award of the CLOC to mitigate cost risk related to civil construction. 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 214 working days. LCLS management will aggressively work to maintain or improve this beam commissioning period.

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

#### **Linac System: SPI = 0.89, CPI = 1.07**

The schedule variance for the Linac is driven entirely by the Controls Systems. In the Controls Systems for Linac the procurement of hardware for the upcoming installation is now being completed. The Controls effort has been focused on preparations for the upcoming installation and commissioning period. These preparations are going well. Linac Controls work, RF waveguides and vacuum hardware for 2007 installation is now scheduled to begin, but is being deferred to support immediate installation needs. This future installation work needs to be replanned, and this plan is now being prepared.

#### **Undulator System: SPI = 0.83, CPI = 0.90**

Schedule variances for undulator system development at ANL have been hurt by delays in the Single Undulator Test, which developed into a larger test than had been anticipated. Completion of the SUT is necessary for beginning procurement of Undulator support and motion hardware. The SUT is nearing completion, and these procurements should get back on track. The impact of these delays on Undulator stand assembly and installation schedule is being closely monitored. The Undulator system work at SLAC is also behind schedule. At the end of July the MMF met the milestone to be prepared to perform Undulator segment tuning, but this is behind



schedule. The Undulator alignment monitoring HLS is scheduled to begin purchasing hardware, and while this has not yet started, it is very close. Oversight of these activities has been escalated.

**XES Controls System: SPI = 0.71, CPI = 1.05**

The schedule variance for the XES is driven entirely by the Controls Systems, 1.6.2. As stated above, the Controls effort has been focused on preparations for the upcoming Injector installation and commissioning period. The XES Controls work needs to be replanned so that it can be properly tracked. This new plan is now being prepared.

**Change Control Activity (July 2006)\***

BCR #	WBS #	Signature Level	Approval Month	BCR Description	Originator	TEC Base Cost Estimate		
						Previous Estimate	Increase (Decrease)	New Estimate
PM-32	1.01.2.01	4	01-Jul-06	Update to Shop Rates and Correction to FY09 Startup Funds.	M. Reichanadter	257,434,628	(2,601)	257,432,027
IJ-39	1.02-2.02	4	01-Jul-06	LCLS PROJECT - Revision of FY2006 Shop Rates and Correction to OTR ANL RSC	Milton/PMCS	257,432,027	(51,810)	257,380,218
LN-39	1.03-2.03	3	01-Jul-06	LINAC SYSTEM ETC	Bong	257,380,218	429,000	257,809,218
CF54	1.09	2	01-Jul-06	Revised Estimate to Complete for Construction Hard Costs based on Awarded Bid Group 1	Saenz	257,809,218	18,081,918	275,891,136
XT-10	1.05 and 2.05	3	01-Jul-06	XTOD Estimate to Complete	D. McMahon	275,891,136	1,218,581	277,109,717
XE-17	1.06 & 2.06	3	01-Jul-06	XES ETC Replan	S. Moeller	277,109,717	129,956	277,239,673
Previous Month Total Base Cost Estimate						257,434,628		
Total Delta Base Cost Change			1-Jul-06				19,805,045	
Current Month Total Base Cost Estimate								277,239,673

\*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.

**Milestone Report (July 2006)**

Approve Date	Milestone Name	Level	May-05 (CD 2) Date	New (Projected) Date	Impacts			Complete (Yes / No)
					Cost	L1 Schedule (Critical Path)	Other	
Jul-06	CRIT: Release RFP - Quadrupoles	L3	4/12/2006	6/14/2006	No	No	No	Yes
Jul-06	1st Article Vendor A Undulator 1 Rcvd @ SLAC	L3	6/2/2006	6/30/2006	No	No	No	Yes
Jul-06	1st Article Vendor B Undulator 2 Rcvd @ SLAC	L3	6/2/2006	5/31/2006	No	No	No	Yes



### DOE (Level 1 - 2) Milestones

	System	Level?	Milestone	Baseline	Updated	Variance	2001		2002		2003		2004		2005		2006		2007		2008		2009	
							Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr
1			☐ <b>Level 1 DOE (SC1) Milestones</b>	<b>8/29/08</b>	<b>3/31/09</b>	<b>140 days</b>																		
2	DOE	ML1	CD0 - Approve Mission Need	6/17/01	6/17/01	0 days	●																	
3	DOE	ML1	CD1 - Approve Preliminary Baseline Range	10/16/02	10/16/02	0 days			●															
4	DOE	ML1	CD2a - Approve Long-Lead Procurement Budget	7/30/04	7/30/04	0 days							●											
5	DOE	ML1	CD3a - Approve Start of Long Lead Procurement	10/29/04	10/29/04	0 days							●											
6	DOE	ML1	CD2b - Approve Performance Baseline	3/31/05	3/31/05	0 days								●										
7	DOE	ML1	CD3b - Approve Start of Construction	2/28/06	3/21/06	15 days												●						
8	DOE	ML1	CD4 - Approve Start of Operations	3/31/09	3/31/09	0 days																	●	
9			☐ <b>Level 2 DOE (SSO) Milestones</b>	<b>8/29/08</b>	<b>11/10/08</b>	<b>51 days</b>																		
10	PM	ML2	Prelim Safety Assessment (PSAD) Doc Complete	4/30/04	4/30/04	0 days							●											
11	PM	ML2	DOE External Independent Review (EIR) Complete	6/15/04	6/15/04	0 days							●											
12	PM	ML2	Fire Hazard Analysis Approved	6/30/05	8/31/05	44 days									●									
13	PM	ML2	Prelim Safety Assessment (PSAD) Doc Approved	2/28/06	1/26/06	-23 days																		
14	UN	ML2	Delivery of Undulator 1st Articles to MMF	7/3/06	6/30/06	-1 day																		
15	CF	ML2	Sector 20/Alcove Beneficial Occupancy	7/21/06	4/14/06	-70 days																		
16	UN	ML2	MMF Qualified & Ready to Measure Prod Undulators	8/28/06	8/28/06	0 days																		
17	CF	ML2	Research Yards Mods Beneficial Occupancy	10/20/06	10/20/06	0 days																		
18	IJ	ML2	Start Injector Commissioning (Drive Laser)	11/20/06	11/20/06	0 days																		
19	IJ	ML2	Injector Laser Commissioning Review Complete	1/16/07	1/16/07	0 days																		
20	CF	ML2	Undulator Facility Beneficial Occupancy	6/4/07	6/4/07	0 days																		
21	CF	ML2	Near Experimental Hall Beneficial Occupancy	6/18/07	6/18/07	0 days																		
22	CF	ML2	Linac Facility Beneficial Occupancy	7/11/07	7/11/07	0 days																		
23	IJ	ML2	Start Injector Commissioning(UV Beam to Cathode)	7/20/07	7/20/07	0 days																		
24	CF	ML2	Far Experimental Hall Beneficial Occupancy	9/4/07	9/4/07	0 days																		
25	IJ	ML2	Injector Accelerator Readiness Review (ARR) Comp	9/20/07	9/20/07	0 days																		
26	CF	ML2	Front End Enclosure Beneficial Occupancy	10/5/07	10/5/07	0 days																		
27	CF	ML2	X-Ray Transport Beneficial Occupancy	10/12/07	10/12/07	0 days																		
30	CF	ML2	Beam Transport Hall Beneficial Occupancy	1/3/08	1/3/08	0 days																		
31	XE	ML2	2-D Pixel Detector Production Start	1/3/08	1/3/08	0 days																		
28	LN	ML2	Linac ARR (L120-L130) Complete	3/7/08	3/7/08	0 days																		
29	PM	ML2	Final Safety Analysis Document (FSAD) Approved	3/31/08	3/31/08	0 days																		
32	LN	ML2	Start Linac (L120-L130) Commissioning	5/8/08	5/8/08	0 days																		
33	PM	ML2	LCLS ARR Complete (BTH thru FEH)	6/9/08	6/9/08	0 days																		
34	LN	ML2	Start Linac-to-Undulator (LTU) Commissioning	6/12/08	6/12/08	0 days																		
35	UN	ML2	Start Undulator Commissioning (1st Light)	8/18/08	8/18/08	0 days																		
38	XE	ML2	Start XES Commissioning	8/18/08	8/18/08	0 days																		
36	XTOD	ML2	Start XTOD Commissioning	8/18/08	8/18/08	0 days																		
37	CF	ML2	Central Lab Office Ctr Beneficial Occupancy	11/10/08	11/10/08	0 days																		

## 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.